

# Coastal

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September/October 2006 \$4.95

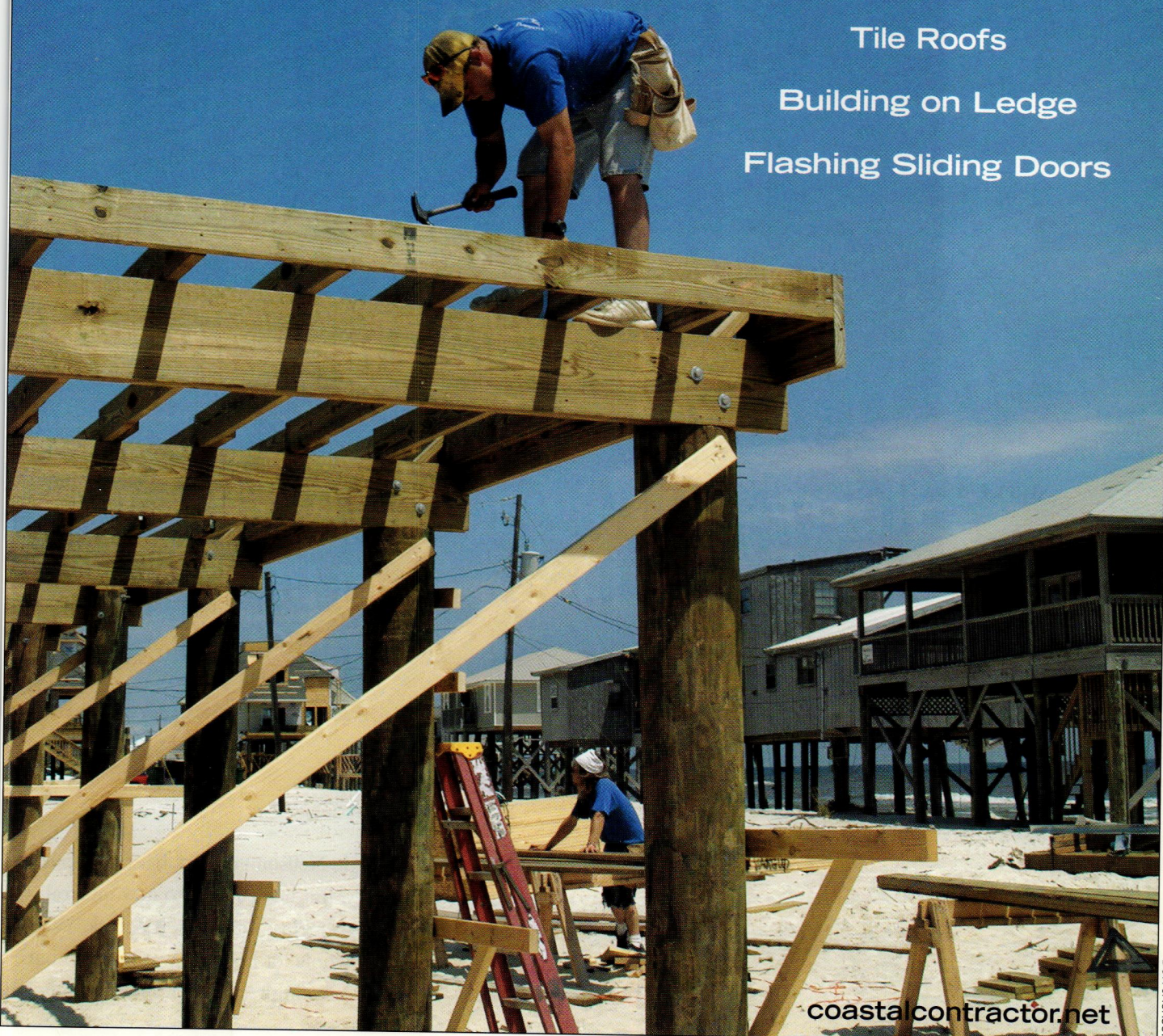
## Evaluating Coastal Foundations

Practical foundation designs to  
streamline rebuilding

Tile Roofs

Building on Ledge

Flashing Sliding Doors

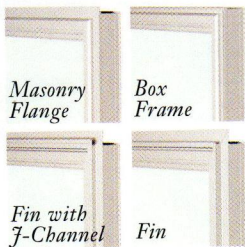


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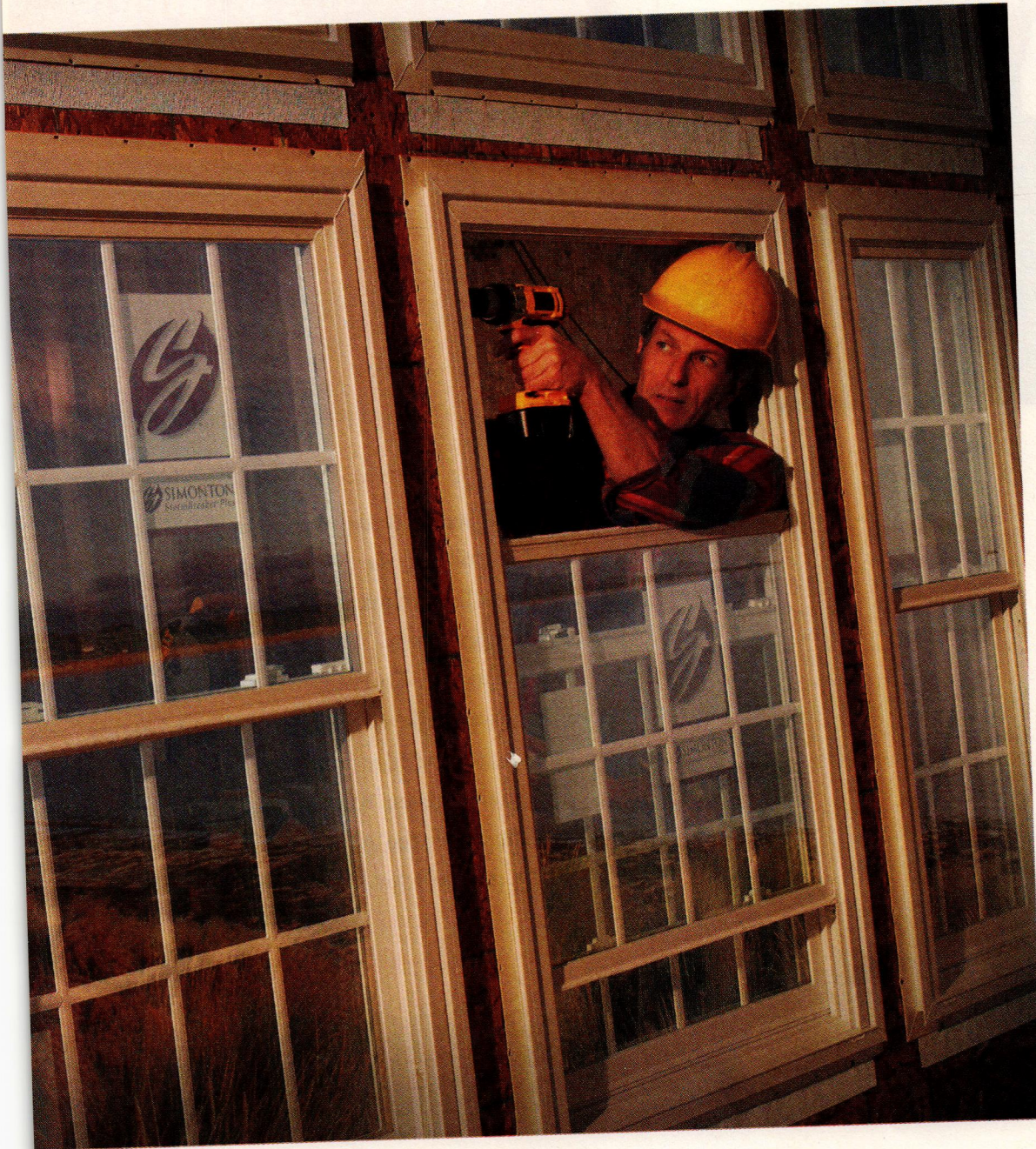
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3:31 PM

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September/October 2006

## Features

### Strong, Safe Foundations

Faced with an unprecedented coastal reconstruction need post-Katrina, the mitigation arm of the Federal Emergency Management Agency has released FEMA 550, *Recommended Residential Construction for the Gulf Coast: Building on Strong and Safe Foundations*. This must-have document for coastal building professionals sets a new standard for practical engineering guidelines. We look at what's included and what it means for builders. — page 24

### The Perfect Storm Flashing

Working on Long Island, remodeling contractor Mike Sloggatt has to prepare homes to weather the occasional nor'easter. So when it comes to installing windows and doors, he's not afraid of overkill. Here, he details the flashing routine he typically employs to create a drainable, water-resistant assembly that *works* (no callbacks). — page 34

### Tile Roofs for Hurricane Zones

One of the most common problems found in the aftermath of hurricanes Frances, Charley, and Ivan was failure of the roofing system. The tile industry responded to the problem with new design criteria and installation details, which have since been added to the Florida Building Code. Charles Wardell sums up the guidelines for best practice, including new hip and ridge requirements, and sheds light on what installers may need to know with the even tougher codes to come. — page 42

### Interview: All in One

Design/build contractor Andrew DiGiammo specializes in high-end custom coastal projects around Providence, R.I., and Fall River, Mass. He discusses the advantages — for clients and for his company — in being both the architect and builder, and examines the different challenges of residential and commercial work. — page 50



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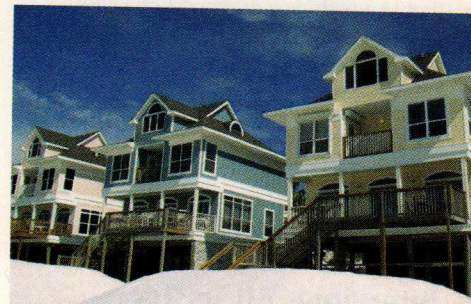
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Printed in the USA

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## One Year After

One year after Hurricane Katrina slammed into Louisiana and Mississippi, the rebuilding continues. It was neither the strongest nor the deadliest U.S. storm. Hurricane Camille, which passed over the same region in 1969, packed stronger sustained winds when it made landfall, as did Carla in 1961, Frederic in 1979, Andrew in 1992, Opal in 1995, and Ivan and Charley in 2004. And the death toll of 8,000 from the Galveston hurricane of 1900 has yet (thankfully) to be eclipsed.

Still, none of that detracts from the impact of Katrina.

No description can capture the extent of Katrina's destruction. It encompasses the annihilation of an entire coastline and the transformation of far more lives than the 1,836 lost. The entire face of a renowned city has been forever altered, and the "easy" way of life that defined the region has been rubbed out, at least for the foreseeable future. No doubt, volumes will be written for ages about the changes this one storm has had on the personal, political, economic, and cultural domains that thread through every facet of the American experience.

The big question we live with in Katrina's wake is how many more like it will come?

By the time this issue makes it off the press and into the mail, we will be into the height of the 2006 hurricane season. The chances during August and September of another major tropical storm making landfall on the Atlantic or Gulf seaboard will be as high as it can get for the year. Yet even if some unnamed depression brewing off the coast of Africa should mount to a great storm before this issue falls into your hands, I'm willing to wager that it won't obscure the impact of Katrina.

Don't read too much into that prediction. It's more of an appeal: Let's never forget this storm. Rather, with unfaltering respect for the lives that ended and those that were upended by that powerful storm, let's continue to learn from its lessons. Most of all, let's learn from the scores of professionals dedicated to building better who have become keen students of Katrina. There will be other storms, some as great. But if we apply the lessons of Katrina, none will ever be so destructive. — Clayton DeKorne

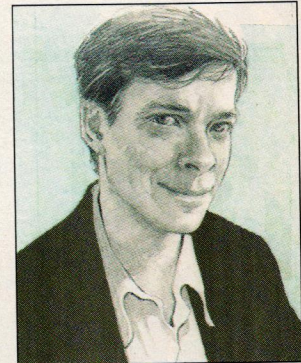
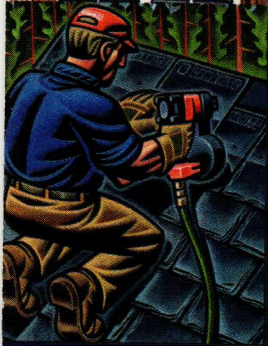


ILLUSTRATION BY JOSEPH ADOLPHE

Coastal Contractor is published six times per year (Jan/Feb, Mar/Apr, May/Jun, Jul/Aug, Sep/Oct, Nov/Dec), and is sent free of charge to qualified professionals in residential home construction and related activities in ME, NH, MA, RI, CT, NY, NJ, DE, MD, VA, NC, SC, GA, FL, AL, MS, LA, and TX. Publisher reserves the right to determine qualification. Annual rates for other US states and possessions is \$19.95; Canada, \$39.95 (US funds); all other countries, \$49.95 (US Funds). To subscribe, please visit [www.ameda.com/coco](http://www.ameda.com/coco). For other subscription questions, e-mail [coco@ameda.com](mailto:coco@ameda.com).



Shake

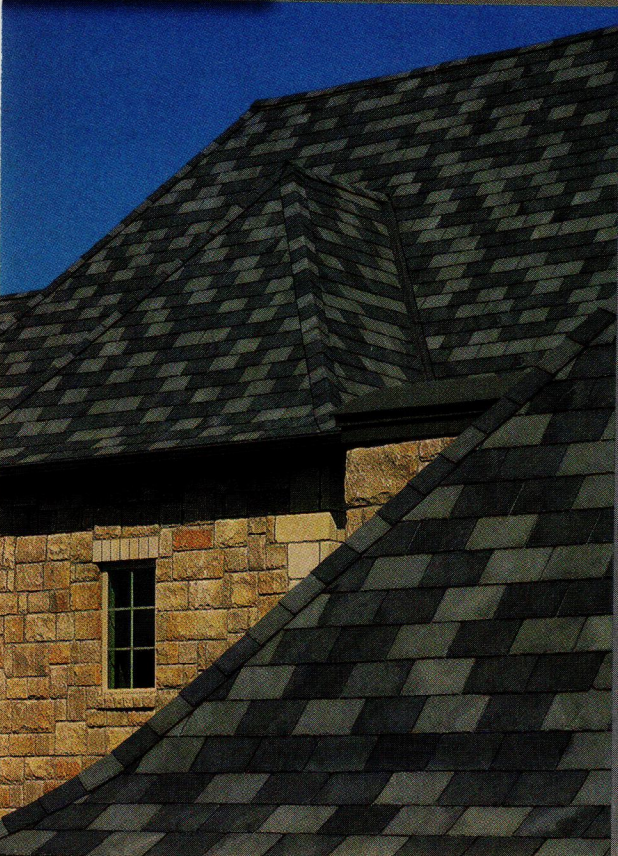


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Circle #1324

## Ventilation Fan Sources

I love your magazine and the tremendous information in each issue.

I live 100 miles from Richmond, Va., on the Chesapeake Bay. My company does a number of crawlspace renovations as well as new foundations. Can you recommend a supplier for the "continuous-duty low-sonic fan" that you show in your article ("Sealing Crawlspace in Flood Zones") on page 19 of the May/June 2006 issue? My HVAC sub has had no luck tracking one down.

Michael Harvey  
(via e-mail)

**Editor's note:** Several manufacturers offer quiet fans rated for continuous duty. Fantech ([www.fantech.net](http://www.fantech.net)) makes a number of inline duct fans that would work, including the 122-cfm FR Series fan, featuring a lightweight plastic housing. These can be mounted in exterior or wet locations, allowing for some

creative placement that can ensure absolute quiet. Panasonic's Whisper Line models ([www.panasonic.com](http://www.panasonic.com)) are also excellent options.

Online sources for these models include Westside Electrical & Lighting ([www.westsidewhole.com](http://www.westsidewhole.com)) and Energy Federation ([www.energyfederation.org](http://www.energyfederation.org)).



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## Detailing Crawlspace

I read your article on sealing crawlspaces in flood zones (*Soundings*, May/June 2006) and found it to be very good, although you may want to consider adding another detail to the job:

Adding batt fiberglass insulation to the rim joist is one way to seal above the foundation. But fiberglass insulation is not an air barrier, and therefore does not effectively seal the crawlspace from heat loss and moisture infiltration. So before adding the batt insulation, I would recommend caulking or air-sealing the rim joist and sill plate with one-part foam. Then add 1-inch foil-faced rigid insulation over the batt, and seal around the rigid insulation. Although this may be time consuming, it will help prevent moisture infiltration and, better yet, prevent excessive heat loss from the conditioned area.

Another method you might want to consider would be to seal the sill and band joist with two-part foam. Although this may be a little more expensive, it would be faster and less labor intensive.

Rich Manning  
Energy Master & Environmental Solutions  
(via e-mail)

## Mold Remediation

Good article on mold remediation ("Genuine Mold," May/June 2006). However, I did detect one item that goes against current wisdom. Post-remediation testing should be conducted by a third party, not by the mold remediation company.

Barbara L. Lee  
(via e-mail)

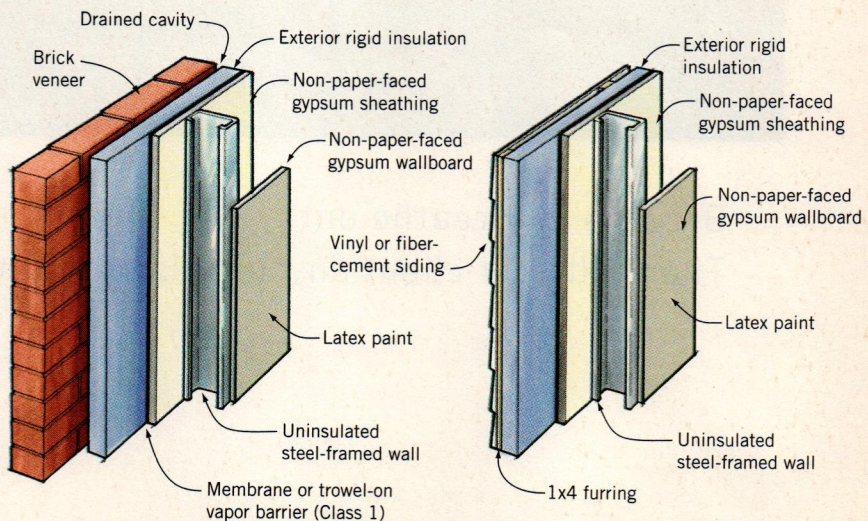
## Illustration Correction

In the article "Low Country Rx: Wet Floodproofing" (July/August 2006), we overlooked inclusion of structural sheathing over the steel studs in one of the cavity-wall assemblies (Figure 3, page 40). The corrected illustration and original caption are shown at right.

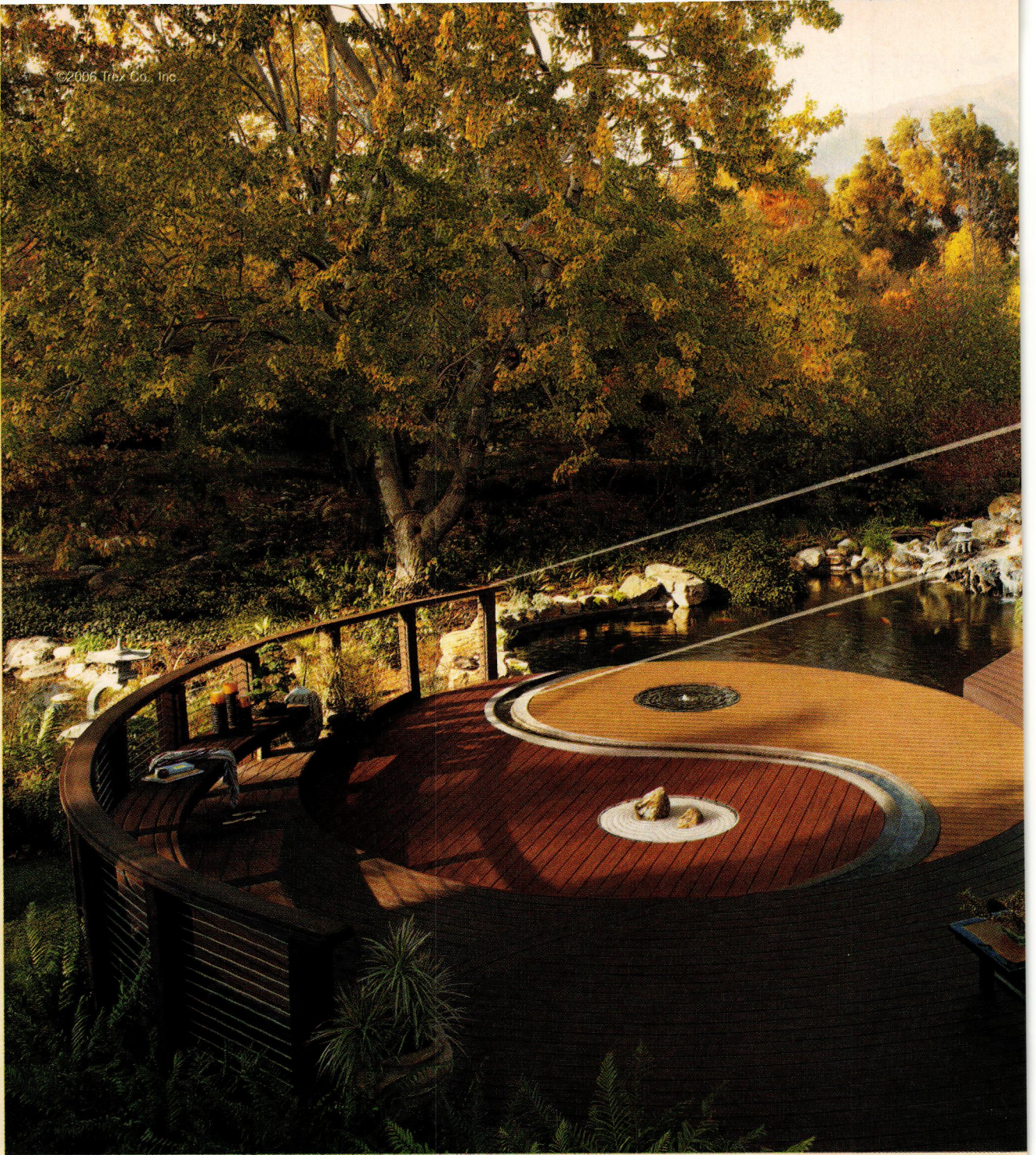
Shown here are two options for drainable and dryable cavity-wall assemblies suggested by building scientist Joseph Lstiburek. The wall designs share several key characteristics:

- (1) No water-sensitive materials are used;
- (2) exterior cavities are vented to the exterior;
- (3) interior cavities can be opened to allow passive air-drying in the event of a flood by removing strips of wall material at top and bottom to encourage convective airflow.

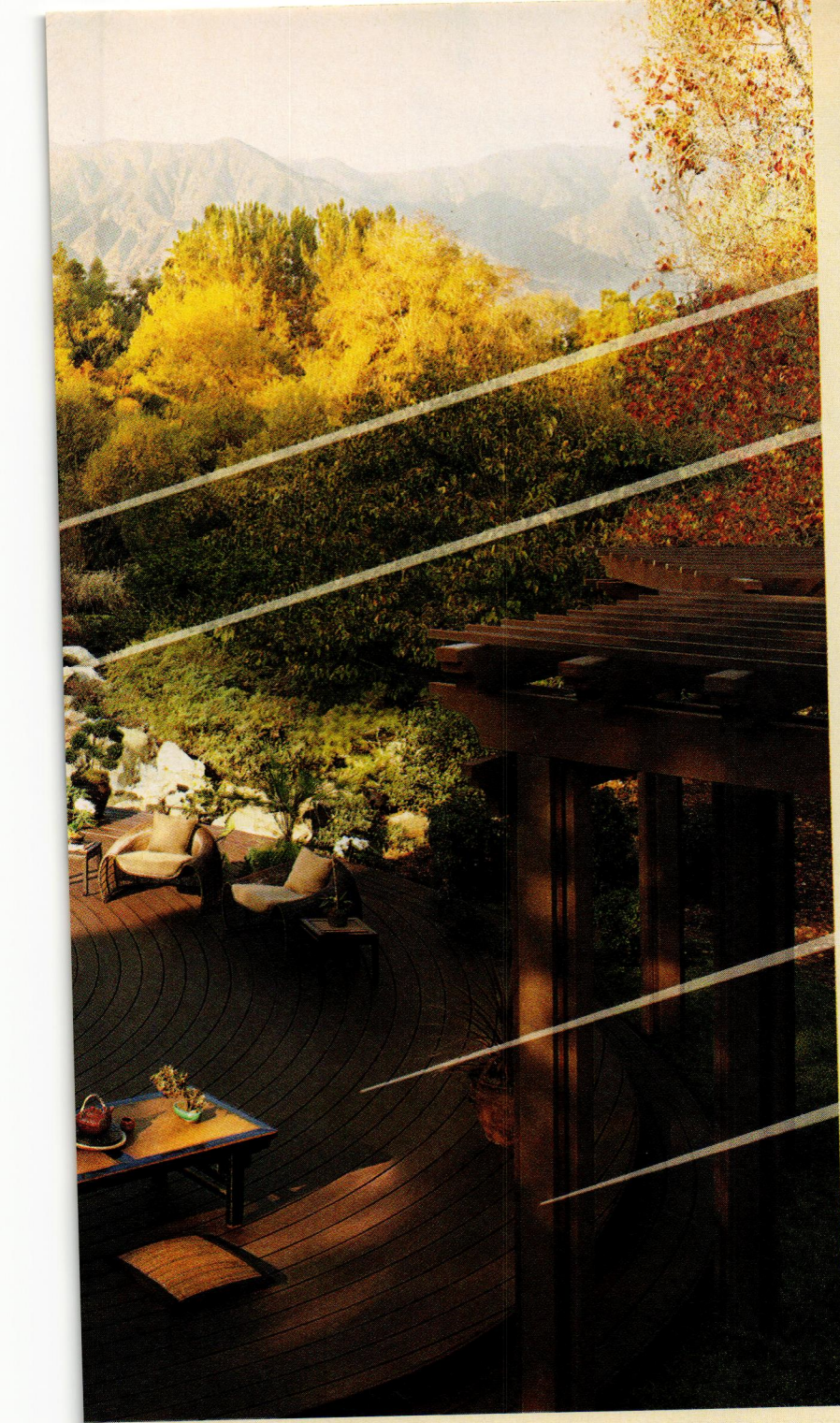
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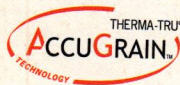
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Circle #1325

# Water Woes

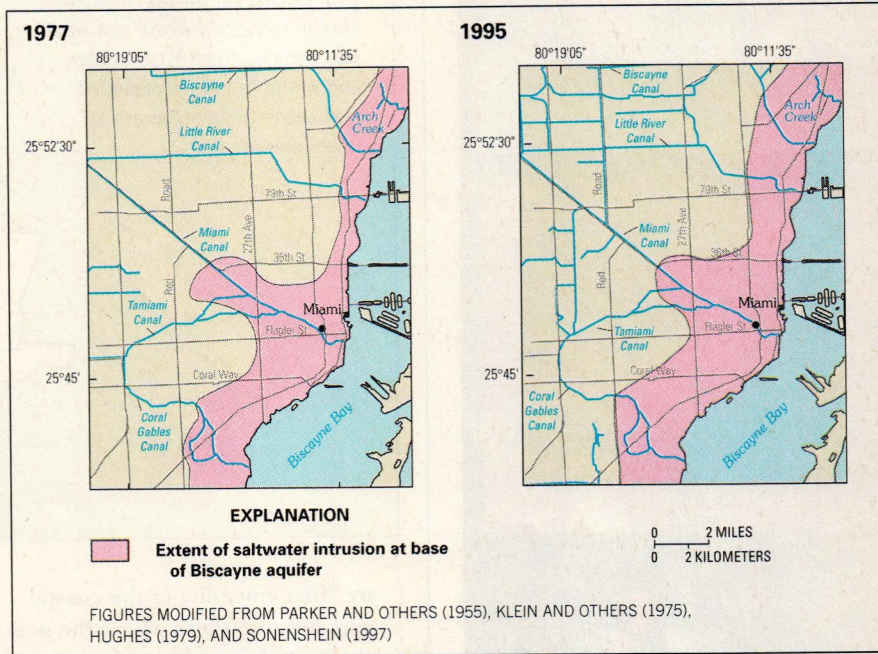
*Shortages along the East Coast pose problems*

In the eastern United States, water flows from higher elevations toward the low-lying coast. As a result, most East Coast cities should have water to spare. "Under natural conditions, if you drew a well even close to the coast, you'd hit some freshwater," says Paul Barlow, a hydrologist with the U.S. Geological Survey.

But overpumping can reverse the flow, drawing salt water where freshwater once drained. Saltwater intrusion of freshwater aquifers is a burgeoning problem in at least nine East Coast hotspots from southeastern Florida to Cape Cod, Mass., according to the USGS. Hardest hit of all may be South Carolina's Hilton Head Island. There, saltwater contamination has forced the island's largest water utility to abandon four supply wells since 1990. It may have to shut a fifth later this year.

"Right now the saltwater intrusion comes to a point halfway through the island, and a lot of our water comes from the edges of that point," says Richard Cyr, general manager for the Hilton Head Public Service District, which serves 25,000 homes.

Traditionally in the U.S., water supply problems were largely confined to the arid West. But whether the cause is saltwater intrusion, overuse by cities and farms, or drought — or a combination of these problems — threatened water supplies are becoming more common in the East. That's especially the case in coastal regions, where populations have soared. "Drought and overall short-of-water supply issues have really become much higher on the agenda in the Gulf Coast and East Coast states in recent years," says Donald Wilhite, director of the



## SALTWATER INTRUSION COMPARISON

The area marked in red indicates the increase of salt intrusion along the base of the Biscayne Aquifer from 1977 to 1995.

National Drought Mitigation Center at the University of Nebraska.

As of mid-July, summer 2006 appeared to be shaping up as normal to moderately dry on the East Coast. But water supply had already become a hot issue in several states:

- In Florida, state and regional water officials rejected a request by Miami-Dade County to boost withdrawals from the stressed Biscayne Aquifer to support new developments. The state later agreed to a temporary increase while Miami-Dade worked out a plan to increase water reuse and make other major overhauls.
- In New Jersey, Governor Jon Corzine proposed a tax of 4¢ per 1,000 gallons

of water to raise money for land preservation and infrastructure improvements to help the state cope with water shortages. Lawmakers rejected the proposal, but the state is proceeding with a comprehensive water-supply plan. "People are paying more attention to it now, because people know that it is not an endless commodity," notes Joe Mattle, supervising environmental engineer for New Jersey's Division of Water Supply.

- In Maine, conflicts between maintaining river flows and lake levels to protect endangered Atlantic salmon and other species while ensuring adequate water supply for cities were on the rise. Water supply issues

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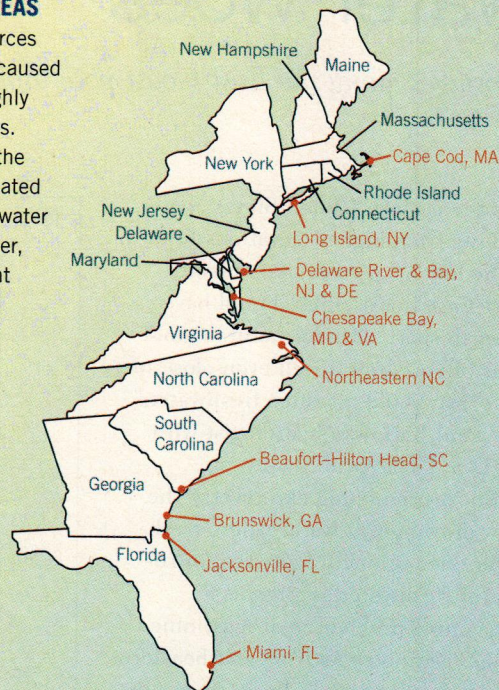
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## ~ Breakline

### FRESHWATER DISTRESS AREAS

Accessing groundwater resources along the Atlantic coast has caused saltwater to intrude many highly productive freshwater aquifers. Selected areas identified by the U.S. Geological Survey (indicated here in red) show where salt water has intruded fresh groundwater, and where future development may cause the most stress to freshwater aquifers.




are “first emerging in the coastal zone because that’s where the population pressures are the greatest,” explains Catherine Schmitt, a science writer with Maine Sea Grant and the author of a report on the effects of the 2001–2002 drought on the Granite State’s drinking water supplies.

Up and down the coast, water supply threats have not forced widespread restrictions on new buildings nor spurred major price increases — at least not yet. But they *are* causing regional conflicts over water supplies and shaping public policy shifts. In June, for example, Georgia adopted a plan aimed in part at guarding freshwater aquifers against more saltwater intrusion along the Georgia–South Carolina border in the Savannah–Hilton Head region. The plan seeks to reduce withdrawals from the Upper Floridan Aquifer by 5 million gallons per day by the end of 2008 — no easy task in light of the fact that

Savannah–Hilton Head lie in an area “expected to experience the highest rates of growth in population during the next 25 years,” the plan notes.

Potential fixes range from increased surface-water withdrawals to boosted water reuse to desalination plants. The Hilton Head Public Service District, which has faced the issue longer than most, now pipes in water from a mainland surface-water system and relies on an extensive reuse infrastructure to reduce demand for new water. All but one of the island’s more than 20 golf courses now tap reused water, says Cyr, the water manager. Despite those and other steps, the utility is moving forward with plans to build a reverse-osmosis plant to transform brackish water into drinking water.

“There’s not only the issue of more water for growth; there’s also the issue of losing what you have,” Cyr notes. “Growth we could handle. It’s losing one of our major wells — *that* we can’t handle.” — *Aaron Hoover*



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## Building on Ledge

**Q:** We are considering using foam forms for a stepped foundation on a steep site overlooking the coast. The tricky part is that the site is mostly granite ledge.

Can the concrete in the forms be pinned to the ledge? If so, how would one go about scribing the forms to fit the uneven surface?

**A:** *Builder Phil Harrison of Portland, Maine, responds:* It's important to bring in an engineer early on such a project. How you pin a foundation to ledge depends on the strength of the rock to hold the anticipated loads. If you have hard, stable rock, it's possible to hold the foundation with steel dowels. If the rock is loose or shattered, however, it may be necessary to blast down to stable material or drill through the rock for piers. It can get complicated very quickly, particularly on cliff-side sites.

Most of the sites we have built on around Casco Bay have had a solid granite ledge beneath thin patches of "blueberry sod." We have to remove the sod entirely, but the rock itself is stable enough to hold epoxy-set pins, allowing us to pin the poured concrete walls without additional footings or pier bearings. While the uneven surface of the rock provides a good key for the concrete, we typically must use dowels cut from No. 6 (3/4-inch-diameter) rebar. These are usually set 6 to 8 inches into the rock and spaced every 2 feet, depending on the contour of the bearing surface and the wall elevation. The engineer

may require a closer spacing near corners or where the foundation radically changes elevation.

We've used foam forms for several poured foundations on ledge. They make sense for a number of reasons. For starters, I feel carpenters are usually better at squaring, plumbing, and leveling than are concrete formers. Also, foam is much easier to cut to fit the complex contour of the rock than are wood forms. And in our area, R-6 insulation on the foundation walls is necessary for the thermal performance of the building, so it makes sense to form and insulate in one step.

### SCRIBE TO FIT

The tricky part, as you seem to understand, is the layout and scribing process. We've done several foundations this way over the years, and we've yet to discover any real shortcut.

We first lay out the corners of the building. Typically, we'll contract with the engineer for this, particularly if the site is very steep. Using a theodolite, a well-trained survey crew can accomplish in an hour what it would take me most of a day with my builder's level, and I wouldn't ever feel very certain of my results. The survey crew gives us clear corners spray-painted on the rock. We can then go to work setting our pins.

To start, we simply stretch a line from the building corners and spray-painted reference marks so we can eyeball the edges of our concrete walls. Then we go to work on the laborious task of drilling for the foundation pins in the center of the wall section. It's not unusual to have 150 pins in a house foundation, so it's nearly a full day for two people just to drill and set the dowels in epoxy.

Once the pins are placed and capped off for safety, we drill additional holes outside the building lines for rebar stakes to support batter boards, and then we string level lines. This is a bit tedious, but once the batter boards are in place and the strings up, we have an essential reference from which to measure to get a rough idea of the difference in elevation for scribing the foam blocks. We rough-cut the blocks with a folding tree saw to match this first rough calculation, then fine-tune the scribe holding a 4-foot level on top of each block. It's slow going, but it ends up fairly accurate. Using this system, we've had good luck avoiding blowouts when pumping the concrete.

Our success at avoiding blowouts can also be attributed to rigorous bracing (we'd rather overbrace



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than risk a blowout), to always using a low (3-inch) slump concrete, and to taking our time to pump slowly, distributing the concrete evenly. We also make good use of a hand-held concrete vibrator to eliminate voids inside the formwork.

**DRAINAGE DETAILS**

The most challenging part of building a foundation on ledge is working out an effective drainage plan. Water tends to flow along the ledge, and it can move through fissures in the ledge, so it's not uncommon to have a spring flowing out of a rock outcropping inside the basement. There's no stopping this water flow. The best steps you can take are to contain it and to divert it outside. We typically run perimeter drains

inside and outside the foundation walls. Inside the foundation, we dump yards and yards of compacted gravel over the drain lines to level out for a slab. The inside lines are connected to the exterior lines at each low point in a stepped section. Backflow valves at these connection points prevent backed-up lines from overflowing into the foundation.

Because EPS foam will absorb water, I am concerned that the forms might become waterlogged in the vigorous runoff that occurs each spring. We waterproof with a self-adhering rubberized asphalt membrane, applying the membrane wherever the foundation will be backfilled, even on the inside if a significant heap of gravel fill bears against the foundation.

## Erosion of Light-Commercial Property

**Q:** I am a manager in St. Augustine, Fla., of a property constructed in 1983. We have a lower parking structure that has suffered erosion because of poor drainage from an upper parking structure (the outlet is simply a square hole). This erosion has washed away the soil below the stucco, leaving about 3 inches of concrete exposed above grade. Which would be the better solution: Haul in dirt to fill the gap and bring the grade up to the stucco line, or bring in 1 to 2 inches of river-rock stone to enable runoff into the drainage ditch that runs horizontally 10 to 12 feet away? Is it true that the concrete being exposed, without stucco on it, makes this lower parking structure more susceptible to cracking?

**A:** *Charlie Gardner, a Philadelphia-based engineer specializing in storm water management, drainage, and hydraulic problems, responds:* When concentrated rainwater falls through air from a roof, it picks up a lot of energy. This energy is showing up at the wrong place on your site, causing long-term erosion, increased foundation exposure, and appearance problems. As a practical matter, think of your problem as requiring a two-part solution: roofing work and work at grade level.

**Roofing work first.** You mention a square hole through which drainage is discharged from an upper parking structure. It sounds as if you need a downspout sized to handle the runoff. The rate of discharge will be proportional to the area drained. Delegate the calculations and code compliance to your roofer, who should be able to size the rainwater

conductor (RWC) according to the applicable local codes or BOCA for the amount of contributing roof area.

A cast-iron or hot-dip galvanized steel collector box with galvanized steel pipe would be used on an elevated highway structure, but this is probably overkill for your application. Regardless, have your roofer show you a picture of the collector box he plans to use and describe how he would hang it. It should be noncorrodible aluminum or plastic. If a plastic RWC is to be used, specify at least Schedule 40 PVC to prevent incidental mechanical damage from minor impacts.

To install it, construct from the roof down. The collector box should be somewhat larger than the aperture in the roof slab to catch all of its discharge. I would try to mount it with an air gap and a 1/4-inch

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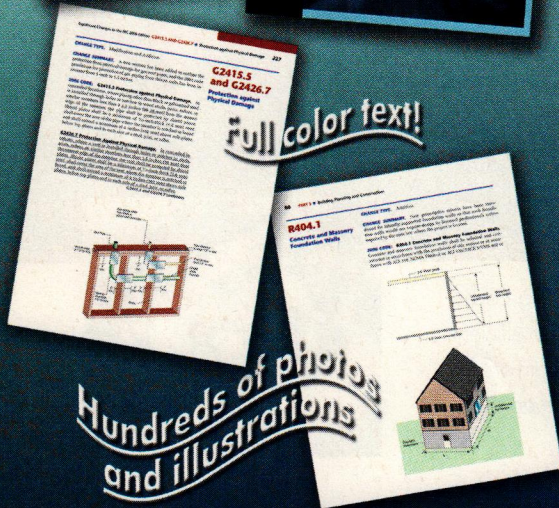
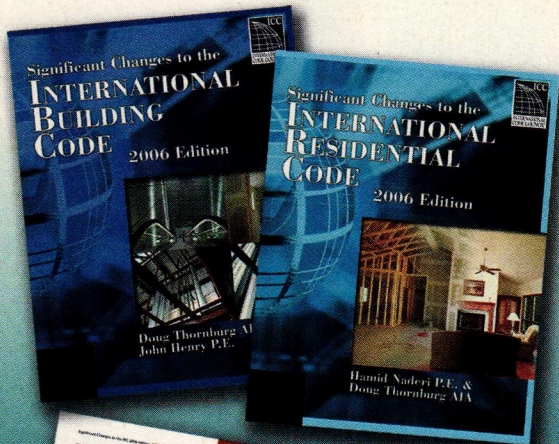
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mesh hardware screen cover to keep out bird nests. The box should be connected with the RWC to the exterior side of a wall and down, terminating in an outward-bending elbow above grade level. You will want the parts to be well fastened, and probably you should consider tamperproof connections.

Every change of direction takes energy away from moving water. Flow friction next to surfaces also takes energy away from moving water. With the RWC, you obtain two benefits: You have made the energy problem shrink, and you now have the wild water under control.

**The work at grade level.** Your letter asks about the desirability of bringing in dirt to raise the grade at the building. This is your decision. Keep in mind that grades adjacent to a building should always slope away from the walls. Life would be simple if all buildings were on hill-tops. Regardless, you are fortunate in having a ditch 10 to 12 feet away into which you can discharge rainwater. The bottom (we call the lowest point in the ditch cross-section the *invert*) should be well below the soil line on the wall. If this is not the case, you should either lower the ditch invert or raise the fill against the wall, or do both.

If the work is to be done by one contractor, he will take responsibility for the fitting and matching of parts. If done by different workmen, mark your proposed soil line at the wall and point it out to the roofer so he can allow for the splash block.

It still remains to dissipate the kinetic energy left in the water that will come shooting out. This will only happen during the kind of rain that keeps people indoors, but it *will* happen. Here you have several choices and even some room for creativity. A large splash block should tilt away from the building. Then armor the flow path to the ditch. I have seen the river rock you mentioned used very attractively. There are several other materials that could be used, including landscaping possibilities. The objective should be to clear the foundation zone and reduce velocity to prevent erosion as the water flows toward the ditch.

**Stucco repair.** As to the lack of stucco causing cracks in structural concrete, I am somewhat skeptical. Concrete does crack for a large number of reasons, but to my knowledge, lack of stucco is not one of them. Even though well-applied stucco is a quality product, the icing is not what holds the cake together. If the issue is cosmetic, consider reapplying stucco, or even a thorough cleaning followed by a good coat of masonry paint.

Although you did not mention seepage through the wall, the interior lower-level garage will be drier after the new RWC is installed. After all, the best way to waterproof a wall is to not charge the soil behind it with water in the first place.

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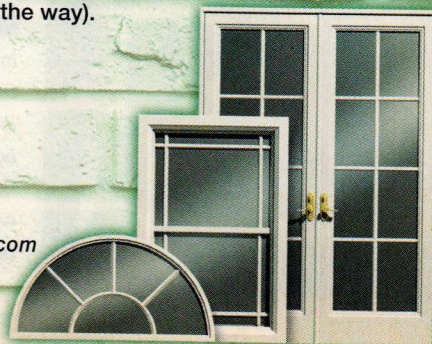
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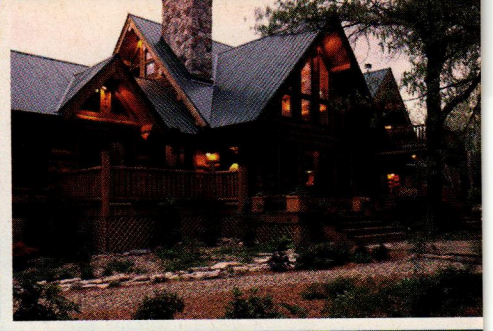
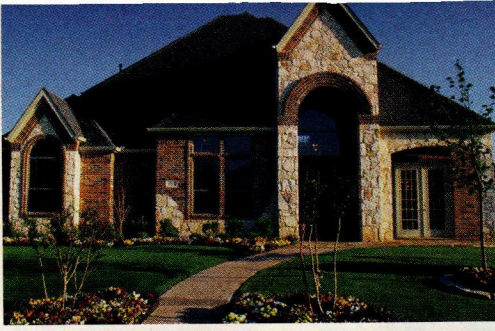
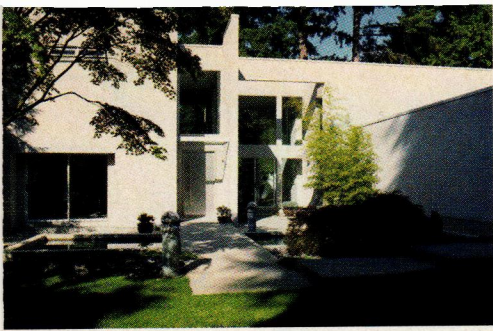
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# Strong, Safe Foundations

*FEMA's latest foundation manual sets a new standard for practical engineering*

by Clayton DeKorne

One year after Katrina, hurricane researchers, engineers, and disaster specialists are still grappling with this storm. Most urge that this hurricane must be understood as a flood event. While the storm reached Category 5 wind speeds of 175 mph in the middle of the Gulf of Mexico, the storm weakened to Category 3 by the time it hit land. But wind speed alone does not make a hurricane, reminds engineer Timothy Marshall, a building failure and damage consultant with Dallas-based HAAG Engineering: "The setup was perfect to maximize surge."

As Marshall explains it, Katrina was an exceptionally large tropical storm. After gathering energy as it passed over the Loop Current — a warm, deep water flow that moves northward through the Gulf of Mexico — satellite images of the storm show a very large, symmetrical cloud shield (a perfect doughnut), which is a clear sign of a powerful storm. The large diameter displaced a wide area of water over the Mississippi Sound, the shallow water basin that extends from Louisiana's delta across the entire coastline of Mississippi. Had the storm blown in over deep water, much of the wind's energy would have been absorbed by the ocean. But over a wide shallow area, all of that energy is concentrated near the surface. The effect, explains Marshall, can be visualized by putting water on a dinner plate and blowing across the surface. It's relatively easy to make the water pile up on the far side and spill over the edge, which is exactly what happened. The swell of water in front of Katrina piled up to almost 30 feet on the east side of the eye wall, where the winds were strongest. Along the

In New Orleans, floodwaters from Hurricane Katrina lifted homes off their foundations. The direction the buildings moved depended on the wind direction as well as on the ebb and flow of the floodwaters.

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An unwelcome visitor, Hurricane Katrina swept into Biloxi, Miss., with a 20-foot storm surge that wiped homes clean off their foundations.

FEMMARK WOLFE

entire Mississippi beachfront, most of the surge was more than 20 feet, and none was lower than 15 feet. Even in the Florida Panhandle, 200 miles away, water levels reached as high as 10 feet. And these levels did not include the height of the waves that danced above the surface of the swell.

In the face of such an immense water load, ordinary homes had little hope of surviving. Aerial photos of the region show a quarter-mile swath of cleared land

in from the shore: Nothing but slabs wiped clean of the structures that stood above them. Most homes on ground-level foundations disintegrated under the intense impact of the oncoming water. Those that held their ground were gutted. Even elevated homes were picked up off their foundations when floor connections failed. Broken-up buildings were turned into floating debris that smashed up other homes. When Katrina was gone, the debris line extended a couple of miles

inland. More than 400,000 homes along the tangled shores of the Gulf region had been destroyed, and an additional 85,000 housing units suffered major damage. This amounted to almost ten times more physical damage than any other U.S. natural disaster. Combined with the damages wrought by hurricanes Rita and Wilma, the record-breaking 2005 hurricane season caused the largest U.S. migration in the past 150 years, leaving more than one million people homeless.

# Strong, Safe Foundations

## FEMA RESPONDS: NOT-YOUR-AVERAGE PAMPHLET

Faced with such an unprecedented reconstruction need, the mitigation arm of the Federal Emergency Management Agency (FEMA) has at last released its own flood of informational assistance to aid survivors in rebuilding. If this evokes visions of a series of shallow, flaccid government pamphlets, think again. These materials have a reassuring depth and forcefulness to them.

FEMA 550, *Recommended Residential Construction for the Gulf Coast: Building on Strong and Safe Foundations*, is an ambitious manual aimed at providing engineers and builders with the essential information needed to build house foundations that can stand up to the forces of a major hurricane. It sets a new standard for practical engineering guidelines, making it a must-have document for any coastal building professional. In five chapters, engineers and mitigation specialists have outlined the essential engineering requirements for foundations inundated by high winds and deep surge. Here's a look at what's included and what it means for coastal builders.

**Engineering calcs.** Crunch time in engineering a coastal foundation begins with calculating the loads imposed by each of the identified hazards: high winds, storm surge, wave action, flood-borne debris, and tidal scour. All of these loads must be accounted for, but if tallied separately, they'd lead to unnecessary overdesign. So the next step is to determine appropriate load combinations for the building site. Load combinations are an engineer's shorthand for computing the relevant forces from a wide range of design loads — dead, wind, wave, uplift, flotation, overturning, and so on. The load combinations used in this manual are those specified by ASCE 7-02, the standard referenced in the 2003 International Building Code (IBC).



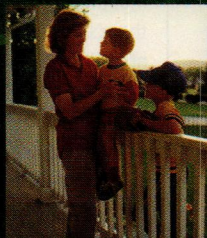
PHOTOS: FEMA 550

While the brunt of Katrina's surge washed harmlessly beneath this home on Dauphin Island (top), the water scoured away the sand from the base of the piles, causing the structure to lean dangerously. Had the piling been longer and buried deeper, as on a nearby home (above), it would have remained upright.



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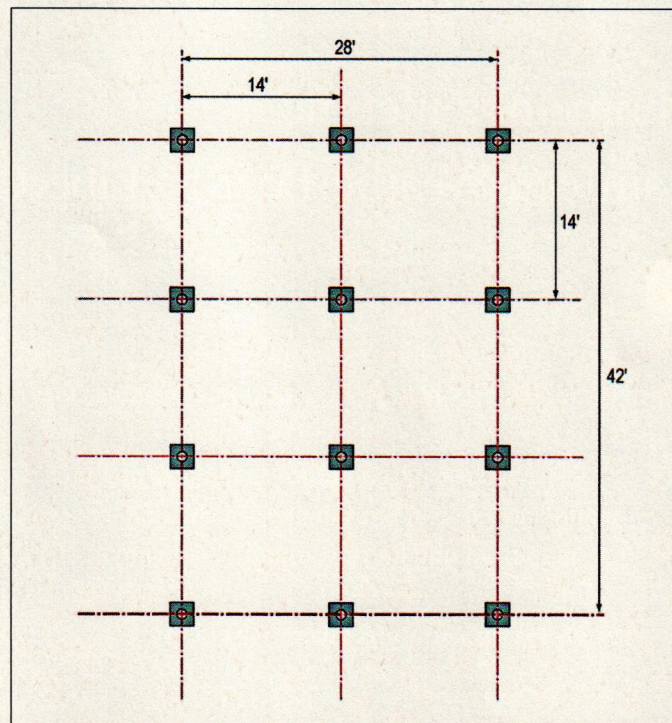
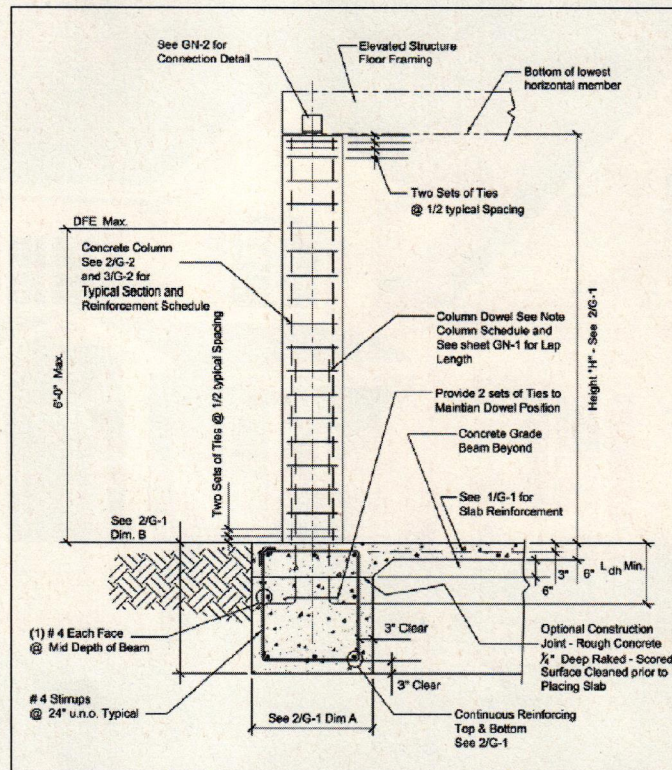
# Strong, Safe Foundations

The rationale for outlining this engineering process, explains project manager Matthew Haupt, stems from the idea that many of the engineers currently assisting in the massive rebuild effort have come from noncoastal regions. They have the design expertise but may not be familiar with the specific forces imposed by high winds and velocity waves.

**Plug-and-play designs.** What makes FEMA 550 unusually rich is that it goes a step beyond summarizing how engineers determine foundation design loads: It provides the designs for seven pre-engineered foundations. These are presented as foundation templates — what Haupt refers to as “model layouts.” If you stick within the design parameters — limiting the size, weight, and roof pitch of the home to a prescribed range — you don’t need to run through the engineering calcs. It’s plug and play: All the design details are included in a set of construction drawings in the document.

Homes whose dimensions, weights, or roof pitches fall outside the ranges provided in FEMA 550 should have a licensed professional engineer’s consult. (Don’t forget to bring a copy of FEMA 550 when you meet with the engineer.)

**Open vs. closed.** The seven foundation designs offered in FEMA 550 provide a range of open and closed foundations suitable for rebuilding in different flood zones. In general, open foundations with deeply driven piles are needed for homes in V zones — beach-front sites that see direct action from breaking waves. Piles present very little face to the impact of the oncoming waves; instead, the brunt of the wave washes through. Closed foundations, which are much less expensive and much more familiar to Gulf Coast builders, are subject to the full force of a breaking wave. They should be used only inland, where the structure may see high water without wave action.



ILLUSTRATIONS: FEMA 550

## PRE-ENGINEERED FOUNDATIONS

FEMA 550 includes construction details for seven different foundation types. As long as the home is built within certain limitations for size, weight, roof pitch, and footprint complexity, and the site conditions match the assumptions engineers have assigned, the foundations can be built without engineering oversight.

## DESIGN MODULE

The foundation designs in FEMA 550 are based on a 14-foot-wide (maximum) by 28-foot-deep (minimum) “module.” While the dimensions of this module are limited, there’s still considerable design flexibility. For example, if a builder sets out to build a 30-foot-deep, 42-foot-wide home, the foundation can be designed around three 14-foot-wide by 30-foot-deep sections. A 28-foot-deep by 50-foot-wide home can be built on four 12½-foot-wide by 28-foot-deep foundation sections.



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# Strong, Safe Foundations

Piers on discrete footings (foreground) failed by rotating and overturning, while piers on more substantial footings — in this case, a concrete mat — survived (background). However, the surge near Pass Christian, Miss., reached almost 30 feet, washing the home off of its foundation.



FEMA 550

## ELEVATION DEBATE

While FEMA's guidelines clarify the foundation design process, the water remains murky around the issue of elevation. How high a home should be raised is a question that elicits strong opinions on both sides of a growing debate.

On one side of the argument are those yelling that it's insane to rebuild too low in a region obviously prone to severe storm surge. This party includes those calling for a limit on subsidizing standard housing that, in all likelihood, taxpayers will have to pay to rebuild again when the next Katrina-sized storm roars ashore. On the other side of the debate are those anxious to get as many homes rebuilt as quickly and inexpensively as possible, so people displaced from their homes can put their lives back together. This party includes most of the displaced themselves and all those fearful that the local residents will be forced to give up their properties to a more gentrified populace.

This debate erupted in November 2005 when FEMA issued advisory flood maps for Mississippi, and it was reignited when the advisory maps were released for Louisiana earlier this year. In keeping with long-standing policies used to administer the National Flood Insurance Program, the new maps are based on an average of recorded flood elevations for the last 20 years. The Advisory Base Flood Elevations (ABFEs) account for the surge levels from Katrina, but there's an

Recommended Foundation Types Based on Zone					
Foundation		Case	V Zones	A Zones in Coastal Areas	
				Coastal A Zone	A Zone
Open Foundation (deep)	Timber pile	A	✓	✓	✓
	Steel-pipe pile with concrete column and grade beam	B	✓	✓	✓
	Timber pile with concrete column and grade beam	C	✓	✓	✓
Open Foundation (shallow)	Concrete column and grade beam	D	NR	✓	✓
	Concrete column and grade beam with slab	G	NR	✓	✓
Closed Foundation (shallow)	Reinforced masonry—crawl space	E	✗	NR	✓
	Reinforced masonry—stem wall	F	✗	✗	✓

✓ = Acceptable  
 NR = Not Recommended  
 ✗ = Not Permitted

Relative costs for a 28- x 42-foot home elevated to 8 feet:  
 •Open Deep Foundation: \$20K  
 •Open Shallow Foundation: \$10K  
 •Closed Shallow Foundation: \$8K

FEMA 550

The seven pre-engineered foundation designs (referred to by case letter in FEMA 550) cover a range of coastal flood conditions. The deep open foundations are suitable for elevating homes 10 to 15 feet above ground level, while the shallower foundation types have a practical upper limit of 8 feet above grade.

averaging down, so the elevations do not match Katrina inundation levels. Those on one side of the debate fret that the advisory elevations may be too low if a Katrina-sized storm blows through again, and those on the other fret the increase will drive the cost of construction too high. The advisory status of the elevations is a halfway measure that puts the onus on local jurisdictions to decide how to enforce elevation requirements. However, once the elevation maps become final (and in all likelihood the elevations will only increase on the official maps), FEMA has the option of restricting municipalities from participating in the flood insurance program if they do not enforce codes consistent with the maps.

#### IN SEARCH OF A REASONABLE COMPROMISE

Caught in the middle are the mitigation engineers who recognize immediately the design ramifications of building too high with generic foundation plans rather than with custom engineered designs. FEMA 550 offers a reasonable compromise, opt-

ing for closed foundation designs that are sufficient up to 8 feet above ground level and open foundation designs up to 15 feet.

These upper limits represent practical limitations of the materials and techniques: When faced with resisting A-zone flood forces, 8-foot-tall foundations are a practical upper limit for 8-inch-thick reinforced block walls. The open design using timber piles is limited to 10 feet above ground level primarily by the availability of longer piles. Steel-reinforced concrete columns are limited to a height of 15 feet above ground level. Above this elevation, the amount of reinforcing steel required in the piles would squeeze out the amount of concrete needed. To go much higher would require steel-pipe piling and individualized engineering. There is some consolation for these practical limits, however: While storm surges from Hurricane Katrina far exceeded these limits in many areas, the added height would have mitigated most of the disaster.

FEMA's Mitigation Assessment Teams concluded that if homes facing the brunt

of Katrina's surge had been elevated to 15 feet, 80% of the damage could have been avoided.

The issue boils down to money. If you want to save the cost of engineering and use a plug-and-play foundation design, you have to accept the elevation limits, which come with certain risks. This message offers a not-so-subtle hint for those who build high-end custom homes: The safest foundations are custom-engineered foundations that elevate homes higher than FEMA's advisory elevations. Look not to the ABFEs but instead to the surge inundation reports (see [www.fema.gov/pdf/hazard/flood/recovery\\_data/ms\\_overview.pdf](http://www.fema.gov/pdf/hazard/flood/recovery_data/ms_overview.pdf)), and build above those levels. Unfortunately, that's probably not a viable option for a majority of landowners who lost their Gulf Coast homes, and their fears of the land passing to a more gentrified population probably have merit. ~

*Clayton DeKorne is editor of Coastal Contractor.*

## Gulf Coast Builder's Review

When compiling the foundation designs for FEMA 550, engineers surveyed Gulf Coast builders for their impressions of the various foundation types presented in the manual. Highlights of this builder analysis follow.

#### DEEP OPEN FOUNDATIONS (CASES A, B & C)

- Deep timber piles are considered a "new approach" for residential construction in many Gulf Coast areas.
- Pile-driving contractors are not abundant in all areas of the Gulf Coast.
- Timber piles are not anticipated to be widely used, but the option is available.

#### SHALLOW OPEN FOUNDATIONS (CASES D & G)

- Foundation type similar to existing Gulf Coast building practice.
- Concrete columns are recommended where masonry has historically been used.

#### ENCLOSED FOUNDATIONS (CASES E & F)

- Familiar construction technique for Gulf Coast builders.
- Common practice for elevation in A zone.

#### COSTS CONSIDERATIONS

Gulf Coast contractors also evaluated the relative costs for the various foundation types. Findings include the following:

- Costs for pile driving vary widely throughout the Gulf region.
- Labor prices are rising as a result of increased demand.
- Material prices are also rising with increased demand.
- As in most markets, an economy of scale from building in quantity can help to lower construction costs.

*Note: The manual includes a breakdown of costs for each design based on May 2006 prices. These prices reportedly include taxes, overhead, and profit, but the summaries do not break these out, rendering them ballpark figures at best.*

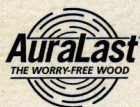
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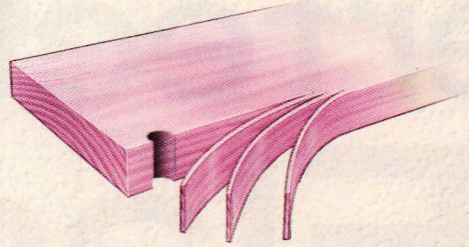


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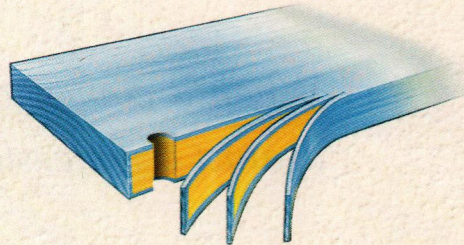
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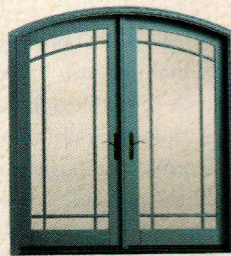
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NOTE: Colors are used for illustration purposes only; AuraLast wood has a clear pine color.

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# The Perfect Storm Flashing

*When it comes to flashing a sliding glass door  
against a nor'easter, a little redundancy never hurts*

by Mike Sloggatt

Working on Long Island, we have to prepare our homes to weather the occasional nor'easter. This type of storm occurs when a powerful low-pressure area forms during winter, producing strong northeasterly winds combined with heavy rainfall or snowfall. (If you're not familiar with one of these storms, watch the movie *The Perfect Storm*.) The rain literally travels parallel to the ground, propelled by intense winds that invariably drive water into places one would never expect. So when it comes to installing windows and doors, I'm not afraid of overkill. I'd rather spend the money and time up front than hassle with the callback later on.

A recent job of mine illustrates the flashing routine I typically employ. On this particular project, I had to replace an existing steel window with a sliding glass door. The home was slightly inland of a 100-mph wind zone, so it did not require the laminated glass and seacoast fastening required on beachfront homes. However, it had its own challenges. Typical of a 1950s "Long Island Split" (a split-level ranch), the home had a brick-veneer exterior, and the existing window had been installed before the brick, making removal difficult.



Remodeling contractor Mike Sloggatt depends on self-adhesive flashing to create a drainable flashing assembly. He has never had a call-back using this method.

### WINDOW DEMOLITION

I wanted to avoid removing the brick to get at the steel flange, so we set about removing the glass and the frame first, which would allow us to pry the flange loose. I've dealt with many windows just like this, so I knew there was no polite way to go about the task. The fastest way by far would be to break away the glass and then cut the steel frame into sections. To contain the glass and avoid the dangerous mess of shattered glass, I used Protective Products' Carpet Protection ([www.protectiveproducts.com](http://www.protectiveproducts.com)), a thin polyethylene film with an adhesive backing, made to protect carpet during

construction. The film also sticks well to glass. By applying it to both sides of the glass, we were able to break the window out of the frame without having it fly all around the job site (Figure 1, page 36).

Once the glass was removed, a reciprocating saw made quick work of the frame. To extract the frame from behind the brick, we slipped a 6-inch metal-cutting blade behind the flange and cut through the nails. This allowed us to pry the frame out from behind the brick using a fireman's 36-inch halligan bar.

The client selected a Marvin Integrity slider — one of the few 9-foot factory-constructed doors that fit our

# The Perfect Storm Flashing

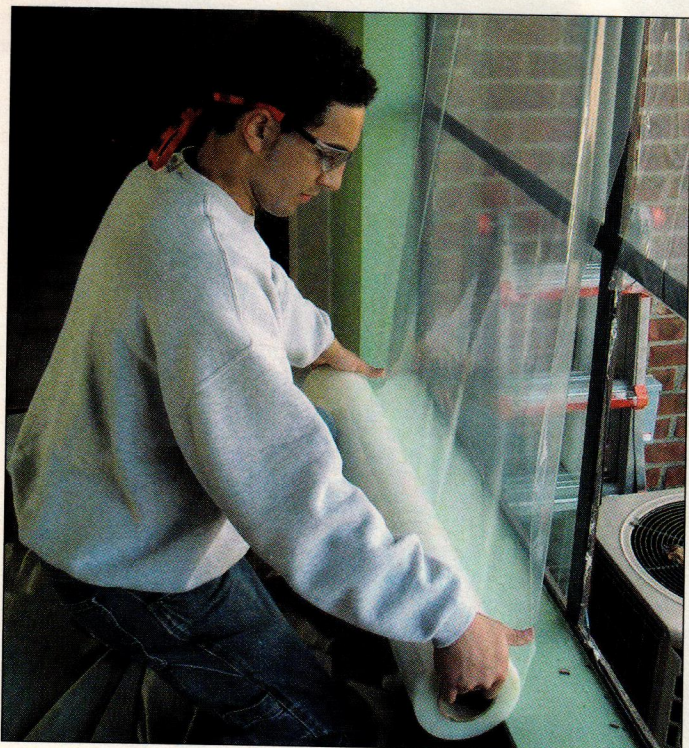


FIGURE 1. Carpet Protection — a strong, self-adhesive plastic film — adheres well to glass (above). When it's applied to both sides of the window, the glass can be broken out without creating a hazard (right).



existing opening. Preparing the opening for the new door simply required removing the remaining low wall below the window and a few courses of brick.

Outside, we will be installing a deck, so I had to plan the door installation to work with the future deck design. I have two major concerns with deck-level door installations: water infiltration and air infiltration.

## DRAINAGE DETAILS

The usual way of coping with water entry is to try to create a barrier to keep out the water, never letting it get past the exterior envelope. That approach rarely works, however. There are too many pathways for water to find and too many elements — caulk, siding, and roofing — that can fail. Moreover, any barrier that keeps water out will also keep water trapped in the building cavity once it gets there.

Instead, I always use the drainage method. This approach assumes that water *will* eventually find its way past the primary line of defense — the siding and trim — and relies on a secondary drainage plane that diverts the leaking water down and away from the opening.

I start establishing my drainage plane from the bottom up. First, I set a layer of self-adhering flashing tape over the rough framing and lap it on top of the brick veneer to direct wind-driven rain away from the void between the sheathing and the brick veneer (Figure 2, facing page). There are a number of peel-and-stick membranes on the market that can be used for this. We typically use Grace Vycor Plus — an asphalt-based flashing tape that I have relied on for many years ([www.graceathome.com](http://www.graceathome.com)). It's economical, and I have never had an instance in which the tape has failed. When I return to install the deck, this first layer of Vycor Plus will be integrated into a protective layer that will isolate the ledger board from the house sheathing.

The next step is to install a copper flashing pan (Figure 3, page 38). This is a positive drainage pan that will prevent any wind-driven water from pushing into the structure from under the door unit. I bend the pan on site with a metal brake and solder the corners for maximum protection.

By bending a  $\frac{3}{4}$ -inch lip on the interior, I can protect the hardwood flooring from any stray moisture that might be blown in from underneath or that might migrate from the door sill or frame. The top of the pan will get caulked against the back of the door frame prior to installing the oak saddle. This is a very important seal. Its primary function is to prevent air infiltration. By sealing this, we are, of course, stopping drafts. But we are also minimizing the pressure differential between the indoor and the outdoor air when a storm is blowing. A strong difference in air pressure can literally suck in water-laden air through the tiniest cracks. Sealing the opening shuts off the air drive that might otherwise force water under the door unit. And by leaving the front of the pan open, any stray water that might find its way to the pan will drain out and away from the building. This keeps the outside environment outside, where we want it.

#### INSTALLING AND FLASHING THE DOOR

Before installing the door, I wrapped the trimmers with the Vycor Plus (Figure 4, page 40). This flashing strip should lap over the upturned edge of the copper pan so that any water that might drip down the flashing will drain into the pan and toward the exterior. It's important to remember to never reverse-lap, or water can seep into the interior cavity.

To install the door, we removed the sliding panel to make the unit as light as possible. We then lifted the door up onto our scaffolding. The sill was already dead level, so shimming the bottom sill was not necessary. (On large door units, I find it better to reset the sill and get it perfectly level rather than try to shim the door.) I checked that the door was square in the opening by using a diagonal measurement across the unit. We double-checked for plumb and level before installing the sliding panel, then checked to make sure the door operated smoothly.

This door model called for nailing the flange to the sheathing with  $1\frac{1}{2}$ -inch roofing nails and side jamb screws. The side jamb screws were not a problem; I first shimmed behind each side jamb screw before setting the factory-supplied screws into the existing trimmer studs, repeatedly checking the door operation as I went. But nailing the flange would have been tough because of the brick veneer. Not willing to risk damage from an errant hammer head, I instructed my helper to screw it in with 2-inch coated deck screws instead of



FIGURE 2. Deck-level sliding doors are susceptible to water and air infiltration. To reduce problems, the author begins with a layer of self-adhesive flashing beneath the subfloor and lapped onto the brick veneer.

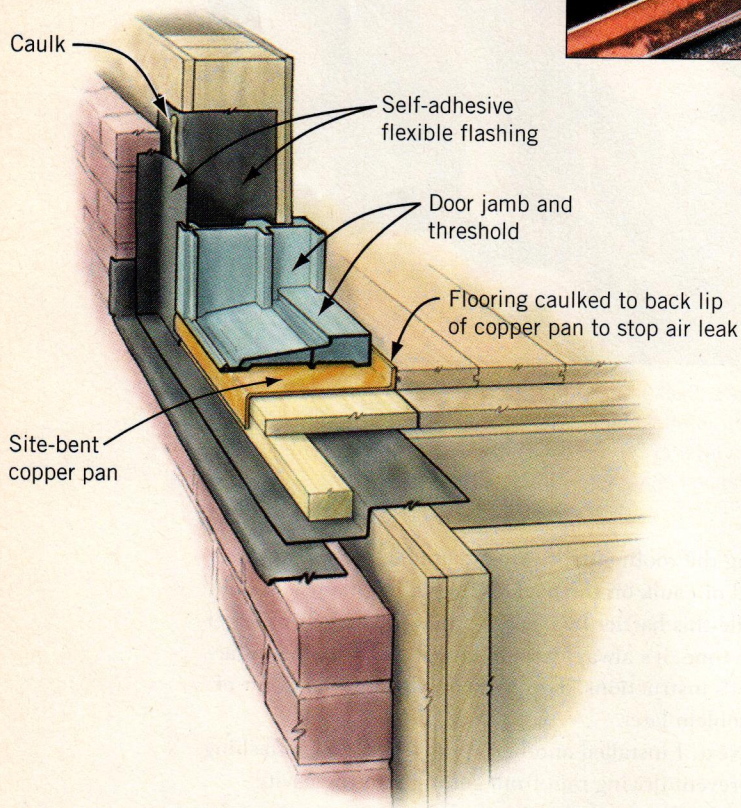
using the roofing nails. Most manufacturers require a bead of caulk on the back of the nailing flange as well. While this barrier by itself is unlikely to keep out water over time, it's always wise to comply with the manufacturer's instructions. This will cover you in the event of a problem later.

Next, I installed another strip of Vycor Plus flashing to prevent driving rain from getting into the cavity between the rough framing and the door unit. To make this piece, I stripped smaller widths out of the standard 9-inch width. To facilitate slicing the flashing tape, I use a scrap strip of plywood into which I've cut saw kerfs at 3, 4, 5, and 6 inches from one edge. I can then lay the tape over the board and easily run a utility knife down the slot.

It's a good idea to wipe down the door frame with

# The Perfect Storm Flashing

## DRAINABLE DOOR ASSEMBLY



alcohol to clean the flange before applying the flashing tape. When installing the flashing, I cover about  $\frac{1}{4}$  inch of the flange — enough to cover the mechanical joint but not so much that it can be seen after the exterior trim is installed.

This particular home had a large soffit overhang, which is a good design for this climate. First, it protects the windows and doors from a lot of the rainwater. Second, there is less heat absorbed through the glass panels in the dead of summer when the sun is high. The winter sun, however, is low enough to shine under this overhang so it can warm the room during the day.

Even with such an overhang protecting the opening from water, we still take care to seal the top flange (Figure 5, page 40). The lesson I've learned is that, invariably, someone will decide to power-wash the soffit, siding, and door. By carefully sealing above the door and pushing the flashing membrane up into the soffit area, I know it won't leak even with water sprayed into the joint at 3,500 psi.

### FINISHING UP

Though it's not shown in the photos, the final exterior treatment will be a wood trim, such as WindsorOne preprimed  $\frac{5}{4}$  trim stock ([www.windsorone.com](http://www.windsorone.com)). In more severe exposures, I would use Azek cellular PVC ([www.azek.com](http://www.azek.com)). We will caulk the exterior face against the brick with a high-quality polyurethane caulk but will leave the bottom joint open for drainage.

FIGURE 3. The best defense against blowing rain is a drainable assembly. A drainable sliding door assembly depends on a copper sill pan (photo above right). The back lip of the pan will be caulked to the interior hardwood floor and the door's oak saddle (illustration above). This helps seal the air leak that would otherwise create a strong pressure differential between the indoors and the outdoors, causing water-laden air to be sucked in.

ILLUSTRATION: CHUCK LOCKHART

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# The Perfect Storm Flashing



FIGURE 4. The author sandwiches the door's nailing flange in Vycor Plus (above and top right) — one layer hugging the trimmers and a second layer lapping the flange. While sometimes considered a redundancy, this “belt and suspenders” approach provides protection from the hard-driving north-easterly winds that blow across Long Island in winter.



FIGURE 5. Even though a deep overhang protects the head jamb of this opening, the author takes care to seal the head as well (above). He's learned from experience that unless this is done, someone will inevitably power-wash the exterior and inadvertently create a leak.

Some builders feel the multiple layers of Vycor are overkill for door flashing, particularly for such a protected opening as this house design affords. But I have never had a callback on a door we've installed using this method. I have, however, repaired many doors that I did not install. In one case — a waterfront home on the north shore of Long Island — water infiltration damaged the hardwood flooring, the wallboard, and the door slab. Four attempts to stop the water had been made by the home builder before the homeowner asked us to remedy the problem. Using the method I've described here, we removed and reinstalled the door, properly layering the weather barrier and removing the caulking the builder had applied in an attempt to stop the water. On that job, I confidently told a very skeptical client to pay me after the next nor'easter. I received my check three months later. ~

*Mike Sloggatt has been remodeling old homes on Long Island for more than 27 years and is a member of the JLC Live construction demonstration team. All photos by the author and his crew.*

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# Tile Roofs for Hurricane Zones

*As Florida continues to tighten its code requirements for tile roofs, the industry responds with new installation techniques and training programs*

by Charles Wardell

**A**fter hurricanes Frances, Charley, and Ivan blew through Florida in 2004, the Federal Emergency Management Agency (FEMA) sent teams to survey damaged homes and buildings. One of the most common problems the teams found was failure of the roofing system. Although the investigators saw failures with all roofing types, the tile industry was the first to respond with new design criteria and installation details. These details have since been added to the Florida Building Code, and more code requirements are under discussion.

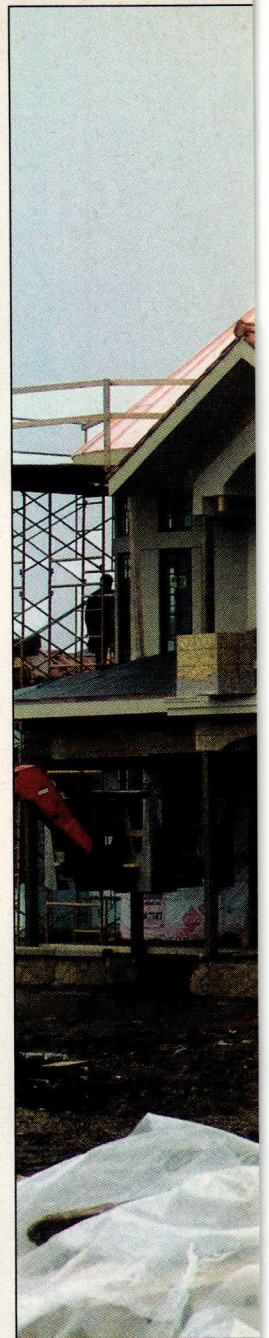
#### **EVOLVING CODES**

This isn't Florida's first storm-driven code revision. The last one was in 1997, five years after the devastation left by Hurricane Andrew. Before then, most tiles installed on low-pitch roofs in Florida had been

set in a bed of mortar.

Because so many of these roofs failed in 1992, the tile industry developed alternative installation techniques that could better resist high winds, including methods for adhesive and mechanical attachment, which were then included as options in the Florida code.

After Hurricane Andrew, Dow and Polyfoam both introduced a foam adhesive that's much stronger than mortar and which is now used by installers certified by each company. In addition, the Tile Roofing Institute (TRI) developed guidelines for using smooth-shank nails, ring-shank nails, and screws. According to TRI Technical Director Rick Olson, the emphasis was as much on cost as it was on safety. "Mortar was running \$30 to \$35 per square at the time, while our



In a tropical storm, hip and ridge cap tiles turn into deadly projectiles. The solution is to attach hip and ridge tiles to a ridge board, using screws through the tile that penetrate at least 1 inch into the board.



PHOTO COURTESY VERMONT SPECIALTY SLATE, INC.

options cost as little as \$6 per square.”

Installers quickly warmed to the new techniques. With few exceptions, most post-1997 roof tiles were fastened in place using one of these systems. The 2004 FEMA survey found that these roofs had a much higher survival rate than those installed earlier.

But some roofers continued to use mortar. Tim Reinhold with the Tampa-based Institute for Business and Home Safety reports that his organization had supported a code-mandated ban on mortar-set tiles in high-wind areas, but he notes that opposition by roof installers was too strong. As a compromise, the indus-

try came out with a code-approved prebagged mortar with just the right amount of sand and cement.

The 2004 FEMA investigation underlined the weakness of mortar set. Tom Smith of TLS Consulting in Rockton, Ill., who served on the FEMA survey teams, says that the size of the blow-off area of mortar-set systems typically was much greater than for tiles attached with foam or mechanical fasteners. He advises against mortar set, no matter what type of mix the roofer uses. FEMA's *Home Builder's Guide to Coastal Construction* ([www.fema.gov/rebuild/mat/mat\\_fema499.shtm](http://www.fema.gov/rebuild/mat/mat_fema499.shtm)),

# Tile Roofs for Hurricane Zones

PHOTO COURTESY POLYFOAM PRODUCTS



Mortar-set roof tiles were easily stripped from an apartment building in Punta Gorda by Hurricane Charley in 2004. To improve attachment, both mechanical fasteners, such as screws or nose clips, and adhesive foam are recommended for coastal homes.

PHOTO COURTESY POLYFOAM PRODUCTS



Tiles properly secured with adhesive foam withstood the onslaught of Hurricane Charley over Port Charlotte Harbor, Fla., in August 2004. The only weak link was the rake detail. Best practice calls for a rake board and battens, as detailed in the illustration on page 46.

published in June 2005, also recommends mechanical attachment rather than mortar set in all high-wind areas.

Other industry groups agree. For instance, Reinhold says that IBHS's Fortified ... for Safer Living program, which certifies homes as disaster resistant, has never approved a mortar-set roof. "We've heard comments that tiles are so dense that it's hard to get a good bond. We recommend against it."

## NEW HIP AND RIDGE REQUIREMENTS

Mortar's weakness was further highlighted in 2004 by problems with hip and ridge tiles. The 1997 code revisions had simply neglected these. "Trim tiles had been treated as decorative accessories, so they were not adequately addressed [by the code]," notes Olson. He reports that many roofers were still setting hip and ridge tiles on a bed of mortar, even where they had nailed or screwed the field tiles. Over time, the mortar's grip on the hip and ridge tiles weakened, leaving them without secure attachment. "They

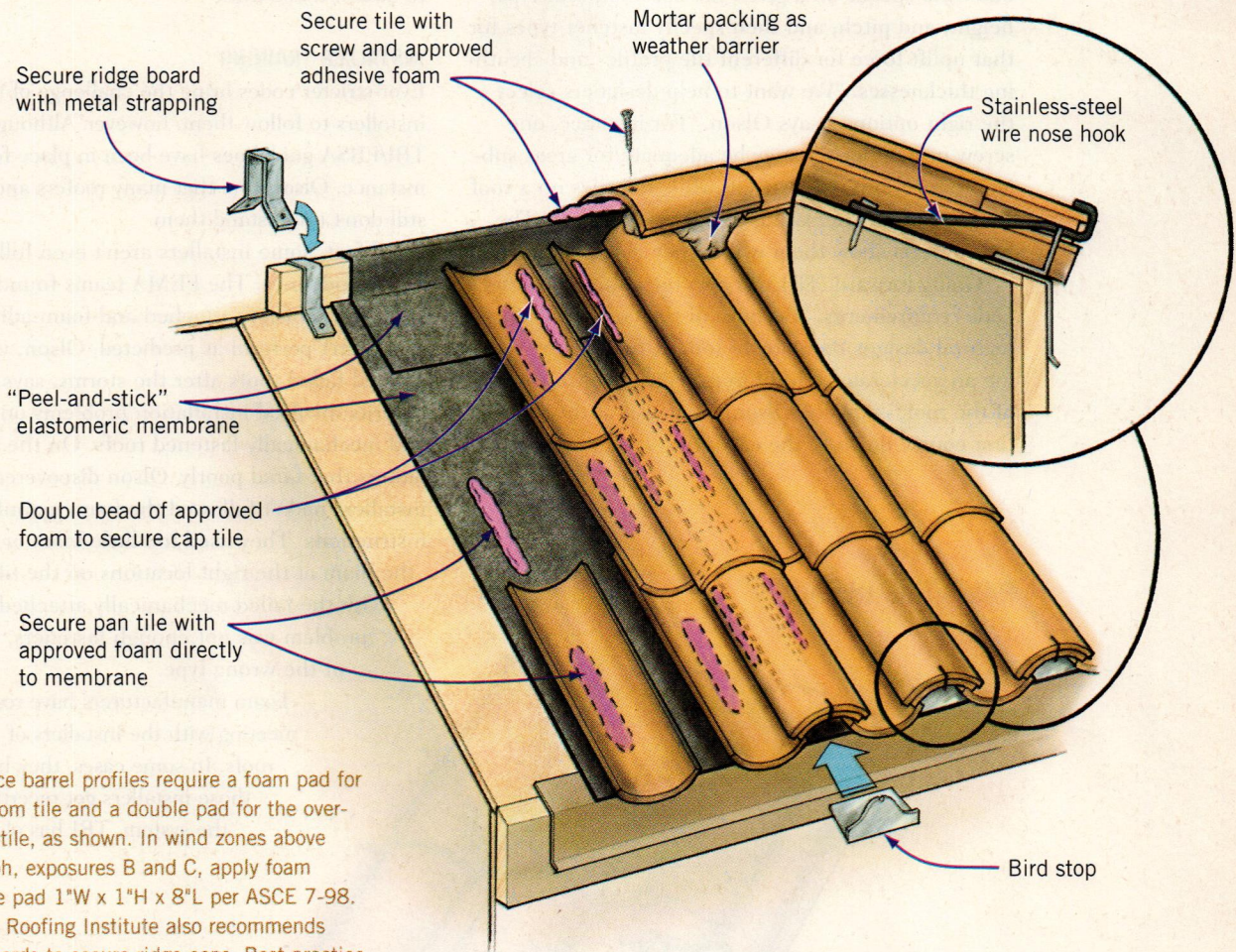
would blow off and become airborne, bouncing across the roof plane, breaking field tiles, and causing other structural damage." This happened even on homes built to current code standards and even on homes far enough from the beach to see considerably lower wind speeds. "We realized that something had to be done," Olson notes.

To solve the problem, TRI worked with the Florida Roofing, Sheet Metal and Air Conditioning Contractors Association, Inc. (FRSA) to develop new attachment guidelines for hip and ridge tiles. The new guidelines were

included in the latest edition of the TRI/FRSA *Concrete and Clay Roof Tile Installation Manual*. The manual was released in October of 2005, and adopted by the Florida Building Code in November.

The new guidelines spell out how to properly install hip and ridge tiles. On all tile roofs, the contractor now has to include wood or metal nailers along hips and ridges, and the installer has to

## ADHESIVE FOAM APPLICATION



ILLUSTRATIONS: CHUCK LOCKHART

Two-piece barrel profiles require a foam pad for the bottom tile and a double pad for the overlapping tile, as shown. In wind zones above 110 mph, exposures B and C, apply foam adhesive pad 1"W x 1"H x 8"L per ASCE 7-98. The Tile Roofing Institute also recommends ridge boards to secure ridge caps. Best practice calls for nose clips to secure the eaves edge, which is most vulnerable to wind uplift.

securely fasten tiles to this board using screws, nails, or a foam adhesive.

Nailers aren't a new idea, of course, but this is the first time they have been required. "Most of the procedures we recommend are not new; they have just now been put into a tremendously detailed document," says FRSA Executive Director Steve Munnell. The new manual's step-by-step instructions and diagrams for doing proper hip and ridge tile installation were based, in part, on the fact that roofs using these techniques fared much better during the storms.

"The folks in South Florida indicated that houses with mechanically attached ridge and edge tiles did better," notes Reinhold.

### UPDATED DESIGN GUIDELINES

TRI has addressed design as well as construction by beefing up its *Concrete and Clay Roof Tile* design criteria. The old version, published in 2002, had just one page dealing with high-wind applications. The new version, released in July 2006, includes nine pages of tables, formulas, and specs for areas subject

# Tile Roofs for Hurricane Zones

to sustained winds over 100 miles per hour. The tables let the designer calculate uplift forces for various wind speeds on a given tile based on roof type, height, and pitch, and then specify fastener types for that uplift force for different tile profiles and sheathing thicknesses. "We want to help designers select the right options," says Olson. "For instance, one screw or nail per tile may be adequate for areas subject to a certain wind speed, while the tiles on a roof subjected to higher winds will need two nails. The new criteria show them which they need when."

Going forward, TRI will also recommend further code requirements. "Because of the complex architectural designs on many of today's roofs, we're seeing an accelerated wind force against the front edge of the roof," explains Olson. "Because of this, the first course down to the eaves has a lot more poten-

tial to pop off [than the courses above it]. By the end of the year, we hope to analyze and find a better way to attach those tiles."

## INSTALLER TRAINING

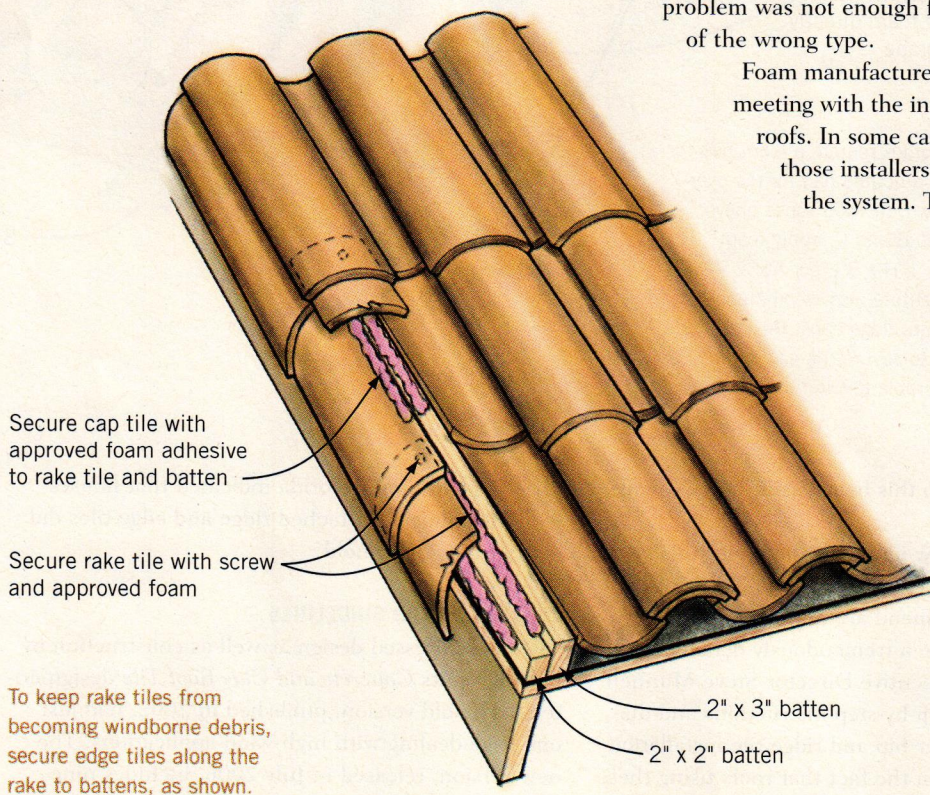
Ever-stricter codes bring the challenge of training installers to follow them, however. Although the TRI/FRSA guidelines have been in place for a year, for instance, Olson says that many roofers and contractors still don't understand them.

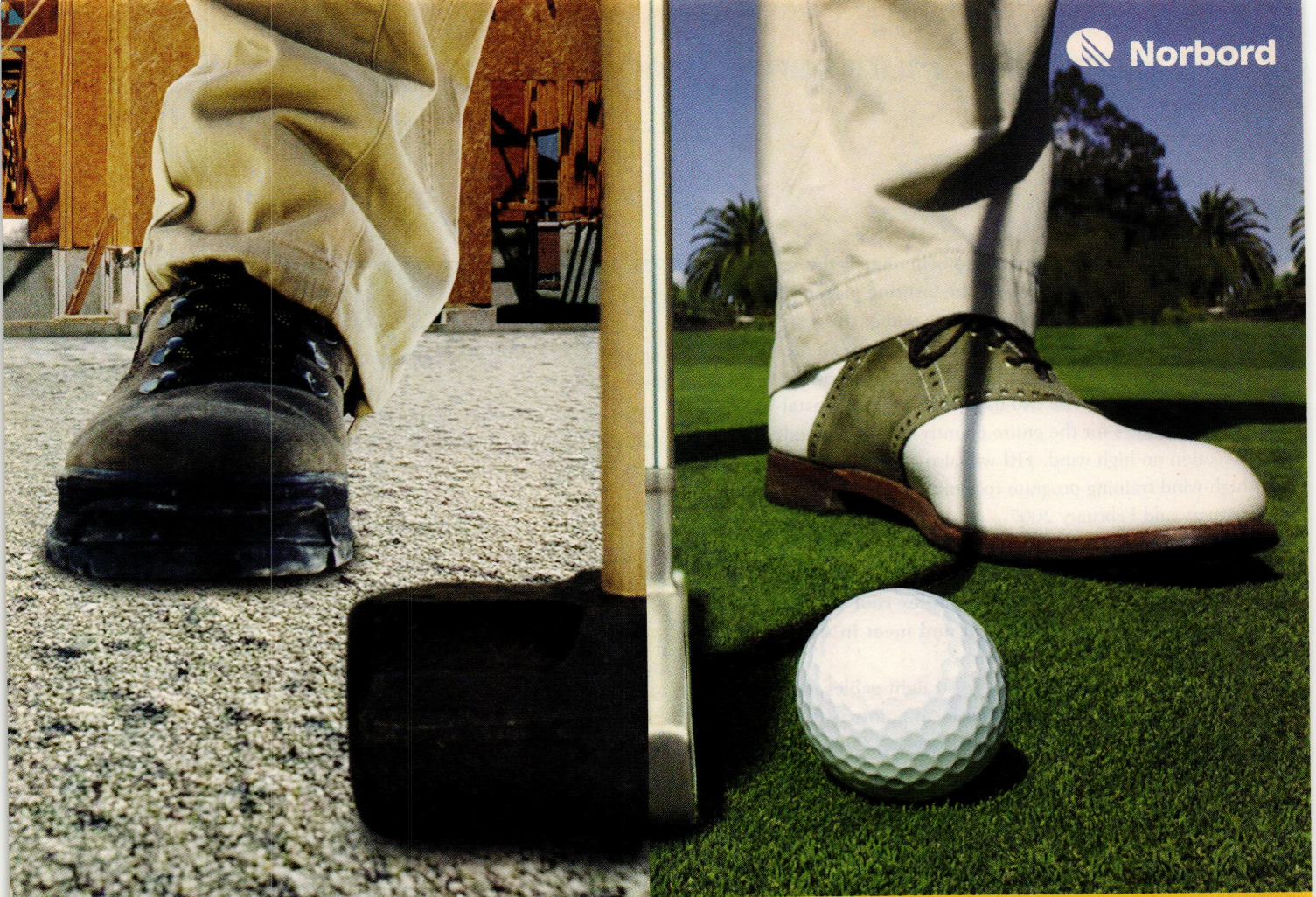
In fact, some installers aren't even following the 1997 guidelines. The FEMA teams found some roofs with mechanically attached and foam-adhered tiles that didn't perform as predicted. Olson, who also studied failed roofs after the storms, says that the culprits involved installation problems on both foam and mechanically fastened roofs. On the foam installations that fared poorly, Olson discovered that installers hadn't followed the foam manufacturer's instructions. They used too little foam or didn't put the foam at the right locations on the tile, or both.

With the failed mechanically attached roofs, the problem was not enough fasteners, or fasteners of the wrong type.

Foam manufacturers have responded by meeting with the installers of problem roofs. In some cases, they have made those installers get recertified to use the system. TRI has also launched

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# Tile Roofs for Hurricane Zones

a nationwide training initiative to help remedy the problems. According to Olson, the institute plans to have completed four trainings by the end of this year, and it will add programs wherever 50 or more attendees sign up. (Cost is \$195 for TRI members and \$295 for nonmembers.) The two-day program covers installation practices for the entire country but also includes a section on high wind. TRI will also offer a special high-wind training program to Florida contractors in January and February 2007.

Both training programs go beyond fastening. Issues covered include:

- **How to properly lay out a complex roof so that the courses are straight and meet in the right places.**

"A lot of installers are used to straight gables, but today's roofs are architectural focal points with features like dormers and different levels," Olson explains.

- **How to properly flash tile.**

Because of their profiles, tiles often don't sit flat against the roof, and many are installed on battens. Olson has seen tile installations by people not familiar with these conditions in which the flashing actually directs water under them. "Ninety percent of the callbacks we see are flashing related," he notes.

- **How to properly fasten tile.**

Often the fastening tables say to use two screws, but the installer uses only one. Or the installer fastens the tiles with the same 8-penny nails used for the battens, when they're supposed to use 10-penny nails. "It's all because people are in a hurry and they don't think anyone will notice. We want to teach them the importance of following the guidelines."

"There really isn't a training school for these guys," says Olson. "This country isn't like Europe, where there's a long tradition of craftsmanship. And after storms, we see a lot of transplanted roofers from other parts of the country who might not be familiar with how to install tile in Florida. We find that a lot of bad habits get passed down." ~

*Charles Wardell writes on construction topics from Vineyard Haven, Mass.*

## High-Wind Tile Specs

Recommendations for high-wind areas from the *Concrete and Clay Roof Tile Installation Manual*:

- For tiles mechanically attached to battens, tile fasteners should be long enough to penetrate the underside of the sheathing by at least 1/4 inch minimum.
- For tiles mechanically attached to counter battens, the fasteners must be long enough to penetrate the underside of the horizontal counter battens by 1/4 inch minimum, and batten-to-batten connections must be engineered.
- For roofs within 3,000 feet of the ocean, straps, fasteners, and clips should be fabricated from stainless steel to ensure durability from the corrosive effects of salt spray.
- Hip and ridge tiles should be mechanically attached to a ridge board, using screws that penetrate at least 1 inch into the board.
- Where the basic wind speed is equal to or greater than 110 mph, clips should be installed on each tile in the first row of tiles at the eaves, for both mechanically attached and foam-adhesive systems.

## FOR MORE INFORMATION

The Fourth Edition of the FRSA/TRI *Concrete and Clay Roof Tile Installation Manual* can be ordered from the Florida Roofing, Sheet Metal and Air Conditioning Contractors Association, Inc., [www.floridarroof.com](http://www.floridarroof.com); 407-671-3772. This manual covers the proper attachment methods for concrete and clay tiles in high-wind zones, using Florida construction standards. An online copy is available free from the Tile Roofing Institute ([www.tilerroofing.org/uploadedFiles/TRI\\_SITE/Become\\_a\\_Member/Florida%20Manual.pdf](http://www.tilerroofing.org/uploadedFiles/TRI_SITE/Become_a_Member/Florida%20Manual.pdf)).

*The Concrete and Clay Roof Tile Installation Manual for Moderate Climate Regions*, which covers best-practice installation methods, industry standards, and code requirements, can be ordered from the Tile Roofing Institute, [www.tilerroofing.org](http://www.tilerroofing.org); 312-670-4177. Cost is \$10.

Foam adhesives come with specific recommendations for installing tiles with their products. For more information, go directly to the manufacturer: Dow Chemical's Tile Bond: [www.dow.com/buildingproducts/tilebond](http://www.dow.com/buildingproducts/tilebond) Polyfoam Products' Polyset One: [www.polyfoam.cc/products/roof/polyset1.html](http://www.polyfoam.cc/products/roof/polyset1.html)

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*Being both an architect and a builder  
brings out the best of both worlds*

Interview by Ted Cushman

**E**veryone was born to do something," says design/build contractor Andrew DiGiammo. "I was born to build. Even when I was a kid, I always knew this was what I wanted to do." In high school, DiGiammo worked for his uncle's construction company. Then he went out on his own, supporting himself as a contractor while he worked through the five-year architecture program at Providence, Rhode Island's Roger Williams University. By his final year at Roger Williams, DiGiammo was already developing the design/build process that forms the core of his business today. Now a registered architect in Massachusetts, DiGiammo owns his own construction company, Residential and Commercial Master Builders of New England. He specializes in high-end custom projects near the water in the coastal communities around Providence, R.I., and Fall River, Mass., doing about \$6 million worth of business volume a year.



# All in One



Architect and builder Andrew DiGiammo prefers to create visual interest with building forms rather than with decorative trim. This bay-front house in Swansea, Mass., with its multicornered footprint, offers a choice of ocean views from every room.

PHOTOS BY TED CUSHMAN

**AS AN ARCHITECT WHO IS ALSO A BUILDER, YOU DESIGN ALL OF YOUR OWN BUILDINGS, AND YOU BUILD MOST OF YOUR OWN DESIGNS. WHAT ADVANTAGE DO YOU GAIN AND WHAT ADVANTAGES DO YOUR CLIENTS GAIN OUT OF THAT ARRANGEMENT?**

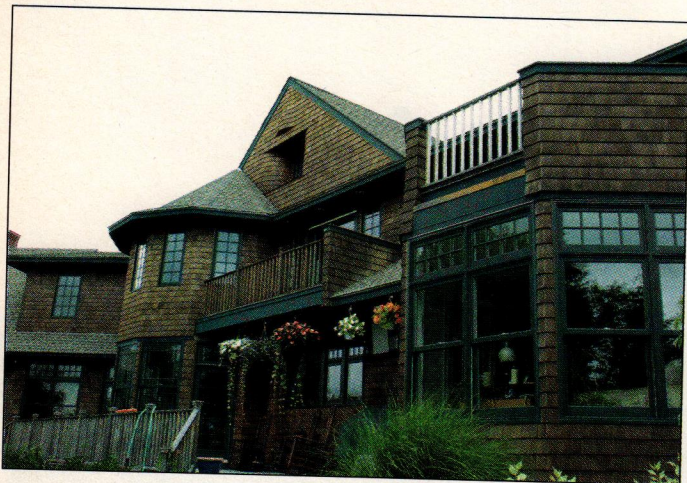
The clients' advantage is that they get single-point responsibility. They get a seamless transition from design to construction, they get accurate cost estimates all through the design, and it's guaranteed that the intent or the spirit of the design carries through to the construction. That's a huge advantage for the clients, especially on single-family residential projects, where the scope

is small enough that one guy can really have his hands around the whole thing.

I like it because, first of all, I save a tremendous amount of time. I don't have to spend time reviewing and studying someone else's print to figure out what is going on and then bidding on it. In high-end custom markets like mine, builders can spend 40 hours on a detailed bid for which they never get the job. I don't have to do that.

Second, when we start construction, I already know the clients, and I have a comfort level with them. When you're

# All in One



about to sign a million-dollar-plus contract with someone, it's nice if you already know the person — and you really do get to know someone during the design process.

Also, while I'm building, I know the project inside and out. So I can eliminate a lot of those things that come up between owners and builders, or between the builder and the architect, when the customer starts to say, "Oh, that's not what we really wanted."

## **SO THAT'S WHY IT'S BETTER FOR YOU AS THE BUILDER. WHAT ABOUT FROM YOUR POINT OF VIEW AS THE ARCHITECT?**

Well, I don't have to put up with the builder trying to get extras off my plans. I am not dealing with questions all of the time. And I save time on cost estimating, because I create the cost estimate at the same time as the design. I don't waste time drawing plans that turn out to be outside the budget. I never even start the working drawings until I know that I am going to meet the client's budget within reason. That determination is made during the initial phase of analysis and evaluation.

## **ISN'T THERE A PHASE AT THE VERY BEGINNING WHERE YOU DON'T KNOW WHETHER YOU ARE GOING TO GET THE JOB OR NOT?**

Yes, there's a predesign meeting, but that is a modest time commitment. When new residential clients contact me, I give them one meeting at their site with no obligation. I ask them to bring any ideas they have, and the site plan if they have one. After we view their site, I take them to see two examples of what I do — one example under construction that is still open and then a finished example.

My goal at that first meeting is to collect enough information on their budget, their site, and their needs that I can define the scope of the project. Then I follow up within the next couple of

DiGiammo's signature bays and bump-outs make the most of ocean-front sites by offering homeowners comfort in all weather. The many-windowed polygon elements help bring outdoor light and cross-breezes into the home, while also sheltering the locations of entryways and outdoor decks.



days with a design proposal. For residential work, I propose a lump sum for the design fee, based on the hours I spent on similar past projects. I can usually prep a new design contract in 15 minutes, based on a previous project — I just modify it for inflation or for any particular needs they have, print it out, and send it. Then I'm done with that client, unless they select me for the work — and lately, it has been a hundred percent. Typically, I spend six hours maximum to get the job.

## **HOW IS COMMERCIAL WORK DIFFERENT?**

It's a different ball game. It's not nearly as personal, and you make a mistake if you try to treat it that way. On commercial projects, I start with a site meeting also, but the focus typically



With its less restrictive codes, residential work offers DiGiammo the most leeway to play with interesting forms and shapes, like this whimsical bridge to an over-the-garage guest suite.

is on the overall cost — what the total project budget will be. The design fee is based on a percentage of the construction cost.

#### **SO MONEY ISSUES PLAY DIFFERENT ROLES?**

Well, they are two different markets. The cost of residential plans can be all over the place, starting at \$600 for stock plans from the Internet up to \$150,000 for custom designs from upper-echelon architects. And how you get high-end coastal residential work is based on much more than lowest price. In that market, shopping by price is the exception, not the norm. But in commercial work, often the primary questions are time and money: “How soon can we have the plans done, and how much is it going to cost?”

An exception to this is some waterfront commercial work, however. Occasionally, a light-commercial project in a nice coastal location, such as a public waterfront, may call for exceptional design work, and that could change the way the clients approach choosing an architect.

#### **THAT FOCUS ON PRICE IN COMMERCIAL WORK SOUNDS LESS ADVANTAGEOUS TO YOU AS A DESIGNER/BUILDER. IS THERE AN UPSIDE TO IT?**

Yes. For one thing, usually the rate for design work on commercial is higher, based on the work you have to do and considering that the building forms are usually simpler. Usually nonprofessionals can't compete — the drawings in commercial work always have to have a stamp. But then again, in coastal areas these days you are going to need a stamp for a residential foundation and probably for a lot of other parts of the house. So that's all changing.

#### **IS ONE TYPE OF PROJECT — RESIDENTIAL OR COMMERCIAL — MORE SATISFYING?**

It's usually the residential work that really allows me the opportunity to produce unique, site-specific designs. That's what residential clients are looking for. Also, in residential design you are free to do a lot more, without all the codes that can determine

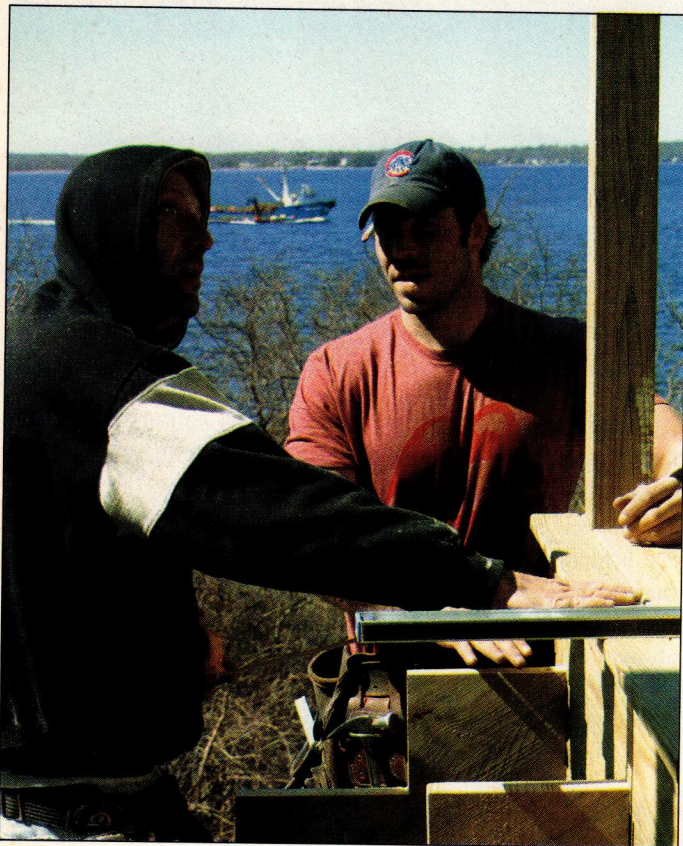
# All in One

so much of the form in a commercial building — accessibility, egress, fire codes, and all that stuff.

## **HOW MUCH OF THE ACTUAL WORK ARE YOU DOING WITH YOUR OWN CREW, AND WHAT KIND OF WORK ARE YOU SUBBING OUT?**

For the homes, I use my own crew, but a lot of the commercial work I sub out — even the framing. That's because commercial buildings usually have simpler building forms — it's more production-type stuff, and I don't have to be there all of the time. That's also easier for a sub to price; a framing contractor can price a simple rectangle for you easily, but maybe not a rectangle with five octagonal bays.

A lot of my homes get their uniqueness from their form. I use elements like bays and bows to make them interesting, both on the inside and on the outside. I think it's a better use of the client's money to create those shapes to take advantage of better



Crew members discuss a framing detail on one of DiGiammo's waterfront condominium projects in Fall River, Mass. On complex residential projects, DiGiammo prefers the efficiency of a crew who knows the more intricate details by heart.

views, better breezes, and to provide a more interesting shape to the room rather than spend it on, say, custom window trim. When someone looks at a beautiful bay, the trim doesn't really matter — people aren't even looking specifically at the trim at that point. They are just seeing the beauty of the shape and its proportions and, of course, the view beyond.

A framing crew can really stumble on those bays and bows if they don't do them very much. My guys know how to do these frequently used details almost by memory. It's kind of like having CAD details in your computer that you can pull in and use in various designs. My crews have been building my designs for 15 years. So by now, the memories of my crew members have become like those details in the computer that you can just pop in. If I draw a detail, usually my foreman already knows that detail. It's a big advantage over a separate architect and builder who don't have that shared experience.

## **IT SOUNDS AS IF THE CREATIVE DESIGN PART OF YOUR WORK IS A BIG FACTOR FOR YOU.**

That's what keeps me going. I like the construction process, too, in a crazy way, and I like seeing the design through to the end. But building is such a tough business. In my area, at least, the general contractors on smaller jobs make a lot less money than the plumbers, the electricians, and the other subs they use. And when I take on a building, all the responsibilities fall on me. I may get three headaches — from the carpet guy, the plumber, and the electrician, you know — all on one day. There is just so much involved when you have sole responsibility.

But when I get out there on a design interview, it's like the greatest thing in the world. It forces me to reflect, and it kind of breathes some new life into me. Whenever I drive away from an interview, I feel refreshed, because I've been back to a finished project, and I've seen what I did.

The process of building that house may have been more of a headache than anything. But after the dust settles and you go back to see it, you've forgotten all the headaches. That dormer or bay that you made to capture that beautiful view — maybe at the time it was something that went over budget, and you hated it for a while. And let's face it; going through a long project with people, even with the best clients, may be rocky at times. But when you bring other people back to a finished house, all that seems to be forgotten. And your old clients meet the prospective clients, and although they might not otherwise say it to your face, you hear them praising you. So those client interviews are a really uplifting thing. If I were building other people's plans and trying to hold the line every day on cost, without the design process and that interaction with the owners, it just wouldn't be the same for me. ~



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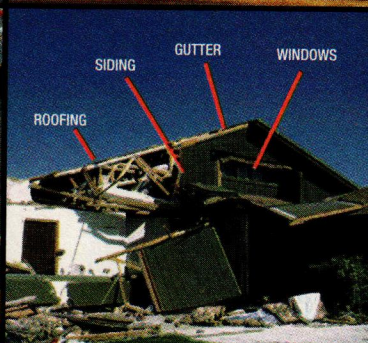
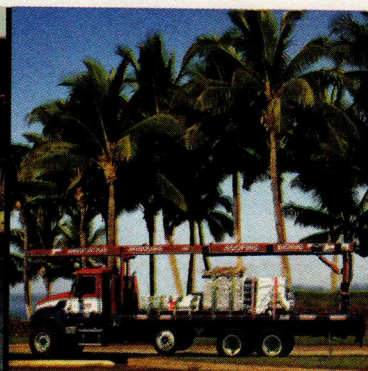
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## Low-Maintenance Railing

*Composite rail system offers integral mildew protection*

**T**he CorrectDeck RapidRail CX railing system includes an antimicrobial to reduce the chance of mildew growth in high-humidity conditions. With a low-luster finish that complements the company's line of composite decking, RapidRail CX is PVC-free and reportedly offers the heft, weight, and feel of lumber — not plastic — without the maintenance of wood. The antimicrobial protection is incorporated into each rail, baluster, and post using a

coextrusion process, so the protection will not wash off or wear away, according to the manufacturer. Because the material's wood fibers are coated with plastic, the product deters grease and food stains, and the addition of concentrated UV inhibitors enables the railing to resist color fading as well.

For more information, contact Correct Building Products, 877-332-5877; [www.correctdeck.com](http://www.correctdeck.com).



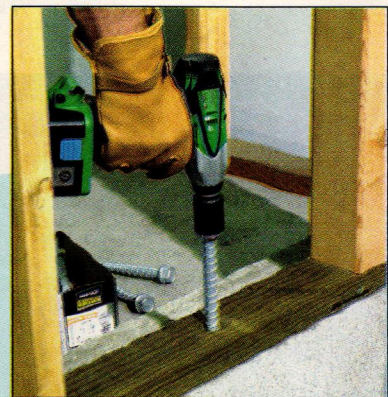
CORRECTDECK RAPIDRAIL CX

## Speedy Anchor

*Structural screw simplifies ledger connections and retrofit sill bolting*

**S**impson Strong-Tie has introduced the Titen HD, a heavy-duty screw anchor for high-strength applications in concrete and masonry. Available in 3/8- to 3/4-inch diameters, the Titen HD is installed in a predrilled hole using a conventionally sized masonry bit. The threads on the Titen HD hold the key to its performance: Hardened cutting teeth at the tip of the anchor undercut the concrete as the anchor

is driven, allowing the rest of the threads to follow with very little friction. The result is a continuous mechanical interlock between the anchor and base material that requires minimal installation torque and does little damage to the base material. For more information, contact Simpson Strong-Tie, 800-999-5099; [www.simpsonanchors.com](http://www.simpsonanchors.com).



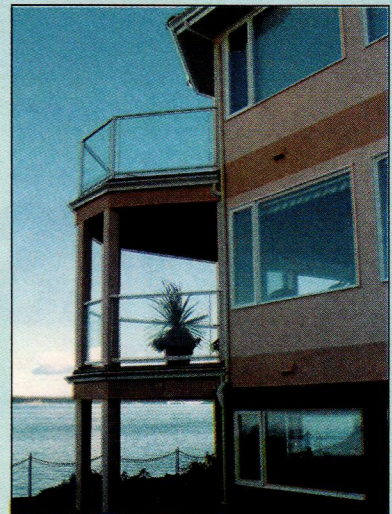
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**D**uradek, a waterproof vinyl that comes in rolls like membrane roofing, is designed to serve as a non-skid wear surface and waterproof sealer for exterior house decks. The material can be glued to virtually any clean, dry substrate, and it comes in a variety of textures to accommodate a range of home styles. According to the manufacturer, the fire-retardant material resists mildew, salt spray, UV radiation, and freeze/thaw cycles. All installers are required to be factory trained

and certified, and the work requires some specialty tools, like heat guns, that few carpenters carry in their toolboxes. The installation techniques, however, are reasonably easy to master and are similar to those needed to install vinyl flooring or single-ply roof membranes. The payoff is a more durable deck covering than fiberglass or epoxy trowel membranes. For more information, contact Duradek Ltd., 800-338-3568; [www.duradek.com](http://www.duradek.com).



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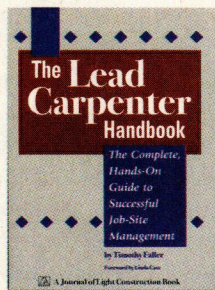
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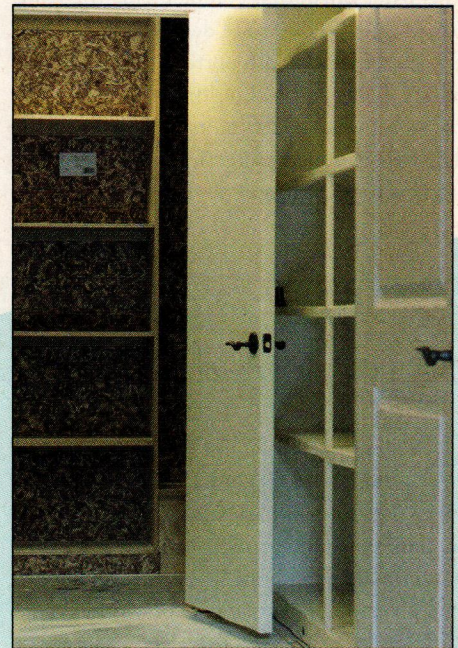
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# Revolutionary Roof

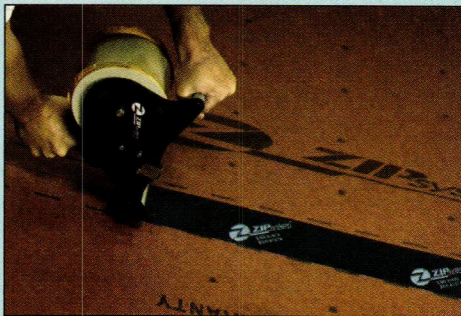
*Moisture-proofed OSB eliminates need for felt*

**H**uber Engineered Woods, the company that brought AdvanTech OSB to the market, recently introduced a roof sheathing with a built-in slip-resistant moisture barrier that doesn't require an additional underlayment. The Zip System Roof is comprised of 1/2-inch-thick paper-laminated OSB panels designed to be installed with proprietary 3 3/4-inch-wide tape at all panel end and edge joints.

Together, panels and seam tape provide a code-recognized replacement for roof sheathing and conventional felt underlayment.

This system allows framers to dry-in a

roof as soon as the sheathing is installed and provides the type of secondary water barrier recommended for roofs in hurricane country. If the roofing blows off in a tropical storm, the roof is still protected from water penetration. For more information, contact Huber Engineered Woods, 800-933-9220; [www.huberwood.com](http://www.huberwood.com).



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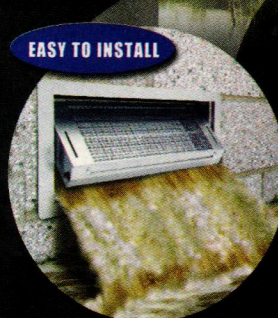
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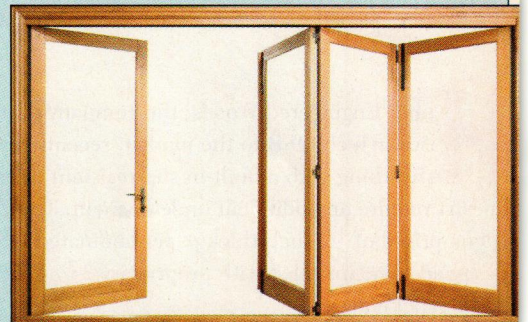
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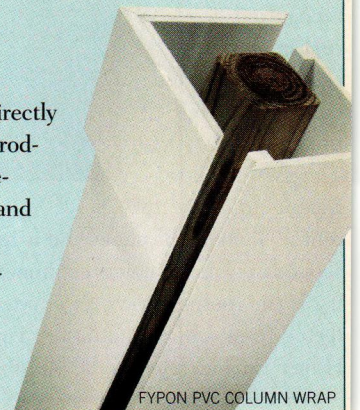
LOEWEN BIFOLD DOORS

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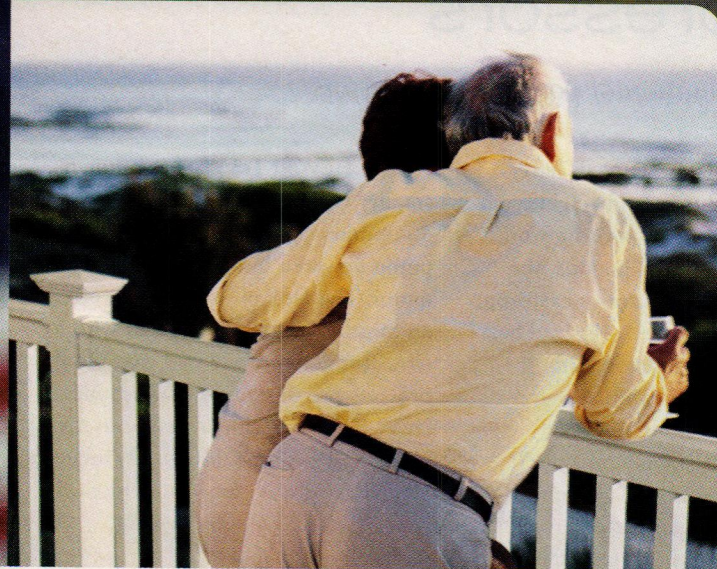
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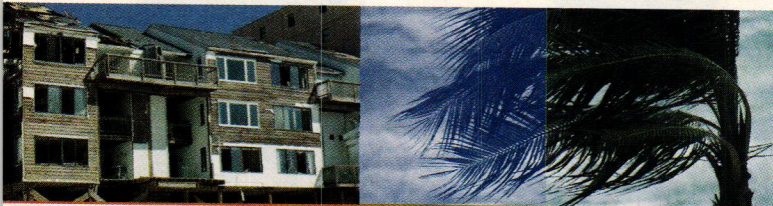
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# Competing Compressors

*The next generation of portable compressors*



HITACHI EC119SA



DEWALT D55141

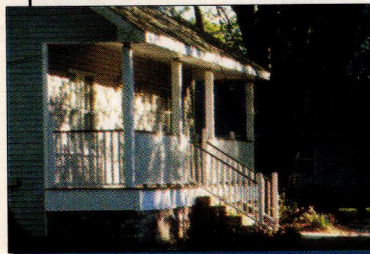
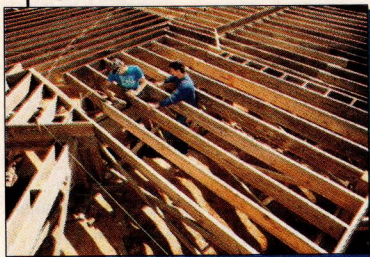
**B**oth Hitachi and DeWalt have introduced new lightweight, compact compressors for trim work. Weighing in at just 63.7 pounds, the Hitachi EC119SA features a cast-iron, oil-lubricated pump with oversized bearings and a 15-amp induction motor, which runs significantly quieter and longer than comparable universal motors. The four-gallon twin stack has been enclosed in a roll cage with an integral control panel that protects the gauge, regulator, and plumbing. Additional features include drain ball valves, a cord wrap, a protected pressure switch, shock-absorbing feet, manual overload protection, a two-handed handle, and two factory-installed couplers.

The DeWalt D55141 is a much smaller two-gallon unit, weighing in at 30 pounds, and it features an oilless pump powered by a 10-amp universal motor. The DeWalt model, too, offers an innovative roll cage design with a wraparound control panel that safely protects the unit and controls, and DeWalt offers a similar menu to the Hitachi of additional features, including a ball drain valve, a convenient cord wrap, and dual quick couplers.

For more information, contact Hitachi Power Tools, 800-829-4752; [www.hitachipowertools.com](http://www.hitachipowertools.com), and DeWalt Power Tools, 800-433-9258; [www.dewalt.com](http://www.dewalt.com).

*Attention Builders:*

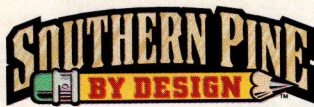
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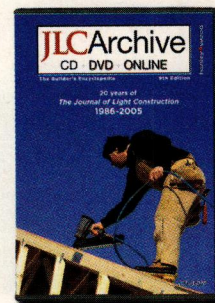
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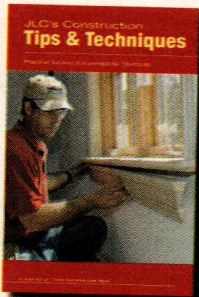
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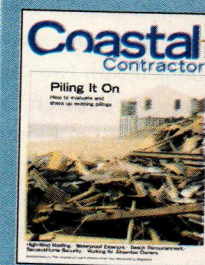
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# Blown Apart

*Armed with cannons, cranes, and wind machines, engineers test houses*

**H**urricanes may be a force of nature, but high winds and heavy rains can be engineered — and the engineers are getting good at it.

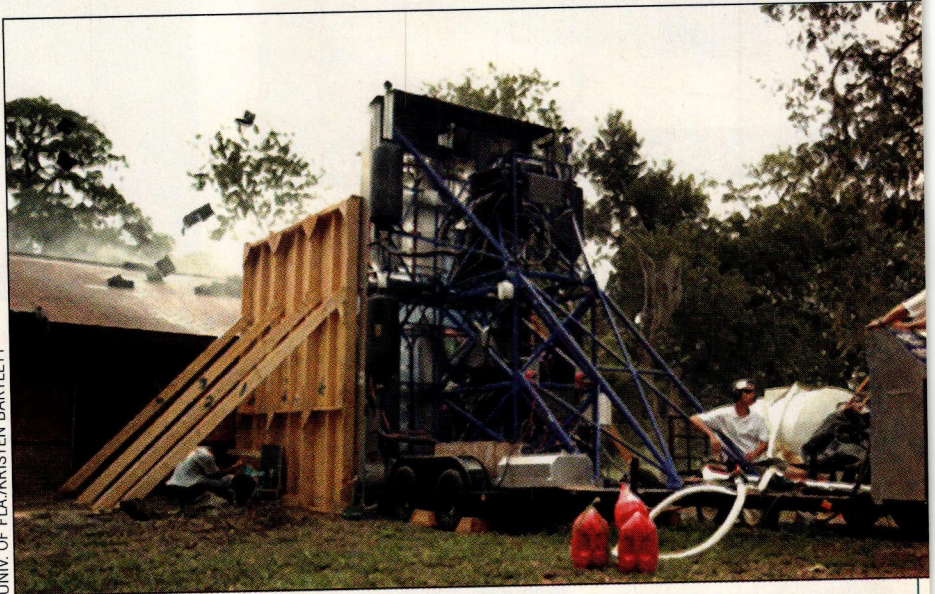
That was the impression conveyed earlier this summer at a gathering of leading hurricane wind engineers from several Florida universities and better-building advocacy groups in rural central Florida.

The engineers were spending a week experimenting on 10 unlucky vacant homes, with the goal of probing how hurricanes rip apart houses built before Florida's first statewide building code in 1994 — and figuring out the best retrofits to prevent that damage. But the tests also showcased the most up-to-date arsenal in the art of hurricane simulation.

Most visible was a "Wall of Wind" machine. Described by one researcher as the "mother of all airboats," the business end of the trailer-mounted rig was equipped with two caged airboat propellers, each driven by Chevrolet V8 502 motors. Built at Florida International University and completed this spring, the machine can generate 120-mph winds. Combined with "rain" sprayed in from a 500-gallon tank, the end product approximates a Category 3 hurricane in a space the size of a car.

"It's not designed to blow down a house," explains Kurt Gurley, an associate professor of civil and coastal engineering at the University of Florida. "It's designed to test the components of the house that are having performance issues."

So, too, is another weapon in the engineers' arsenal: the 2x4 air cannon. Hauled in by engineers at the Tampa-based Institute for Business and Home Safety (IBHS), the trailer-mounted cannon has a long PVC barrel



UNIV. OF FLA./KRISTEN BARTLETT

Shingles and tar paper fly off of the roof of a vacant home in central Florida as a custom-built wind machine pounds it with hurricane-force winds. Part of a University of Florida-led hurricane research project, the experiment was one of several aimed at learning more about how hurricanes damage homes that were built before Florida adopted its first statewide building code in 1994.

"charged" with compressed air.

The cannon can fire a 2x4 at 100 miles per hour, but the engineers were seeking to mimic flying debris from only a Category 3 storm. They pounded the homes' windows, covered with Lexan protective sheathing, with 40-mph projectiles. The clear Lexan bowed severely, highlighting the need to space it far from glass panes.

One of the odder tools on site was the nail puller. Invented by Tim Reinhold, vice president of engineering at IBHS, the 2-foot puller looks like a giant's wine opener — the kind with opposed handles that yank the cork free when pulled down. But instead of a corkscrew, the puller has a metal hook that attaches to the nail and a force transducer that measures the pressure required to pull it free.

Gurley says hurricanes often yank roofing plywood off of homes. The engineers use the puller to measure the forces involved, with the goal of specifying the size, number, and distribution of nails to ensure the plywood stays attached.

That's a bit more complicated than it at first appears, however: Gurley reports that the vacant home tests revealed nail-pulling forces ranging from 30 to 200 pounds, depending on the size, condition, and location of the nail, such as if it was driven into a knothole.

The wind machine, air cannon, nail puller, and other equipment may be unusual, but they're all essential to hurricane wind research, Gurley notes.

"We have our engineering equations and our assumptions, but there's nothing quite like breaking something," he explains. — Aaron Hoover