May/June 2018

ICF BUILDER

The Insulating Concrete Forms Magazine

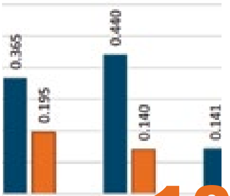
Green Building

Zero Energy Homes
Insurance Savings
Optimal Insulation

BUILDING QUALITY PRODUCTS FOR OVER FIFTY YEARS
50+
OZTEC
Turn the entire length of rebar into a vibrator with the Oztec Rebar Shaker™
Patented
Absolutely Nothing consolidates concrete in ICF better than the Oztec RebarShaker!
See Oztec's full line of vibrating equipment on our web site: www.oztec.com
PROUDLY MADE IN USA
Oztec Industries, Inc. Tel: 1.800.533.9055 . 1.516.883.8857
OZTEC
Concrete Vibrating Equipment

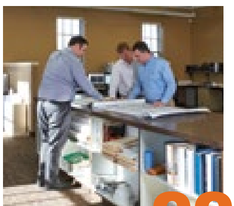
Elevate your structure with a groundbreaking flooring system.
The Ecospan Composite Floor System is the smarter choice for your next structure. Boasting an impressive combination of steel components with open web design, it has the versatility to perform in low, mid and high-rise structures. The lightweight and high strength design allows for longer spans, shallower floor depths, greater rigidity and enhanced performance – all without sacrificing aesthetics. Quite simply, it's a better way to build.
Forge ahead of industry expectations with Ecospan. Call or go online and start building success today.
ECOSPAN® IS THE BETTER CHOICE FOR:
- Apartments
- Condominiums
- Hotels and Resorts
- Medical Facilities
- Mezzanines
- Military Housing
- Office Buildings
- Schools
- Senior Living and Care Facilities
- Student Housing and more.
Concrete Slab (by others)
Concrete Reinforcement (by others)
Vulcraft/Verco Steel Deck
Shearflex® HD screw
Vulcraft E-Series Steel Joist
The L, Chicago, IL
This six-story, 120-unit multifamily apartment building, with its unique design and features, creates an exceptional living experience. One distinctive feature of this building is the use of a retired CTA rail car as a lounge on the deck.
ECOSPAN
COMPOSITE FLOOR SYSTEM
NUCOR®
VULCRAFT/VERCO GROUP
Ecospan Composite Floor System
Nucor Vulcraft National Accounts
6230 Shiloh Road, Suite 140
Alpharetta, GA 30005
678.965.6667
888.375.9787
www.ecospan-usa.com
UL
FIRE RATED 1,2,&3 HOURS
STC 57
IAPMO
CERTIFIED

Inside This Issue

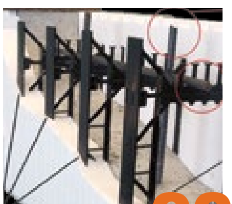


10

14



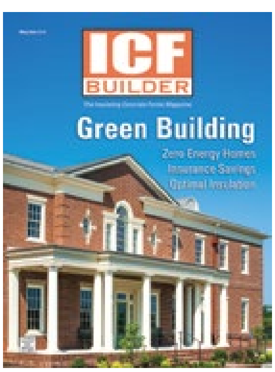
22



28

Features

Departments



On the Cover: *CMTA Engineering's new office in Lexington, Kentucky, was awarded LEED-Platinum for sustainability, in part due to the ICF walls. See story on p 22.*

Photo by Wes Battoclette, copyright CMTA

ICF BUILDER

Advertising
Craig Shorts
craig@icfmag.com

Editorial Director
Clark Ricks
editor@icfmag.com

Art Director
Jason Robinson

Webmaster
Brad Moulton

Contributing Editors
Robert Klob
Robert Sculthorpe

Contributors
Steve Bluestone
Brian Corder
Eric Cotes
Jamie Draper
Steve Heinrich
Mark Mueller
Pieter VanderWerf

Summit Publishing
884 East 700 North
Mapleton, UT, 84664-3761
Toll-free: 877-229-9174
International: 801-207-1971
Editorial: ext. 2
Advertising: ext. 1
Subscriptions: ext. 3
Fax: 801-207-1971
www.icfmag.com

@ICFBuilderMag

Volume 14 Number 3

ICF Builder magazine is published bi-monthly: January, March, May, July, September, and November by Summit Publishing, LLC, 884 East 700 North, Mapleton, UT, 84664-3761. Subscription price: $30 per year.

ICFs MAKE CONCRETE SIMPLE, FUN, AND COMFORTABLE!

LEARN MORE WITH FREE TRAINING AT BUILDBLOCK.COM/ICFB

This BuildBlock ICF residential home is poured and ready for completion. The ICF job site is clean with little to no waste and ready for trades.

BuildBlock is the industry leader in ICF training and education. Now with the BuildBlock Online Training Portal, ICF training is easier and more accessible than ever before. Take your ICF home & pool building skills to the next level with this FREE online training.

REGISTER FOR FREE & START LEARNING TODAY AT BUILDBLOCK.COM/TRAINING

Build an energy-efficient ICF pool using BuildRadius and BuildBlock ICF forms. ICF pools are stronger, faster, and easy to build using less labor & materials.

BuildBlock ICF Pool using the Fastlane® Endless Pool System.

BuildBlock INSULATING CONCRETE FORMS

866-222-2575 | BUILDBLOCK.COM

PROVERBS 24:27

BECOME A BUILDBLOCK DISTRIBUTOR AT BUILDBLOCK.COM/NETWORK

As I See It

Welcome to the Future

By Clark Ricks

Welcome to the future of construction. We've gained a significant number of readers in the past months, so for many of you, this May/June issue may be a first introduction to insulated concrete forms. Those of us familiar with this technology recognize that ICF is frequently the easiest and most cost-effective way to build sustainable, energy-efficient building.

This magazine, like previous May/June editions, is a special issue focused on sustainability and green construction. It includes new research on how ICFs reduce insurance premiums (p. 10) and how to calculate the most cost-effective level of insulation (p. 26).

It also includes real-world examples. In nearly every state, there are ICF homes that meet the highest green building, efficiency, and disaster-resistance standards. This issue profiles two recent projects: the Otten Home (p. 18), which meets net-zero and accessibility standards while being built to withstand tornadoes and earthquakes. The other, Emerald City Residence (p. 16), is certified to LEED-Platinum sustainability standards, despite being located at a remote site in the Colorado Rockies. Its curved insulated concrete roof is a reminder of the design flexibility the system offers.

ICFs have been similarly successful in the commercial sector. Schools, churches, apartment buildings, retail space, and offices have all been built to the highest commercial green building standards. Additionally, the design teams report that ICF was the most cost-effective way to "build green." To illustrate, Beach Green North Apartments in New York (see story on p. 23) is the largest building yet certified by the Passive House Institute U.S. (PHIUS). The CMTA office in Kentucky exceeds LEED-Platinum requirements (see story on p. 26). There are scores of similar projects across the country.

Energy codes and durability standards are becoming increasingly demanding. Fortunately, with ICF construction, it's possible to build better than tomorrow's standards, today.

I hope you enjoy this magazine. ■

News Roundup

Framing Lumber Prices Rise

The cost of lumber in the United States is approaching record highs as builders stock up for what is expected to be one of the busiest construction seasons in years.

In November, the Trump administration slapped a 20% import tax on Canadian lumber, claiming the industry was unfairly subsidized. Nationally, about 25% of framing material comes from north of the border, but in some areas of the west, it's closer to 40%. Additionally, massive wildfires last summer destroyed prime forests in Oregon and Montana.

The price increase comes at a bad time for U.S. builders, which are already contending with labor shortages. “You have a kind of perfect storm brewing for the homebuilder,” says Jim Barbes, vice president of national sales at 84 Lumber Co., one of the nation’s largest lumber yards.

David Logan, director of tax and trade policy at the National Association of Home Builders (NAHB) says that in some areas, lumber prices have increased 31% in the past 12 months, and are heading towards the highest level in 32 years. “We’re talking about the potential not just for a record-setting year, but one that is unprecedented,” he says.

TV News Promotes ICF

When the ready-mix concrete supplier in Marquette, Michigan chose to build a new plant with ICFs, the local news station gave the technology a big publicity boost. The segment covers how ICF construction works, its advantages, and why homebuilders should consider using ICFs. The news clip can be watched online on YouTube.

Andy Lennox, marketing manager for Logix ICF, the brand used, credits the local ICF distributor for doing all the hard groundwork. He adds, "ICF was wonderfully covered in the local news recently as Fraco Concrete chooses Logix ICF to build their new facility."

Studies Confirm Resilient Materials Save Money

Last year was the most expensive year on record for disasters in the United States, thanks to powerful hurricanes in the Gulf of Mexico and devastating wildfires in the west. There were 16 separate billion-dollar disasters, with the cumulative damage of these events totaling $306.2 billion. That's $100 billion more than 2005, the next highest year, when hurricanes Katrina and Ike devastated the Gulf Coast.

As expected, last year's disasters also created the costliest year in history for the global insurance industry – totaling $135 billion – with the U.S. accounting for half of these costs.

The concrete construction industry hopes that these disasters will motivate the country to rebuild with disaster-resistant materials.

“There’s evidence that building with less resilient materials costs more in the long run,” said Robert Garbini, president of the National Ready Mixed Concrete Association in a letter to *The Orlando Sentinel*. “Whether the issue is stability in the face of high winds, or rotting and molding after floodwaters, the materials used to build make a difference.”

Fab-Form Release Video Promoting ICF

Fab-Form, makers of the popular fabric footing material, released a video online explaining how the system works with ICF to reduce moisture penetration into buildings.

The narrator, Jeff Langford at JDL Homes, made the switch to Fastfoot footings and ICF more than two years ago. He says the flexible footing forms allow him to easily deal with uneven excavations, and protects the homeowner with a capillary break on his footings. The video can be viewed on the Fab-Form website.

New Corporate Office for BuildBlock

In January, BuildBlock Building Systems, the Oklahoma-based ICF brand, relocated their headquarters to a larger office space to accommodate growth. "Last year was the most successful year to date for BuildBlock and as we grow, our needs grow with us," says Brian Corder, president of sales and marketing. "This new office space meets many of the needs our growing company has, and provides us with a beautiful and functional workspace for the coming years, allowing us to better serve our customers."

Energy Efficiency Tax Benefits Preserved

In February, the U.S. Congress passed a budget act which extended two energy efficiency tax credits. Sections 179D and 45L of the code, create incentives of up to $1.80 per square foot for qualifying ICF buildings. The bill is retroactive, so structures built in 2017 qualify for the provision.

“Passage will allow projects placed in service in 2017 to be certified for qualifying energy tax incentives,” reports Walker Reid Strategies, a tax credit consulting firm partnered with PolyCreteUSA.

Dodge Expands Canadian Reach

Dodge Data and Analytics has partnered with several large Canadian construction associations to significantly increase the number of projects and documents reported from that country. The move is anticipated to provide better value and coverage to their customer base.

Dodge has entered exclusive relationships with the British Columbia Construction Association (BCCA) and the majority of local construction associations within the province of Ontario. Leveraging the analytical capacity and combined data sets of all parties, Dodge will further develop Canadian economic- and construction-related materials and forecasts for association members and Dodge customers.

The move is fortuitous for the ICF industry, as the improved data collection is primarily in Ontario and British Columbia, two regions that use ICFs extensively. Dodge estimates that 40% of all construction activity in Canada happens in Ontario.

"Through these strategic partnerships, Dodge is doubling down on Canadian construction and reaffirming its commitment to providing unparalleled market insights on Canadian construction activity," said Mike Petrullo, CEO of Dodge Data. "As always, we will continue to seek new Canadian sources to enhance our coverage and the value we offer the industry."

Dodge will continue to serve the Canadian market through a number of other channels, including a Canada-specific construction activity forecast. The semi-annual Canadian Construction Forecasting Service (CCFS) provides a detailed outlook for Canadian construction with a five-year forecast of building permits for 15 structure types, covering the nation, provinces and 10 largest metropolitan areas.

NRMCA Releases ICF Promotional Videos

The National Ready Mixed Concrete Association (NRMCA) Build With Strength campaign has released a series of videos highlighting the benefits of using ICFs. The 11-segment series explains how ICFs have made Kentucky's public schools some of the strongest and most efficient in the country.

"Richardsville Elementary School is a school we have not had to pay an electric bill since it opened," said Jay Wilson, facilities director for Warren County (Kentucky) Public Schools. "The building actually generates more electricity than it consumes. At the end of the school year we usually get a check back from the utility company in excess of $30,000."

"One of the biggest benefits we've seen since moving to ICFs is the speed of construction," said Kenny Stanfield of Sherman Carter Barnhart, the architecture firm for Jennings Creek Elementary. "ICFs allow us to build rapidly, saving man-hours and costs in the long run."

The series of 11 videos can be viewed on YouTube or at the *www.buildwithstrength.com* website. ■

Commercial Insurance Savings With ICFs

By Pieter VanderWerf

Six months ago, a Boston apartment building five miles from my office went up in flames. It was under construction at the time, but the six-story structure was nearly complete. The fire reportedly started on the roof. It destroyed the roof deck. The deck collapsed and the flames dropped down to the next floor, and then the next and the next, until the fire reached the ground. The developer had insurance, but had to start construction over.

We found insurance to be lower for ICF in every region, for finished buildings and those under construction.

One month later, a near-rerun occurred in the town of Waltham, this time two miles away from me. A major complex of five 4- and 5-story apartment buildings under construction caught fire and the buildings collapsed. According to the Waltham Fire Chief, what was left of the buildings consisted of a "large pile of debris" (*Boston Globe*).

In both cases the buildings were wood frame construction.

Around that time, the National Concrete Ready Mixed Association (NRMCA) asked my research group to find out how the cost of building insurance differed for an apartment building constructed with concrete instead of wood frame. This could serve two purposes. First, it would tell us how much money in the form of insurance premiums one might save by building with concrete. Second, the difference in insurance premiums would give us an idea of the difference in risks and potential property losses using different materials. The insurers are the people who actually have to pay for the property damage, and if they set the rates at a certain level it's generally because they feel that's how much they need to cover the potential cost.

We gathered quotes from insurance agents across a range of U.S. cities and found them to be lower for ICF concrete construction in every case—regardless of region and regardless of whether the insurance was for a building under construction or a building that was completed and in operation.

Background

About a decade ago various building jurisdictions around the country began permitting the construction of taller multi-unit residential buildings with wood frame. In practice most of these structures use 2x6 studs and plates in the structural walls and engineered wood trusses for the floor decks and roof. In 2009 the International Building Code increased the height of such buildings that could be constructed without special provisions to six stories.

The argument in favor of permitting more wood frame construction was almost always cost. Municipalities frequently cited the need for reduced costs to help encourage construction in the wake of the 2007-2008 financial crisis. More recently they have argued that wood construction is important to the creation of affordable housing units as population has boomed in some areas. Now it appears that one downside to the supposed construction savings is greater risk of damage from disaster and greater insurance cost.

NRMCA tries to keep track of reports on wood frame apartment buildings around the U.S. that have burned down. It shows that we in Massachusetts are far from unusual. Their informal tally of news articles shows more than 100 major low- and mid-rise wood apartment fires in the past three years. No one knows how many more have escaped their notice.

In theory, the fire damage can be controlled. Many sources have claimed that wood is "safe" after the building is complete. Their reasoning is that during construction, fire suppression sprinklers and alarm systems are not activated. This makes the building vulnerable. But after work is complete and the systems are on, they are supposed to prevent the spread of fire and reduce the risk of damage. Nonetheless, there are many examples of wood frame apartment buildings with these systems that have burned to the ground.

We also have to remember that the world gives us other types of disasters. High winds and flooding can be destructive as well. And losses from these disasters are not likely reduced by fire protection systems. Instead, wind and flood damage are limited more by the strength of the building structure. Reinforced concrete is generally one of the strongest structural materials.

Insurance agents agree that in most areas, the losses from fire are greater than from any other cause, but these other disasters do factor in.

There are actually different insurance policies for buildings under construction versus those that are completed. For a building under construction, the developer or general contractor buys Builder's Risk Insurance (BRI). The exact terms of a BRI policy vary from case to case, but in general it covers damage while the building is still under construction. If there is damage the insurance company pays the builder the cost of repairing or reconstructing the building to return it to its state before the damage occurred.

Commercial Property Insurance (CPI) is purchased by the building owner to cover damage after the building is complete. Similar to BRI, a CPI policy pays the owner the costs of getting the building back to its original state in the event of damage.

Questions

By getting quotes for both Builder's Risk and Commercial Property Insurance for both wood and concrete apartment buildings we hoped to learn which material had lower insurance costs, and under what circumstances. This would also tell us how much risk the insurance industry feels each material has in different scenarios.

Our basic research questions were:

1. Is the cost of Builder's Risk Insurance greater for concrete or wood frame multifamily buildings?
2. Is the cost of Commercial Property Insurance greater for concrete or wood-frame multifamily buildings?
3. In each case, how big are the differences?
4. Are the insurance premium savings less for concrete after construction?
5. How do all these rates vary across different areas of the country?

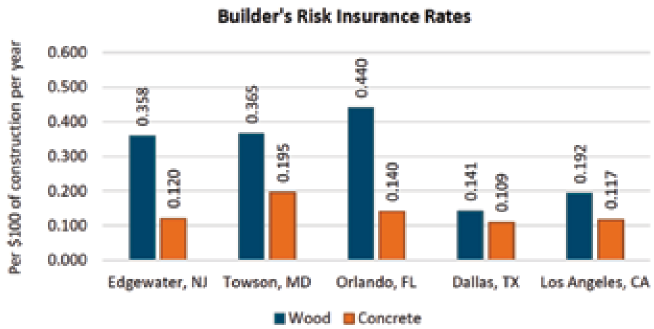
Methods

We set out to gather insurance quotes that would let us compare apples-to-apples.

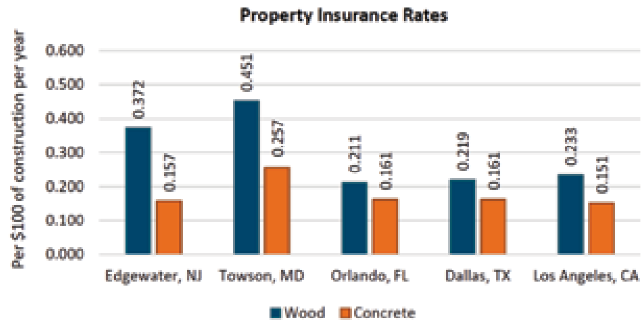
NRMCA requested that our quotes be for a single, uniform building, and provided us with floor plans for it. This "reference building" was a four-story, 92-unit apartment building. NRMCA estimated its cost of construction in today's market would be about $14 million, although that could vary with circumstances.

For concrete construction, we assumed that the walls would be insulated concrete forms and the floor and roof decks would be precast hollow-core plank. (NRMCA believes this to be the most common configuration for multi-floor multifamily concrete buildings.)

Because every insurer includes somewhat different coverage and services in its policies, we decided to get all insurance quotes in pairs. For example, if we wanted the cost of Builder's Risk Insurance for the model building in Dallas, we asked a single agent for a quote for the building if it were constructed of wood and a separate quote for the building if it were constructed of concrete. We told the agent to assume that everything stays the same (location, design, policy



Graph 1: Average rates found for Builder's Risk Insurance in Five Different Cities



Graph 2: Average rates found for Commercial Property Insurance in Five Different Cities

coverage, etc.) except for the materials.

To get results more representative of the entire U.S., NRMCA asked that we get quotes for five different metropolitan areas of the country: Edgewater, New Jersey; Towson, Maryland; Orlando, Florida; Dallas, Texas; and Los Angeles, California.

We were concerned that some agents we happened to interview might have unusual circumstances and give us quotes that were different from the norm in their area.

To guard against this we got quotes from two different agents in each case. So for Builder's Risk in Dallas, for example, we got one quote for a concrete building and one quote for a wood building from one insurance agent. Then we got a pair of quotes for the same thing from a different agent at a different company. We then did the same thing (quotes from two different agents) for the Commercial Property insurance to round out the data for Dallas. And we followed this same procedure in each of the five metropolitan areas.

Even though the overall rates change, there was always savings with concrete.

In practice we had to compromise our methods a bit. The insurance agents we interviewed received no benefit from their participation in the study other than making a contribution to research. As a result, they could devote only limited time to it. Some were not able to prepare an original set of quotes for the reference building. However, some had recently prepared quotes for a similar building in their area and were willing to rerun it assuming the two different construction materials. In truth, we were not concerned so much with the exact amount of a premium for a particular building, but more with how the premium would change if the building material were changed. These quotes promised to give us reasonable estimates of the differences, so we accepted them.

Results

Two sets of graphs above summarize the results. Graphs 1 and 2 contain the average insurance rates we were quoted. Graphs 3 and 4 contain the total insurance bills for the reference building that we calculated from the rates.

The first obvious conclusion is that the insurance rate is lower for concrete in all cases. No matter whether the quotes were for BRI or CPI, and no matter what city they were for, the average rate for concrete was always lower.

Consider the figures for Edgewater, New Jersey: For Builder's Risk Insurance, the average estimated premium rate for a wood building was 35.8 cents per year for each $100 of construction cost of the building. If the building cost $14 million to construct, that works out to about $50,120 per year. For a typical 15-month construction period, the total Builder's Risk Insurance for the building would be $62,650. For concrete the rate is 12.0 cents per hundred dollars per year, for a 15-month premium of $21,000. That would be a savings for concrete of $41,650 while the building is under construction. Looked at differently, the premium for concrete is about 66% less than the premium for wood.

For Commercial Property Insurance in Edgewater, our quotes suggest that the annual premium to the owner of a $14 million building will be $52,080 per year for wood and $21,980 for concrete. That is $30,100 less per year, or about 58% less for concrete.

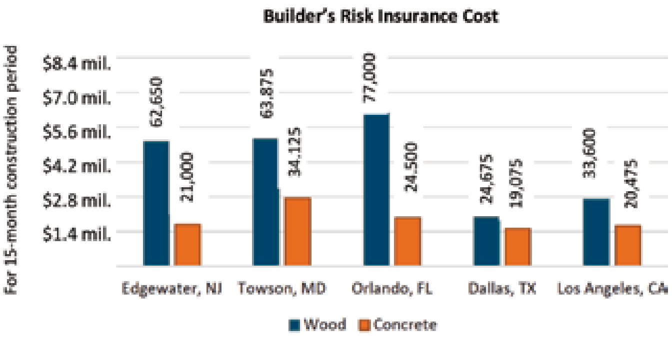
The figures are in the same ballpark for Towson, Maryland. They are also similar for Builder's Risk Insurance in Orlando. However, the quotes are much lower in Orlando for Commercial Property Insurance.

And in Dallas and LA, rates overall are lower for both types of insurance. For example, in Dallas the average quoted Builder's Risk premium works out to be $24,675 during 15 months of construction for wood, and $19,075 for concrete. This is a savings of $5,600, or about 23%. For Commercial Property Insurance, the estimated premium is $30,660 each year for wood and $22,540 for concrete. That's a savings of $8,120 per year for concrete, or about 26%.

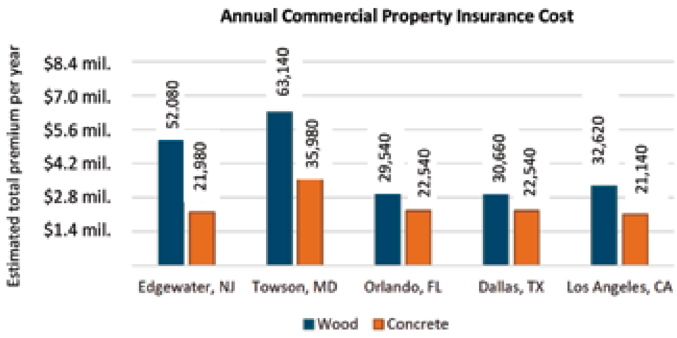
Conclusions

In addition to collecting the numbers, we asked the agents what factors were behind them.

They agreed that most of the cost of building insurance is to cover the fire risk. However, we can see from the numbers that completing the building and getting the fire suppression and alarm systems running usually makes little difference. In Orlando there was a big drop in the cost of insurance for a wood building



Graph 3: Estimated amounts for Builder's Risk Insurance for a $14 million apartment building in Five Different Cities



Graph 4: Estimated amounts for Commercial Property Insurance in Five Different Cities

from before the building was complete (Builder's Risk Insurance) to after (Commercial Property Insurance). But for all other cities the savings from using concrete was about the same even after the building was complete.

More important is where the building is located. Agents agreed that rates may vary widely depending on local risk conditions and differences in what insurance policies include in different regions. Nonetheless, even though the overall rates change from place to place, there were always savings with concrete—often, big savings.

Although it is impossible to know the future, some of the agents felt that the difference in rates would increase in the near future. They say that the agencies have been watching the rate of fires among these new, taller wood-frame apartment buildings, and they see how frequent they have been and how big the insurance payouts are. That, they feel will lead them to increase insurance rates for the wood frame buildings. And that will increase the savings to concrete.

Pieter VanderWerf is a professor at Boston College and president of Building Works, Inc., a consulting firm that helps companies develop and commercialize new construction products. He can be reached at pieter.vanderwerf@bc.edu. The author acknowledges the contributions of Nicholas Haidari, lead researcher on this project, who made major contributions to this story.

Technology for Zero Energy Homes

Photo courtesy Mark Mueller

Over the past decade, Zero Energy (ZE) homes have quietly gone from research to reality—and they're becoming increasingly affordable.

For the purposes of this article, a ZE building is defined as a highly efficient structure that produces as much energy as it uses over the course of a year through on-site renewable power generation.

ZE differs significantly from the more widely-known LEED certification program. While both focus on sustainability, ZE is focused exclusively on energy.

The following pages spotlight two separate "green-built" homes. (A pair of sustainable commercial buildings are also featured in this issue). These case studies demonstrate not only how to achieve sustainability, but the thought processes and rational behind those decisions.

The biggest factor on the road to net zero is energy efficiency, and ICFs are incredibly energy efficient and readily available. They're also durable, disaster-resistant, and are easily recycled.

However, while ICFs are a great start towards sustainability, they should be coupled with other green technologies to maximize the benefit. Luckily, these technologies are readily available and easily integrated with ICFs.

Complete the Building Envelope

Most of the energy benefits of ICF construction is lost unless the roof and windows are also highly efficient. Emerald City, the Colorado project on the following page, used an EPS roof deck topped with concrete. These are a perfect complement for ICF construction because they offer the same durability, disaster resistance, and energy savings as the walls.

Structurally Insulated Panels (SIPs) are a lightweight alternative that is still much stronger than conventional construction. A six-inch thick SIP roof provides an R-Value of 29.5, compared to R-19 for the same thickness of fiberglass batt.

Otten House (pg. 18) used conventional wood trusses and spray urethane foam. This is less expensive than SIPs, but still offers outstanding airtightness, insulation (R-7 per inch), and adds some structural strength by tying the roof deck to the rafters or trusses.

Design and placement of windows is another key. Passive design experts say incoming solar heat through the windows will cover close to 40% of the heat losses if guidelines are followed. Triple-glazed windows are common for ZE homes, although some use double glazing and compensate in other areas. For example, the Otten project used glass primarily on the south side in order to reap the maximum energy benefits.

HVAC Systems

Heating and cooling systems should be carefully matched to the building envelope. Standard-sized equipment will "short-cycle," turning on and off so frequently that it will negate any energy savings. Smaller equipment costs less upfront, and will ensure maximum efficiency over the long-term, too.

A ground source heat pump takes advantage of the steady temperatures found just a few feet underground to heat and cool the building. Open loop systems use water in a pond, well or river as the heat transfer fluid. Closed loop systems keep the fluid used for heat transfer within the system piping, which can be arranged vertically (as a well) or horizontally (in trenches). Some horizontal systems use coiled pipe to increase the heat transfer per foot of trench.

Highly efficient mechanical systems with zone control are also recommended. Radiant hydronic heat, mini-split A/C units, and evaporative coolers, all work well.

Other Concerns

Efficient appliances, lighting, and water heating equipment is also essential. Tankless water heaters are best if the home will not be constantly occupied. Low-flow showers and faucets will also decrease hot water demands.

Energy efficient lighting will also reduce loads. LED or compact fluorescent bulbs are compatible with most light fixtures. Commercial fluorescent tubes or the LED equivalent are often used in residential construction as well.

A well-designed house can usually reduce energy use to about 20% of code standard. Renewable power makes up the rest. Solar panels (photovoltaic systems) are by far the most common. In some areas, wind generation and modern water-powered Pelton wheels may also be effective. ■

Large Residential — **Winner**

Built high in the Colorado Rockies, these two ICF homes both feature radius walls, a curved ICF roof, and LEED certification.

EMERALD CITY

One of the more unique green homes is Emerald City and its attached guest house, which is located outside the Colorado ski resort town of Steamboat Springs.

Mark Mueller, the homeowner, not only did the design work himself, but also served as GC and ICF installer. Mueller says "From the beginning, the objective of the Emerald City Project has been to significantly advance and showcase state-of-the-art sustainable building and living in ways that not only avoid compromises, but significantly enhance the lifestyle and beauty that a structure provides. ICFs proved to be the ideal medium for meeting those goals for countless reasons."

The homes feature extensive windows, radius walls, and even multiple large curved ICF roofs that add a unique look while also bringing many energy efficiency advantages. In total, the house used more than 1,000 cubic yards of concrete and 115 tons of stone quarried on site.

The project lies within one of the coldest climate regions in the U.S., so comfort and efficiency was a major concern. The homes benefit from copious amounts of passive solar gains, which is absorbed by the abundant stone, concrete and plaster during the day and released back into the homes at night. Heating costs for the combined 6,000 sq. ft of living space averages less than $160 per month. Ultimately, Mueller wants Emerald City produce twice the energy that it consumes through efficiency and renewable onsite power generation.

In addition to the ICF walls and roof, the homes have many other sustainable features: energy efficient appliances, low voltage DC off-grid LED lighting, heat recovery ventilators, active solar collectors, triple glazed windows, wood burning stove, windows with automated shutters, rooftop decks with raised ICF garden beds; and extensive use of fly-ash concrete, a byproduct from a power plant less that 40 miles away.

Early on, the Emerald City project was accepted into the USGBC's LEED for Homes pilot program as a platinum level project. Mueller says it "significantly influenced the design of the program as it relates to green building, energy efficiency, and sustainability." Ultimately, though, he chose not to see certification to completion, in part because he felt the energy modeling software could not account for thermal mass and would not reflect real-world conditions.

The home is actually a substantial rebuilt/remodel of an existing residence on the site, plus the construction of a second residence which is connected via an underground tunnel (also ICF) that also serves as a wine cellar.

Mueller says, "All of the many advantages that ICFs provide in design, construction and the finishes were explored with this project with outstanding success. Even

All photos courtesy Mark Mueller

The main roof required 70 yards of concrete, placed at a 17º slope.

my outdoor hot tub is made from ICF!"

The wall portion of the remodel project was quite complex. The crawlspace under the existing house was transformed into a full-height ICF basement. The delicate job involved placing the structure on stilts, removing the old foundation and replacing it with 10-foot high ICF walls.

The new home has ICF radius walls up to 20 feet high. The straight portions reach as high as 36 feet. There were many complex joints where curved and straight ICF walls connected with curved and flat roof and deck surfaces, concrete bond beams and columns. Much of these details were resolved using sophisticated CAD software. 3D model libraries were produced for all applicable ICF roof and wall forms to minimize waste and fabricate joints and bucking with great precision.

The curved roof is intended to reflect the sun's heat into rooms and nearby solar panels. Second, air ducts near the high point of the interior collect hot air from the house and redirect it to the basement level." He admits the curved roofs and support structure could have been fabricated off-site with steel, but says the cost savings, flexibility, and convenience of doing it on-site with ICFs was far more attractive. Additionally, he says, steel could not have matched the thermal mass and insulation.

"Creating curved concrete roofs with Insul-Deck literally takes ICFs to a new dimension in both design and energy efficiency," he says. The 3rd story main roof required placing 70 yards of concrete with as much as a 17 degree slope. It's capable of supporting 140 PSF snow loads.

As an owner/builder project, Mueller took his time building. The construction phase of the project extended over five years, and the walls were stacked using the now-retired Formtech and Reward Wall ICF brands. (Both companies were purchased by Fox Block several years ago). *Continued on 27.*

Project Statistics

Location: Steamboat Springs, Colorado

Type: Private Residence

Size: 6,000 sq. ft. (floor)

ICF Use: 16,531 sq. ft.

Cost: $1.2 million

Total Construction: 220 weeks

ICF Installation Time: 240 days

Construction Team

Owner + General Contractor + ICF Installer: High Energy Solar

Architect: High Energy Solar

ICF System: Insul-Deck, Reward, FormTech

Fast Facts

Curved ICF roof with 38' span

Main roof 35' high with 17 degree slope

20' high curved wall, single pour

LEED Platinum rating

National recognition from green building community

This Net-Zero home looks conventional, thanks to ICF and modern adaptation of old-school heating and cooling methods.

OTTEN HOUSE

By Steve Heinrich

The Otten House, located just across the Mississippi River from St. Louis, appears to be an average family home. In reality, the Otten House is a net zero home, engineered to seamlessly blend proven, old-school technologies with modern materials and systems to create a beautiful, comfortable living space that generates as much energy as it consumes.

This house is special because it demonstrates that a house can achieve net zero energy without requiring exotic technology, complex systems, or looking weird.

The owner is a trained engineer and retired Air Force pilot who understands the reliability problems inherent in complicated mechanical systems. In designing this "forever home," he favored simple systems over complex ones. He figured he got something right before construction was even completed when, on a bitterly cold but sunny December day, with temperatures in the single digits outside, the house was 69º F inside—before HVAC was even installed.

ICF construction is the key that enables this house to achieve energy net zero.

Given that this house was built as the homeowners' "forever home", ICF construction was also selected for several reasons beyond energy savings, including disaster-resistance and aging-in-place design. One homeowner concern was tornados. The house falls within an area of the most frequent and severe tornado activity in the country, and is also within the damage area of the New Madrid seismic zone. ICF is perhaps the most robust building method available to withstand these disasters.

A rainwater harvesting system minimizes public water usage while increasing sustainability and disaster-preparedness. Rainwater from the roof is funneled into a 5,100-gallon cistern. A well pump moves water from the cistern through three levels of carbon filtration and UV purification into a pressure tank. The tank supplies water to inside toilets and outside hose bibs. The system is designed to handle the home's projected flushing and gardening needs and is sized to accommodate St. Louis' typical summer drought conditions. In operation, the rainwater catchment system has decreased the homeowner's public water usage to one third of previous levels.

To decrease the chances of an accident or old age chasing them from their forever home, the homeowner designed in handicap access from the beginning. ICF construction eliminated the need for those stairs up to the front door and stairs up from the garage typically seen in conventionally framed houses. In fact, if mobility circumstances dictate, the owners could live entirely on the main floor, which includes not only the kitchen and laundry room, but a full bath with a wheelchair-friendly, roll-in shower.

To solve the net zero energy puzzle, the owner began with the building shell. ICF construction established a relatively small heating and cooling energy requirement up front. Exterior walls on all three levels are formed with Logix's Platinum Series ICF blocks (R-28). To complete the energy envelope, four-inch thick (R-20) rigid foam insulation was installed under the slab and open cell spray foam insulation was used on the underside of the roof sheathing. To meet the home's remaining energy needs, 36 different combinations of technologies were evaluated, modeled, and assessed using an engineering decision matrix. Decision criteria included system complexity, acquisition cost, and solar array size. In the end, the net zero design solution selected (HVAC air source heat pump with forced air distribution, heat pump water heater, and earth tubes) was one of the least complicated and most cost-effective, achieving net zero with a solar array sized to fit well within the confines of the southern facing roof.

ICF construction is the backbone that enables this tight and highly insulated house to achieve energy net zero. The general contractor for the project, James Otten of Otten Contracting Inc., has 18-plus years of ICF building experience, ranging from small energy efficient ICF homes to a seven-story ICF hotel and an ICF mosque. His painstaking attention to detail, such as back-foaming all exterior wall protrusions and mapping out clean and efficient HVAC duct work, made the superb energy performance of this house possible. His skill with ICF made construction of the numerous large windows and doors seem effortless, using custom-made metal bucks to tackle difficult wall pours with multiple 12'x6' window openings.


All Photos courtesy Steve Heinrich

As testament to his efforts, blower door testing of the house's building envelope achieved a natural air changes per hour (ACH) value of 0.05 for whole house infiltration, a truly phenomenal number considering that energy-efficient homes typically have ACH values between 0.35 and 0.5.

The house uses a synergistic blend of passive and active

A set of ventilation pipes run from the air intake in the foreground 200 feet to the house, tempering the air using the mass of the earth.

systems for heating and cooling. Passive systems include a large wall of south-facing windows and a 200-foot long set of earth tubes. Active systems include a small air source heat pump outside the house and a heat pump water heater.

Half of the house's winter heating needs are met by capturing solar thermal energy using a large south-facing wall of double paned, high-transmittance windows. To capture the heat, two of the three house floors are concrete. The thermal mass of the concrete allows the floors to absorb radiant energy during the day and then slowly release the heat at night. The six-inch basement slab sits atop foam insulation, and the four-inch main floor slab sits atop beefed up conventional framing. To manage solar gain in non-heating seasons, the home takes a page from the ancient Puebloans' playbook at Mesa Verde, sporting overhangs on all three levels of the southern-facing windows. The overhangs are engineered to provide full sun in three months of the winter, and full shade for three months of the summer. To manage solar gain in between summer and winter, the house uses exterior shutters to stop sunlight before it gets to the window glass.

The house's eastern and western exposures have no windows, a design decision made to ensure that windows—an otherwise costly break in the highly insulated ICF exterior—are placed only where they can yield maximum energy gain. As a result, several smaller interior rooms (e.g. bathrooms, pantry, laundry room) have no windows. To get natural light into those spaces, 12 sun tubes bring light from the rooftop deep into the home interior. They're so effective that one can

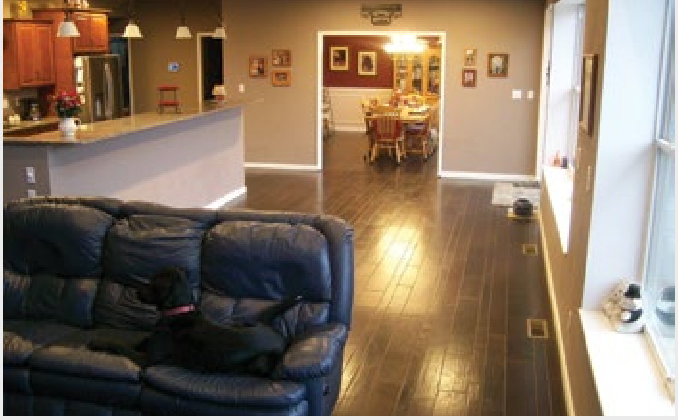
Windows and solar panels are clustered on the home's southern exposure for maximum effect.

wander the whole house during daylight hours without ever needing to turn on a light switch.

Another passive energy source for the house are the Earth Tubes, otherwise known as ground-coupled heat exchangers or earth-air heat exchangers (EAHE). Two, six-inch diameter PVC pipes run 200 feet from the house to a sheltered air intake. Buried 10 feet below the surface, they temper the air using the thermal mass of the earth. Around St. Louis, the ground temperature at that depth is about 55° Fahrenheit. In the winter, cold air is drawn into the Earth Tubes and warmed to the 50s before entering the home. In the summer, hot, humid air is drawn into the Earth Tubes and cooled to the 50s before entering the home. This provides 38% of summer cooling needs. As an added benefit, the cooled air is also dehumidified. Excess moisture condenses on the Earth Tubes, which are sloped at 2.5 degrees, and runs away from the house to a French Drain at the end of the tube.

Aiding the ventilation is the cupola, which sits at the roof peak and increasing the house's natural stack effect. When temperatures inside are warmer than outside, the stack effect draws air in through the Earth Tubes, sending it on a zigzagging path through passive vents in the floors/ceilings, up to the cupola and out an eight-inch diameter duct. In the summer, when the stack effect does not pull air through the house, ventilation is achieved actively with either the HRV, a solar powered fan in the cupola attic, or a powered fan in the cupola's ceiling duct. Note that a key enabler of this passive cupola ventilation in this house is the reduced air infiltration inherent in ICF construction. With such a tight structure, the cupola draws air in through the earth tubes instead of drawing it in through leaks in the building envelope.

In light of the house's superior insulation and infiltration level, a much smaller than normal heater/air conditioner was required. With the house's 5,656 sq. ft. of heated floor space and three high-ceiling levels, HVAC rules of thumb would call for 10 to 12 tons of air conditioning and multiple heating/cooling zones. Instead, this house uses a 4-ton variable air source heat pump. The system performed admirably last year through both an abnormally hot summer



(over two weeks with highs topping 100° F) and an abnormally cold winter (nearly three weeks below freezing with single digit temperatures at night).

A 12.3 kilowatt solar panel array on the roof meets all annual electric needs. The solar array is net metered with the power company on an annual cycle, allowing energy requirements and production to be balanced over the entire year.

To synchronize the house's various environmental and energy systems, the homeowner created a custom home automation system. The system monitors the sunlight, outside temperature, inside temperatures, HVAC temperature, Earth Tube temperature, and outside humidity, and then makes decisions about ventilation, earth tube cooling, and window shading to minimize energy use. When asked about the complexity of this smart house design, the homeowner responded, "The control algorithms are just a series of simple 'if/then' instructions, coded using Microsoft Visual C++ freeware, implemented using common USB relays and USB sensors. It's not rocket science. And I can say that, since I have an engineering degree in astronautical controls." ■

Project Statistics

Location: St. Louis area

Type: Private Residence

Size: 5,656 sq. ft. (floor)

ICF Use: 6,703 sq. ft.

Total Construction: 40 weeks

ICF Installation Time: 9 days

Construction Team

Owner: Stephen Heinrich

General Contractor + ICF Installer: James Otten

Form Distributor: James Otten

ICF System: Logix ICF

Fast Facts

Net Zero with 12.3 kW solar array

Passive solar design

Cupola draws cool air into home from earth tubes

Many large window and door openings

Rainwater harvesting

Age-in-Place and Disaster-Resistant Design

Built to LEED Platinum standards, CMTA office building is a recent example of sustainable commercial construction.

Photo by Wes Battoclette, copyright CMTA

Green ICFs in the Commercial Sector

Buildings, it turns out, are the largest single consumer of energy worldwide (about 40% of total energy consumed). And on a square footage basis, commercial buildings—because of their higher occupancy rates and code requirements—consume far more than homes.

To address this, several initiatives seek to make commercial construction more sustainable and energy-efficient. Three of the most popular are the U.S. Green Building Council's LEED program, the Passive House standards, and Zero Energy (ZE). These programs all share the goal of improved efficiency, but are significantly different.

Photo courtesy Sherman Carter Barnhart

Built at a cost comparable to traditional school construction, Richardsville Elementary saves about $155,000 annually in energy costs.

This type of building can be built quite affordably using readily available, "off-the-shelf" technology such as Insulating Concrete Forms (ICF). In recent years, dozens of these highly-efficient commercial buildings have been built across North America.

On the following pages, we highlight just two. One is a Kentucky office building certified as LEED Platinum. The other is the largest apartment building yet certified by the Passive House Institute U.S. (PHIUS). Both used ICF for the exterior wall system. They state that the key to success is "an integrated design approach with careful attention to building site and layout, mechanical systems, and electrical systems."

Zero Energy

A Zero Energy building is not only efficient, but also produces enough energy to meet all of its electrical, heating and cooling needs.

Perhaps the most famous of these "zero energy" buildings is Richardsville Elementary in Kentucky. Designed by architectural firm Sherman Carter Barhart in 2008, the 77,000-sq.-ft. school features highly efficient ICF walls, careful site layout for passive ventilation and cooling, and a rooftop solar array. The cost was comparable to traditional school construction (approximately $193 per sq. ft. for Richardsville versus a national average of $190), and saves about $155,000 annually in avoided energy costs.

While ZE commercial buildings are associated with schools, the list also includes office buildings and other types in a variety of climate zones. For more information, the Zero Energy Commercial Building Consortium (CBC) has a host of information.

PHIUS

As stringent as Zero Energy standards are, Passive House standards demand even greater energy efficiency; structures so tight and efficient that only the make-up air needs to be heated or cooled. The movement has its roots in the 1990s when the first PassivHaus was build in Darmstadt, Germany under the guidelines set up by the PassivHaus Institut (PHI). The movement came to the United States a few years later as the Passive House Institute U.S. (PHIUS). Originally, PHIUS was the American branch of the European PHI, but in 2011, the two organizations split. One major point of contention is that the European PHI standard makes no allowance for differing climates. The PHI standard is simple: the building must have (1) an air infiltration rate no greater than 0.60 air changes per hour; (2) a maximum annual heating and cooling load of no more than 1.4 kWh per square per sq. ft., and (3) total energy use for all purposes not exceeding 11.1 kWh per sq. ft. The standards were originally developed for homes, but have since been applied to commercial buildings as well.

When, in 2015, PHIUS introduced its own climate-specific passive building standards, it created a permanent rift between the organizations. The new PHIUS rules base efficiency on the number

Photo courtesy John Nielsen/Concordia Language Village

The first building in North America to be certified by Germany's Passivhaus Institute is the 5,000 sq. ft. Waldsee BioHaus in Bemidji, Minnesota. It used Amvic ICFs for all exterior walls.

of occupants (rather than square footage) and consider climate in the allowable heating and cooling loads. Either way, developers now have to decide whether to certify through PHI or PHIUS.

The U.S. standard seems to be the most popular, with PHIUS reporting that 97% of all passive house projects in North America last year used the new PHIUS+ 2015 rules. These rules make it simple to convert to Zero Energy, and certified projects automatically qualify for U.S. DOE Zero Energy Ready Home

Built at a cost comparable to CMU, Beach Green North meets the rigorous standards of PHIUS.

Photos courtesy Steve Bluestone/The Bluestone Organization

(ZERH) status. PHIUS+ 2015 projects also earn U.S. EPA Indoor airPLUS status for air quality.

Not surprisingly, insulating concrete forms (ICFs) are a popular choice for passive house construction. In fact, the first passive house in North America was built with Amvic ICF (See story in the October 2006 issue of this magazine, available online).

Beach Green North

One of the most notable recent Passive House projects is also built with ICF. Completed just last fall, Beach Green North is located in the Rockaways, a coastal suburb of New York City on Long Island in the borough of Queens.

The 101-unit midrise apartment building was developed by the Bluestone Organization, which has been using ICFs for large-scale urban projects since 2007. This is their 11th multifamily ICF building in the New York City area. "We have found it to be extremely affordable, strong, resilient, and sustainable," says Steve Bluestone. "It allows for us to greatly reduce operating costs compared to other buildings in our portfolio."

In 2010, they built a six-story ICF apartment complex that nearly met Passive House standards. Beach Green North was just the next step in efficiency. It proved to be surprisingly affordable. In the New York City market, ICF cost $18-22 per sq. ft. of installed wall, compared to the $28-32 per sq. ft. it would take to get a CMU wall to the same level of efficiency.

Bluestone says, "This building is certified by the Passive House Institute U.S. (PHIUS). To date, it is the largest building in the world to have achieved certification by this organization. It is anticipated that the building will use 90% less energy than comparable buildings in the area.

Achieving this highly coveted certification, at little to no extra cost, shows the global community that constructing such a highly efficient building is not complicated whatsoever."

He continues, "By and large, the single largest feature of the building that makes the low operating costs possible is the ICF envelope."

The total annual heating/cooling costs for the entire 108,000-sq.-ft. building would be in the range of $15,000 to $20,000 before taking into account the electricity that will be produced onsite. The roof is covered with a 133 kWh solar photovoltaic array system that will produce a substantial portion of the building's energy needs, and a 10kWh combined heat and power generator (CHP or "co-gen" unit) was also installed. It will provide 100% of the building's hot water needs using natural gas for fuel, and will also provide additional electrical power for the building. The co-gen unit will also double as a generator during grid outages.

Each apartment is mechanically ventilated by individual energy recovery ventilators (ERVs). Bluestone reports that the total cost of all this technology works out to be about $233 per sq. ft., a price that includes the solar array and co-gen unit.

There were construction challenges, most of which centered on the foundation. Built on a low-lying site just a few hundred feet from the Atlantic Ocean, the area was submerged under at least five

Project Statistics

Location: Far Rockaway, New York

Type: 101 Unit Apartment Building

Size: 108,350 sq. ft. (floor)

ICF Use: 79,140 sq. ft.

Cost: $32 million

Total Construction: 77 weeks

ICF Installation Time: 95 days

Construction Team

Owner: The Bluestone Organization

General Contractor: Banta Homes

ICF Installer: Europa Concrete

Architect: Curtis + Ginsburg

ICF System: NUDURA

Fast Facts

Largest building certified by Passive House Institute

Uses 90% less energy than similar buildings in area

100Kw solar array on roof

Driven pile foundation required due to poor soil and flooding

A 133 kWh solar array on the roof supplies nearly all of building's energy needs.

feet of water when Superstorm Sandy came ashore a few years ago. FEMA standards required the lowest occupied floor of the building to be 4' above the street grade. The owners set the first floor 6.5' above the street grade, just in case FEMA got it wrong.

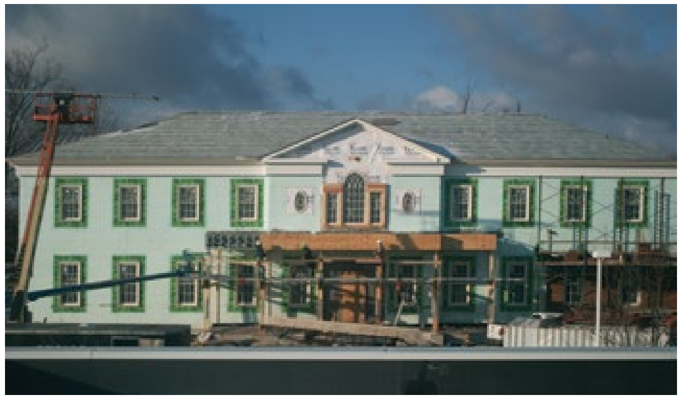
To deal with the sandy soils, the entire foundation was constructed on wooden piles driven 30 to 40 feet below the surface of the site and tied together with massive grade beams and pile caps.

The design was also complicated by building codes, which specified the building had to fill the entire lot from side to side. At one side, the property line was a couple of degrees off of 90 from the front wall of the building, and the main street façade wall had to set back at various increments in order to maintain a certain distance from the curb. Bluestone says, "Building at odd angles and also stepping the building wall multiple times added some level of difficulty."

Completed in September of 2017, the building was fully occupied almost immediately. More than 100,000 applications were received, and a lucky one in a thousand received a lease. Despite an elevated NYC rail line that runs just 60' away from many of the apartment windows, tenants comment on the comfort and quiet.

LEED

The USGBC's LEED program is the oldest and most widely used green building standard. Unlike ZE and PHIUS, which focus



Photos copyright CMTA.

primarily on energy use, LEED certification involves the use of eco-friendly building materials, site use, water conservation, and proximity to mass transit. The latest iteration, LEEDv4, has categories for new construction and remodeling, residential and commercial, and LEEDv4.1 is under development and currently open for public comment. The program has four different levels: certified, silver, gold, and platinum. ICF projects have been scored at all four levels.

One of the most interesting and recent LEED Platinum commercial projects is the CMTA Office Building in Lexington, Kentucky. Built as the headquarters for a local engineering firm, it was completed in June of 2013.

CMTA is known nationally for its high-performance sustainable designs, and these were showcased in their Lexington headquarters. The site location was selected due to its proximity to clients, the University of Kentucky, and easy access to interstate traffic.

The sustainable design features serve as an active illustration of their core values and design beliefs.

Energy-saving features include ICF walls, geothermal heating and cooling with variable speed geothermal heat pumps, daylighting, LED lighting in offices and lobby area, solar photovoltaics, and individually metered building systems including HVAC, receptacles, and lighting. Ten vertical wells, each 350 feet deep with 1-1/4" piping provide the equivalent of 17 tons of heating capacity.

The project was named 1st Runner-Up, Light Commercial in the 2017 ICF Builder awards. "Having ICF walls in our own office building allow us to speak to clients about this type of construction in a more personal way," the entry notebook states. "ICF walls help increase our thermal mass which reduce our utility bills. We now have utility data which we show our clients to illustrate the effectiveness of this type of construction."

Lighting systems consume only 0.56 watts per square foot. The 8.58 kW photovoltaic system on the southeast-facing rear roof provides 16-20% the annual power usage.

The notebook adds, "In addition, ICF walls meant our building was constructed more quickly which saved time and money on the project." In total, the project came in at around $246 per sq. ft., and utility bills for the 11,750 sq ft office have averaged about $590 monthly.

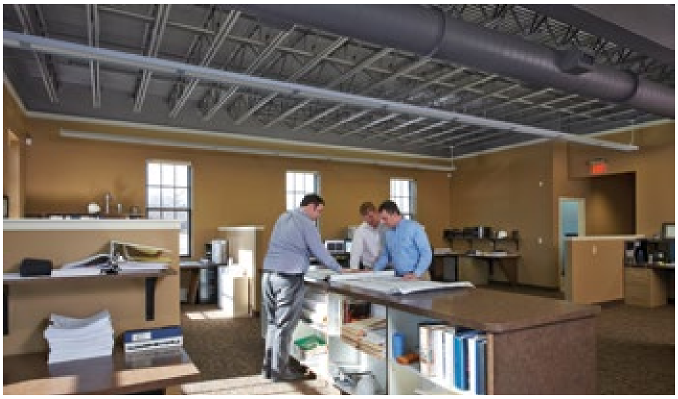
Designers deliberately chose a fairly simple, rectangular design to reduce construction costs and facilitate a tight building envelope. It's a perfect fit for the classic Federal-style architecture, with a symmetrical façade, stately brick finish, and double-hung divided-light windows. It not only looks beautiful, but also blends in with the other nearby offices.

Olympic Construction did the ICF install, and ensured the walls were straight, plumb, and flat, with no voids being seen in the concrete core when it was exposed during mechanical rough-in. Sub-trades commented that the installation was some of the best cast-in-place concrete work they have worked with, period.

CMTA reports the office was completed on time and within budget.

The project is the first LEED Platinum office building in Kentucky. It received a 2013 Environmental Award from the Lexington-Fayette Urban County Government Environmental Commission.

Energy efficiency will always be the most important factor, and a thermally sound, energy-efficient building envelope will always be the most important component in overall efficiency. ■



Photos by Lavenson Photography, copyright CMTA.

Project Statistics

Location: Lexington, Kentucky

Type: Engineering Firm Office Building

Size: 11,750 sq. ft. (floor)

ICF Use: 9,835 sq. ft.

Cost: $2.9 million

Total Construction: 330 weeks

ICF Installation Time: 90 days

Construction Team

Owner: CMTA

General Contractor: Buzick Construction

ICF Installer: Olympic Construction

Form Distributor: Holdfast Technologies

Architect: Sherman Carter Barnhart Architects

ICF System: NUDURA

Fast Facts

First LEED Platinum office building in Kentucky

Energy Star 100

2013 Environment Award from county environmental commission

Geothermal HVAC, solar array

Continued from 17.

He reports, "By far the largest challenge was the weather. Construction took place year round, and most winters the temperature would never exceed the teens for at least two months, with occasional dips to 50 below. ICF construction was well suited for these conditions. The forms would keep the concrete from freezing while it cured. And as long as the top was covered to keep out snow, a prepared wall could sit indefinitely in any weather conditions until it was filled with fresh concrete."

He continues, "The Emerald City project has been and remains an overwhelming success. The project receives continuous interest from the local community and beyond. Efforts are continuing to showcase the home via online exposure, media coverage, and educational tours and publications. The second home is used for short-term vacation rentals, and Mueller says they come "specifically just to be able to experience it, and they never stop raving about it throughout and after their stay."

All photos courtesy Mark Mueller

Optimal Insulation for Cost-Effective Construction

By Brian Corder

So you're building a new home or expanding your existing home and you have the same questions we all do. When it comes to insulation, how much is enough? What are my options? And at what point, as the phrase goes, "are we putting lipstick on a pig?"

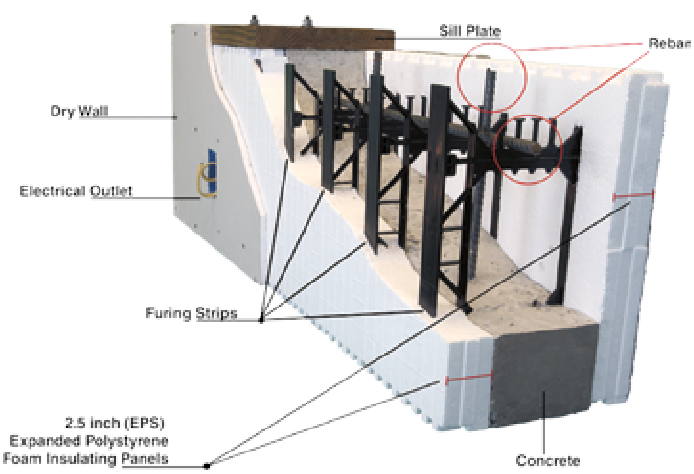
Some people will tell you more is better, but at a certain point more is actually about the same.

If you're building a home and using wood or steel framed construction, you will need to use insulation inside the wall cavity. This is usually blown cellulose or fiberglass batt insulation. It's cheap, code compliant, and has been used for decades. But it's not so great.

It's not really efficient, and for added insulation, walls must be made thicker. The insulation is dependent on the trapped air to deliver benefits; they are highly susceptible to leaks, compaction over time, and when wet it loses nearly all insulative value.

Cavity walls of all types also suffer from thermal bridging because the studs that connect the interior to the exterior aren't insulated, and transmit heat or cold between the inside and outside of a structure. Many climate zones are now requiring special continuous insulation added to the outside, increasing complexity and costing more time, labor, and materials.

ICFs deliver a wide range of benefits over cavity wall construction (they're strong, soundproof, and come pre-furred with insulated studs and a built-in vapor barrier too), but let's focus on insulation.



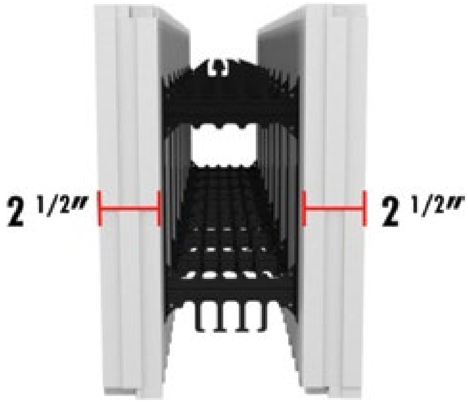
Most all ICFs provide at least 5" of EPS foam, split evenly with R-11 on both sides of a solid reinforced concrete wall (R-22 total). Why not put it all on the outside? Why is that important? The concrete core, while being very strong, is also very slow to change temperature. Insulating both sides keeps the wall temperature incredibly stable. There's not enough heating during the day or cooling at night to affect the concrete wall. The walls are also air tight, meaning that you're not blowing energy out of the wall and heating or air conditioning doesn't have to work as hard (or at all in some climates).

That means that you can buy smaller units to match the real world need. Purchasing smaller units saves you money upfront, but you'll also save money every month for the lifespan of the home because your HVAC system doesn't have to work as hard as in traditional cavity wall construction. You also get significant resistance to natural disasters (4-hour fire rating and 200 mph wind protection), noise (STC 50+), and longevity (EPS foam doesn't rot, decay, host mildew or mold, or lose its insulation value unlike most other insulation). Once protected behind wall finishes, EPS foam will deliver insulation performance beyond the lifespan of any other conventional building material.

Real World Performance

We all know that products have two levels of performance: what's promised and what's delivered. Insulation is no different; the "estimated" miles per gallon when you buy a car and how far you can really drive before you need to refill are different. In the case of ICFs, the real world, in-use performance is greater than the sum of its components. For most other types of insulation, the opposite is true.

ICFs are generally 2.5" thick EPS foam panels that are



connected together with plastic webs. These webs typically include embedded stud flanges and are spaced evenly inside the panel. Together they create a form for making an insulated concrete sandwich. Why 2.5" you might ask? We'll cover that more in the next section, but based on independent testing, 2.5" panels (5" total) delivers so much insulation value that adding more doesn't make much of a difference. It's also rigid enough to not deflect, break, bulge or crack when filled with concrete and rebar.

A few years ago, the ICF industry went to an independent ISO and SCC certified lab to do open ASTM standards-based testing. The lab compared a code-compliant 2×6 wood-framed cavity wall (actually built better than most homes) to a standard six-inch core ICF wall.

Nothing special was done to the ICF wall. It was stacked, reinforced, poured, and cured for 30 days.

The lab then subjected one side of each wall to extremely cold temperatures (-35°). At that temperature Fahrenheit and Celsius are basically the same number. While cooling the outside they measured the amount of energy needed to maintain the interior temperature at a constant room temperature (70°F/22°C). In technical terms, this is called steady state. What matters is they did the same test for each wall. The wood framed cavity wall took 39.9kWh (132,828 BTU) to maintain a constant temperature. The standard ICF wall only took 15.6kWh (53,209 BTU) to do the same work. That's 2.5X the amount of heat needed, or more simply, 2.5X more money. If that were a monthly electrical bill, the wood frame wall would cost you $132 and the ICF wall $53. That adds up quickly.

Foam Thickness

Bacon, steak, icing and deep dish pizza are great examples of things that are better when they're thicker, but at some point, enough is enough. EPS foam thickness is important for two reasons:

First, ICF forms must be able to withstand the pressures created when concrete is poured into the forms. Most ICFs are generally poured in 48" lifts, and a 2.5" panel is strong enough to keep the foam from distorting. Pressure in an ICF wall depends on the height of concrete poured at once. Pouring in "lifts" means concrete is poured to a certain height and working in a continuous direction around the structure. Once you reach where you started, a second lift is poured following the same path. This process keeps the pressure limited to the height of the lift and is repeated until the full height of the ICF wall is reached.

A few brands, including BuildBlock and Amvic go a step further and place webs every 6 inches (most other brands space their webs 8 inches on center). The closer spacing adds to the strength of the blocks and ensures that they don't deform even in very tall or thick walls.

Secondly, the 2.5" panels provide 5" of insulation, which is a tested value of R-21 wall. (EPS foam molded at a density of 1.5 pounds per cubic foot delivers 4.2 Rs per inch, so 5 x 4.2 = 21).

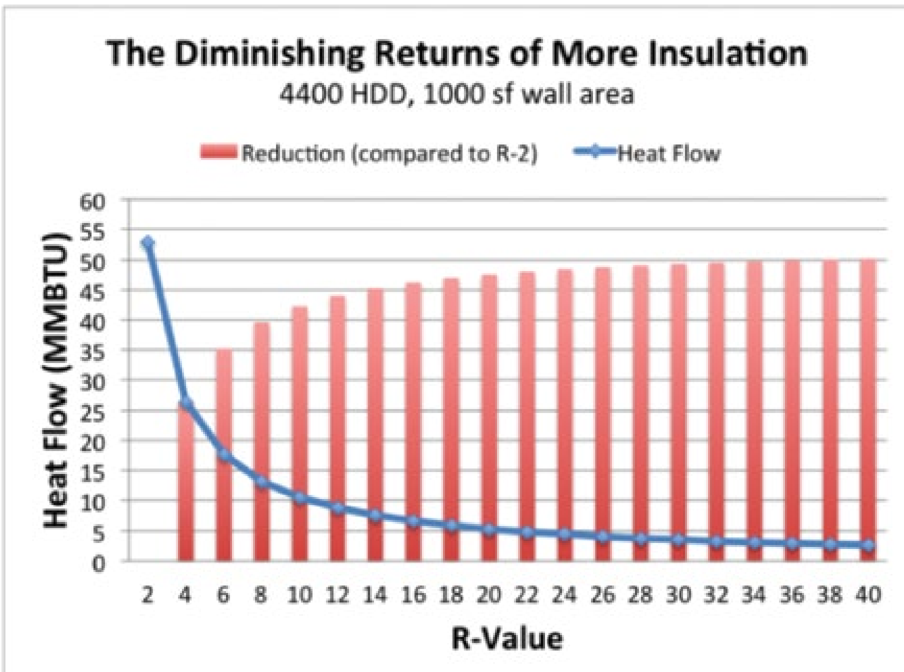
R-value Versus Value

It also comes down to value. At what point am I getting the ultimate value for my investment? Does R-value drastically rise if more insulation is added? Just like putting premium gas in your car might increase your mileage slightly, the cost difference typically isn't worth it. I can't explain it better than Allison Bales does in her article *The Diminishing Returns of Adding More Insulation*.

Let's compare heat loss reduction at several different R-values. In the graph below you can easily see that the greatest reduction is achieved through R-20. The additional reduction past R-40 is very slight.

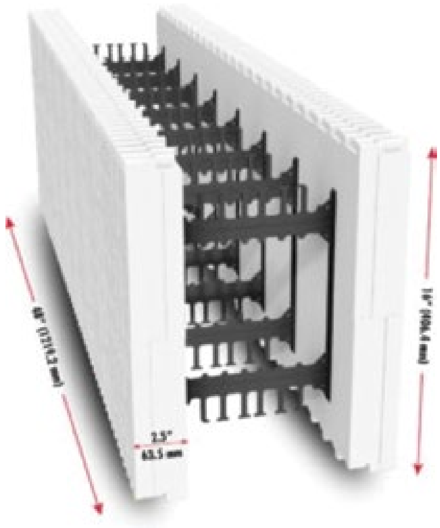
Now, this is looking at normal R-values from the materials themselves. We learned earlier that ICFs really deliver an actual R-value of R-21, but what about all that concrete? Does it make a difference?

We've covered the basic types of insulation, discussed the properties of ICFs,



Data courtesy EnergyVanguard.com

Beyond R-23, insulation gains are minimal, and usually not cost-effective.



and talked about the difference between actual and performance R-value. Now let's take a look at the wizard behind the curtain, the secret sauce, the ICF MVP: concrete.

Concrete doesn't really add any substantial R-Value, but it has so much mass that it resists sudden changes in temperature extremely well and is air tight. Think about a concrete sidewalk after a hot summer day. That concrete will radiate heat and is still warm to the touch several hours into the night.

Why is this important? ICFs are a sandwich with really great insulation on both sides of a really strong concrete core that doesn't change temperature unless a lot of heat is applied to it. So how does this sandwich stack up? A standard ICF wall will deliver performance equivalent to R-45 to R-55 depending on the climate zone. The more extreme the temperature swing, the better ICFs perform. And as we saw above, once you move beyond R-45 the savings become negligible.

Building codes recognize that there is a real difference between cavity walls and mass walls. Therefore, there are separate requirements for each in the code. ICF mass walls are nearly airtight and have a built-in class II vapor barrier. This means no air leaks through the wall and the elimination of an additional vapor barrier, saving on labor and cost. ICF mass walls actually have lower minimum material insulation requirements because the actual performance is so high.

Is the ICF form with the thickest foam panels the best option? Not necessarily. When you take a look at actual insulation performance, especially in a concrete mass wall, beyond R-22 the benefit becomes negligible. Just like a sponge can only hold so much water before it stops being effective, insulation by itself works the same way. You will very easily reach a point where your home expends more energy heating water than it does to heat or cool your home.

Beyond R-22 the homeowner isn't going to see or feel drastic benefits, especially when compared to the added cost of thicker blocks. The latest industry testing by the ICF Manufacturers Association used a 2 5/8" panel and proves the wall delivers more than sufficient insulation, even at the test temperature of -35°C.

When it comes to ICF form thickness, some people will tell you "more is better", but science has proven that at a certain point, more is actually about the same. ICFs exceed current and future insulation code requirements and provide drastic advantages over any other type of insulated construction.

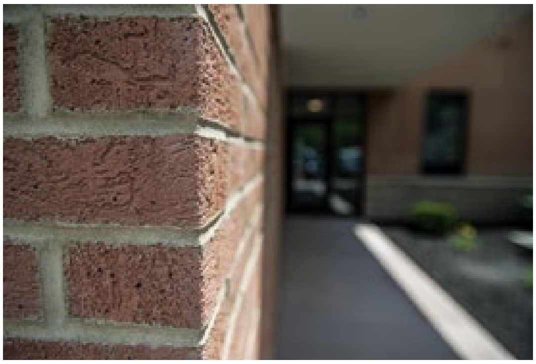
Making an Educated Purchase

There are several quality products to choose from when building your ICF structure, but don't be fooled by marketing tricks saying that you need an ICF with thicker panels. Five inches of insulation makes an incredibly efficient wall without the added cost associated with thicker forms and at the end of the day delivers the same performance, disaster resilience, and peace of mind.

Brian Corder is the president of sales and marketing for BuildBlock Building Systems. This article is based on a four part series on ICFs, "R-Value, and Insulation" available at buildblock.com/blog and was prepared in collaboration with Insulating Concrete Forms Manufacturers Association (ICFMA) members.

New Products

Brick Veneer from Dryvit



In 2017, Dryvit Systems, Inc. launched a brick veneer product perfect for Insulated Concrete Forms. Called NewBrick, it's Dryvit's first non-EIFS product.

At 1/12th the weight of traditional clay brick, NewBrick is a lightweight insulated brick coated with a specially formulated finish. It matches clay brick's classic size and appearance but offers state-of-the-art engineering and technology to meet today's building challenges.

NewBrick can be installed over ICF without a brickledge or masonry ties, and further enhances the energy-saving properties of ICF. NewBrick can be matched to virtually any color pattern.

Its built-in horizontal alignment guide eliminates the need for support pans and mortar joint spacers, speeding installation by establishing the perfect 3/8" spacing for mortar. It's lightweight, which accelerates installation and provides further cost savings since NewBrick requires less structural reinforcement. Also, since no brick ties are needed, penetrations through the water resistive barrier are eliminated.

For more information, visit *www.NewBrick.com*.

New Engineering on Ledger Bracket

RP Watkins' OneLedge bracket, made for securing ledger boards to ICF walls, now has structural engineering documentation.

"The wait is over for the structural engineering documentation for the patent pending OneLedge Series," says Michael Summers. "With an unprecedented allowable downward load of over 2700 lbs. per bracket to support your engineered floor systems, the one-piece OneLedge system helps RP Watkins keep our pledge of making ICF easier."

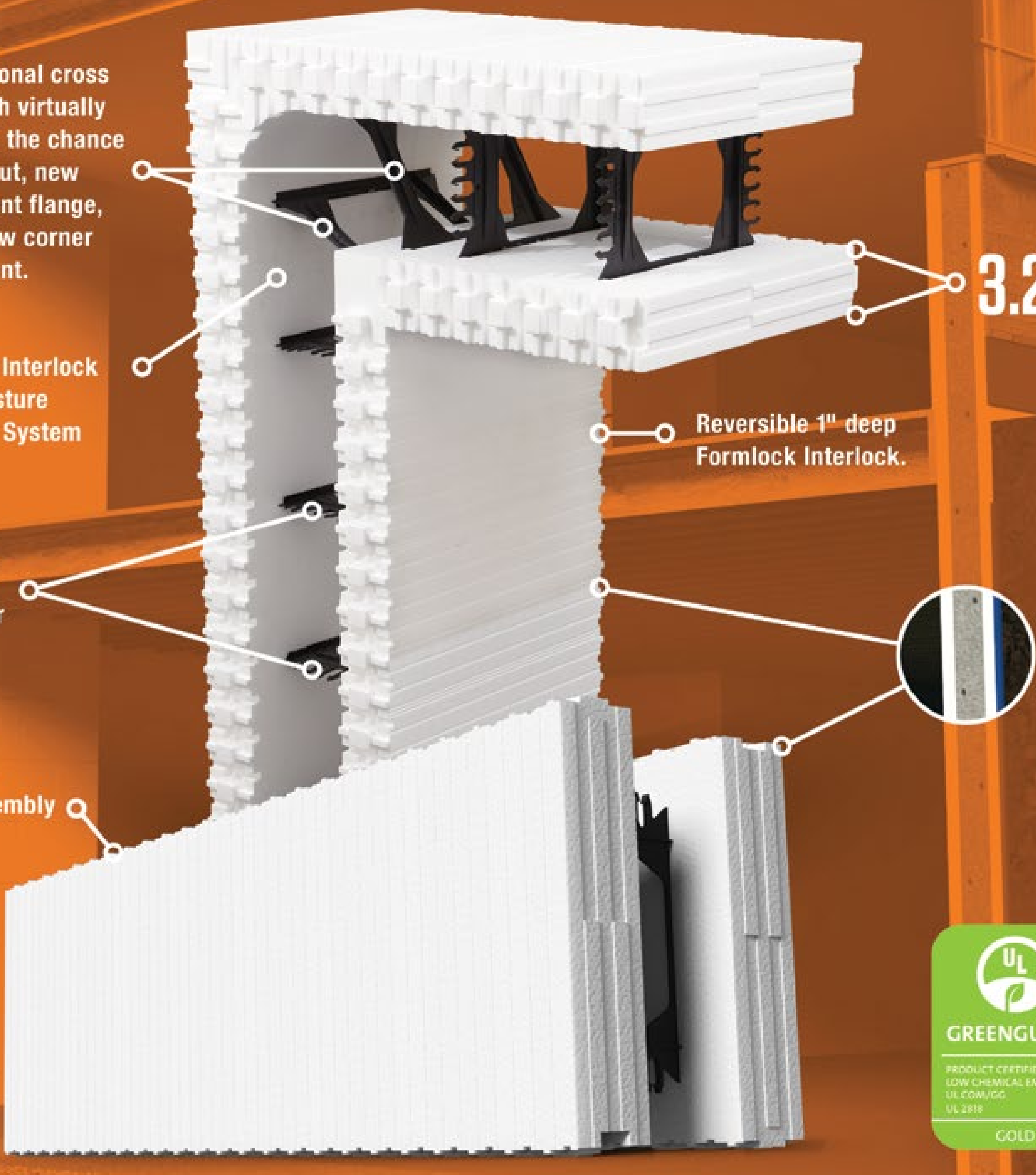
The bracket is available in two widths: 1.5" for nominal lumber ledger board applications, and 1.75" for LVL beam ledger board applications. Both are in a "short leg" version (intended for forms with a concrete core of 5.5" or less) and standards (6" voids and up) and are compatible with all ICF form manufacturers, even those with foam thicknesses above 2.5".

The product can be purchased directly from the website *www.rpwatkins.com*. ■

Ad Index

AMVIC+ 3.30 ICF BLOCK

STRONGER, QUIETER, HEALTHIER AND 30% MORE ENERGY EFFICIENT



UL GREENGUARD
PRODUCT CERTIFIED FOR LOW CHEMICAL EMISSIONS
UL.COM/GG
UL 2818
GOLD

AMVIC.COM | 1.877.470.9991

amvic building system