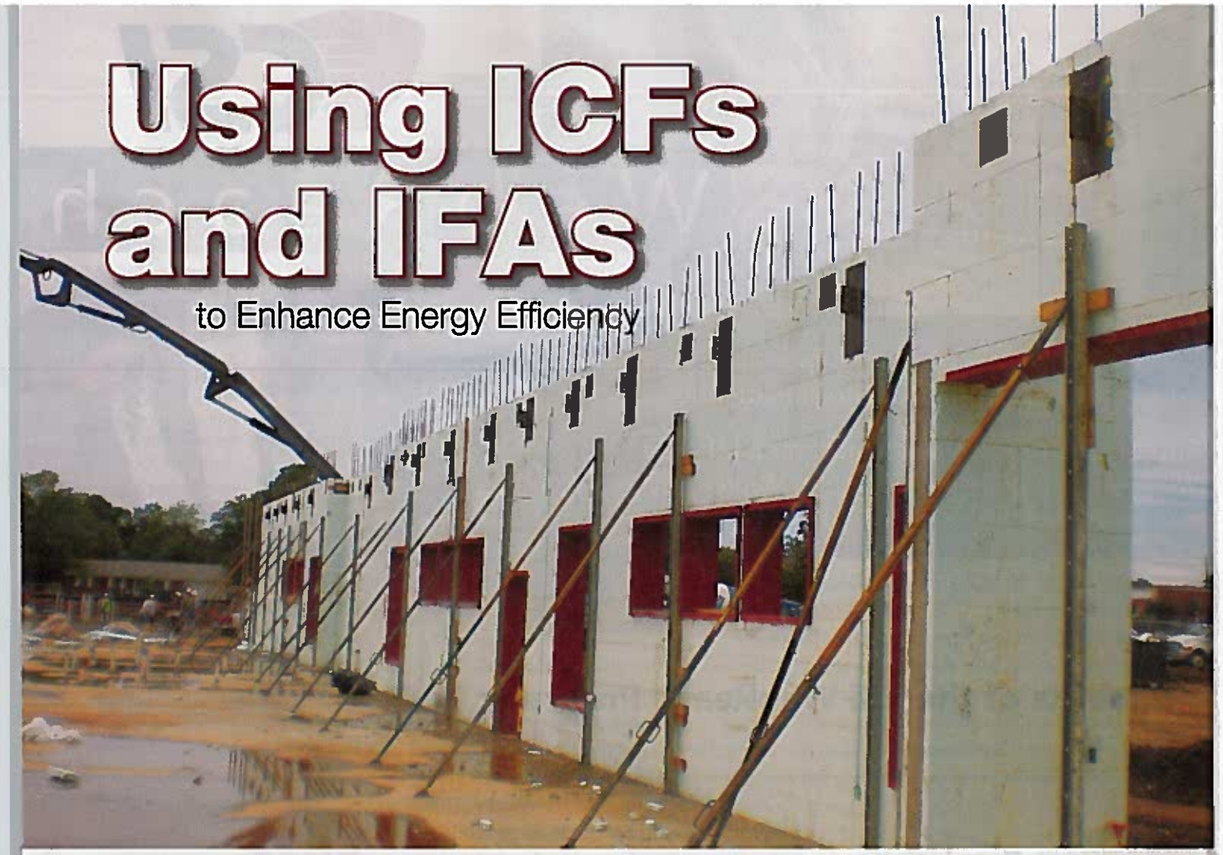
Using ICFs and IFAs

to Enhance Energy Efficiency



by Chris Keith and Cameron Ware

Photo courtesy Stala Integrated Assemblies LLC

THE ACADEMY AT NOLA DUNN IS A K–5 ELEMENTARY SCHOOL IN TEXAS' BURLESON INDEPENDENT SCHOOL DISTRICT (ISD). COMPLETED IN 2010, THE 9940-M² (107,000-SF) BUILDING HAS AN EXTERNAL ENVELOPE CONSISTING OF INSULATED CONCRETE FORM (ICF) WALLS AND INTEGRATED FRAMING ASSEMBLY (IFA) DOOR AND WINDOW FRAMES. THIS COMBINATION OF TWO CONSTRUCTION METHODS CONTRIBUTES SIGNIFICANTLY TO THE BUILDING'S HIGH ENERGY EFFICIENCY, ENABLING IT TO WIN A BEST IN CLASS AWARD FOR HEAVY COMMERCIAL CONSTRUCTION FROM *ICF BUILDER* MAGAZINE.[1]

ICF construction involves stacking hollow rectangular blocks of expanded polystyrene (EPS) atop one another and then filling the cavity created by the stacked blocks with concrete. Typically, steel rod reinforcing is also placed in the cavity prior to the concrete pour. This construction method first appeared in the residential real estate market, and one can even find textbooks for building residentially with ICFs.[2] However, nonresidential construction has taken up more than half of the total ICF market in North America for the past several years,[3] with buildings such as military barracks, churches, hospitals, hotels, and educational facilities now being constructed with this method. The most recent market prediction for 2016 suggested almost 3 million m² (32 million sf) of the ICF market's total 5.1 million m² (55 million sf) would be commercial construction.[4]

The Academy at Nola Dunn

The Academy at Nola Dunn is the first all-ICF school in the state of Texas. The education sector is increasingly using the ICF method because of the structural stability, high RSI/R-value, and low life-cycle costs it offers. Many buildings recently constructed with this method have also been certified to the Leadership in Energy and Environmental Design (LEED) rating program.

The finished interior of the Academy at Nola Dunn, featuring insulated concrete form (ICF) and integrated framing assembly (IFA) door and window openings, including 7.5-m (25-ft) daylight windows.

Photos courtesy Futurestone LLC

The finished exterior of the Academy, with a view of its IFA windows and door as well as one ICF wall.

The Academy outperformed all other schools in the Burleson Independent School District (ISD) in terms of energy efficiency, thanks to its innovative use of ICFs and IFAs.

Several schools utilizing this product, such as Richardsville Elementary School (Bowling Green, Kentucky) and Dearing Elementary School (Pflugerville, Texas), have even achieved net-zero energy.[5] Richardsville has been featured in *Forbes* as a "model for the future" and "a harbinger of a coming trend,"[6] though the trend predates both schools. Burleson ISD in particular has led the way in environmentally conscious use of ICFs in school designs, as demonstrated by the Academy's highly energy-efficient performance.

Employing these innovative methods and having specific focus on the building envelope as the best expenditure of its "green dollars"[7] has paid off for the district, and not just in terms of awards and public recognition. According to an independent study by CLEAResult (contracted by Oncor energy), not only did Burleson ISD schools consume less energy (kBTU/sf) per year than local districts—in some cases, consuming less than half in comparison—but the Academy at Nola Dunn was also by far the most energy-efficient building within the district.[8] It consumed a third less annual energy than the next closest building in Oncor's study (13.2 kBtu/sf compared to 20.6 kBtu/sf at Clinkscale Elementary School), and earned a U.S. Environmental Protection Agency (EPA) energy portfolio manager ranking of 99. Its energy cost index (annual energy costs/sf) was $0.43—the lowest of any building in the school district.[9]

This information cumulatively points to ICF buildings' value as energy-efficient uses of public funds. It suggests owners may want to focus on the building envelope before securing places in their budgets for other green aspects such as solar panels, rainwater reclamation systems, or wind-harnessing devices.

> No matter how detailed the specifications or how high-quality the materials, a product can offer no protection against improper installation.

The Academy's unfinished interior. ICF block is stacked around door and window IFAs.

Photos courtesy Stala Integrated Assemblies LLC

The Academy's large windows were designed by SHW Group to give the building a classic look. Some IFAs were also designed to double as interior seating.

Innovations with IFAs

In Oncor's study, the Academy at Nola Dunn outperformed other buildings in low energy consumption rates. Multiple factors contribute to this, including the school's use of IFAs as part of the building envelope. To date, the Academy is the only ICF school in Texas to employ integrated framing at door and window openings.

IFAs solve a perennial issue in commercial ICF construction—namely, the labor-intensive process of blocking out door and window openings with wood or vinyl bucking systems only to return to each opening, make adjustments to ensure the opening is plumb and true, and install the door and window frames. This practice may be tolerable on 30-opening residential projects, but can be costly from time and human resource (HR) perspectives on a 300-opening commercial building like the Academy or a nearly 500-opening building like Joseph Warren Middle and High School in Bowling Green.[10]

Unlike wood and vinyl bucks, IFA steel framing systems receive the ICF block prior to the concrete pour and remain in place afterward, already being prepared to receive doors, windows, and hardware. In short, an IFA doubles as both a bucking system and a hollow metal frame. These systems can also coordinate with trades like masonry and drywall, contributing to a quicker and more efficient installation process overall.[11]

IFAs also differ from other bucking methods in their ability to be shipped from the factory in any design. For the Academy, architects at SHW Group (now part of Stantec) designed five 7.5-m (25-ft) arched daylight windows to be displayed prominently in the front of the building, which give it a classic aesthetic. Architects also strategically designed some of the larger, lower-positioned window IFAs to serve a dual function, calling for the bottom portion of the frame to double as a ledge for interior seating. In this way, these framing assemblies can be incorporated more directly into users' experience of a building.

Perhaps the most relevant contribution IFAs can make is to the overall strength and seal of the building envelope. Not only do these assemblies aid in wall alignment by holding the block in position before, during, and after the concrete pour, but they also enable a tighter seal between the concrete and the frame. Under alternative methods of bucking, door and window openings become a liability to energy efficiency, as the multi-stage process of first bucking the opening, then separately installing a door frame after the concrete is set creates a fit with inevitable air pockets permitting heat and cold transfer.[12]

The door and window openings of IFAs are more thermally sealed, because the concrete pours around the framing system and then cures in that position without the IFA ever being removed. Thus, although conventional wisdom suggests the steel of the framing system would serve as a natural conductor of heat and cold, this method creates a more energy-efficient opening overall. It is also worth noting IFAs are available with a thermal break consisting of a strip of rigid polyvinyl chloride (PVC), which runs the course of the assembly and prevents heat and cold transfer between the interior and exterior of the building. This design increases IFAs' capacity to contribute to a building's energy efficiency.

Conclusion

The Academy at Nola Dunn is a clear example of why many school districts are using ICFs for new construction, as the school's innovative use of ICFs and IFAs has greatly enhanced its energy efficiency and thermal performance. The project's success highlights the advantages of focusing on the building envelope in environmentally conscious commercial construction. **CS**

Shown here are the first and second floors of ICF block, stacked around door and window IFAs. This method was used with all 300 of the Academy's openings.

Notes

[1] For the March/April 2014 issue of *ICF Builder*, which featured the winners of this award, visit www.icfmag.com/builder_awards/2013/Heavy_Commercial_00.html. The school was also featured in "Reviewing Lessons Learned in Schools: Why Many Texas Schools Are Choosing ICF Technology and Realizing Big Benefits," an article by one of this article's authors (Cameron Ware) in the February 2016 issue of *Concrete Homes and Low-rise Construction.*

> Owners may want to focus on the building envelope before securing places in their budgets for other green aspects such as solar panels, rainwater reclamation systems, or wind-harnessing devices.

[2] These textbooks include 2006's *Concrete Systems for Homes and Low-rise Construction: A Portland Cement Association Guide* by Pieter A. VanderWerf, Ivan S. Panushev, Mark Nicholson, and Daniel Kokonowski and 2007's *The Concrete House: Building Solid, Safe, and Efficient with Insulating Concrete Forms* by VanderWerf.

[3] See the market analysis in the January/February 2016 issue of *ICF Builder* at www.icfmag.com/articles/features/2016-01_Report.html. For a global perspective on the market, see Mordor Intelligence's "Global Insulated Concrete Form (ICF) Market 2015-2020: Market Shares, Forecasts, and Trends" from 2016, available at www.mordorintelligence.com/industry-reports/global-insulated-concrete-form-icf-market-industry.

[4] See the issue of *ICF Builder* cited in note 3.

[5] Richardsville Elementary School was the nation's first net-zero school. *Engineering News and Record Texas and Louisiana* named Dearing Elementary School in Pflugerville, Texas, its Best Green Project in 2015, as shown at www.enr.com/articles/38188-best-green-project-dearing-elementary-school.

[6] These quotations are derived from *Forbes* article "Net Zero Schools in Kentucky: Models for the Future Come from Surprising Places" by Peter Kelly-Detwiler, published in 2012. Visit www.forbes.com/sites/peterdetwiler/2012/12/10/net-zero-schools-in-kentucky-models-for-the-future-come-from-surprising-places/#1eb3e900402b.

[7] This term comes from a quotation by Cliff Holden, construction manager for Burleson Independent School District (ISD), which is referenced in the Ware article from note 1: "Given our experience and database of lessons learned we concluded that the best green dollar spent is the one you don't spend. … We have concluded that the least expensive way to save energy is to focus on the envelope first."

[8] This data comes from the "Burleson ISD Energy Benchmarking Report" from November 2013.

[9] See note 8.

[10] For more information on this project, which included 497 integrated framing assembly (IFA) door and window openings, see the article by J. Andrew Keith and Chris Keith, "Integrating IFAs and ICFs," in the July 2009 issue of *Construction Canada*. Visit www.kenilworth.com/publications/cc/de/200907/index.html.

[11] For a general introduction to IFAs, see the article from the December 2008 *Construction Specifier* article, "Integrated Framing and ICF Construction," by the same authors as note 10.

[12] IFAs address the general issue of wall development lagging behind other aspects of ICF construction. This can be explained with a quotation from the Ware article in note 1: "Basically, the status quo thermally weak school wall design is a problem. Walls, in effect, have become the weakest link in the chain since they previously have not received much in the way of technological advancement."

ADDITIONAL **INFORMATION**

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Abstract

Insulated concrete form (ICF) construction involves stacking hollow rectangular blocks of expanded polystyrene (EPS) insulation, then filling the cavities with concrete. This method offers numerous benefits, but a major downside is the labor-intensive nature of blocking out openings with wood or vinyl bucking systems only to return to each one, make adjustments, then install door and window frames. Using a Texan elementary school as a case study, this article examines how a combination of ICFs and specialized integrated framing assemblies (IFAs) can enhance jobsite and energy efficiency.

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