Integrating IFAs and ICFs
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As today's construction market thrives on methods that enable greater productivity, insulating concrete form (ICF) construction has begun to receive more attention. Although initially viewed with skepticism,[1] ICF buildings have recently become more popular. In this construction, wall sections are built by stacking 'blocks' atop each other prior to pouring concrete. Each block consists of two foam panels spanned by webbing of some design. (The foam is typically expanded polystyrene [EPS], but occasionally extruded polystyrene [XPS].) Consequently, when stacked, the panelling forms two sides of a wall, with a cavity in the middle. The concrete is poured into the cavity and, on curing, the foam exterior is left in place, providing insulation (and the material's namesake).

ICF buildings can have several advantages over traditional assemblies of concrete masonry units (CMUs) and stick-frame walls. These attributes range from greater structural stability to improved energy efficiency to lower lifecycle costs.[2] A practical field advantage ICFs offer is shorter project completion times. Crews can easily move the lightweight foam blocks across a site and stack them according to project design. Due to these benefits, the moderately higher initial costs of ICF construction have not been a deterrent to many commercial and residential owners.

In light of the sluggish residential housing market, many ICF professionals are now focusing on commercial buildings; some industry experts have even provided guidance to ICF businesses that need to transition to commercial construction.[3]

Despite its many benefits, a particularly acute problem with commercial ICF construction has been door and window openings. Traditional techniques involving blocking out (or 'bucking') the door and window openings during concrete pouring have proven insufficient for large, commercial projects with hundreds of openings, primarily because these solutions were originally designed for the residential market. This article introduces a new solution—integrated framing assemblies (IFAs)—for door and window openings on commercial ICF projects in Canada.

Integrated framing assemblies

Integrated framing assemblies are proprietary 14-gauge galvanized steel frames that serve simultaneously as the door or window frame and the 'buck' that blocks out the opening during the pouring and curing of the concrete. Essentially, they are installed prior to the concrete pour and remain in place afterwards, ready to receive doors and/or aluminum windows immediately. As with some bucking methods such as vinyl or wood, IFAs can meet specifications for any jamb depth. Unlike other bucking methods, however, IFAs can be anchored into the footer before the foundation is even poured. They also contain a unique alignment flange around which the concrete is poured and set during construction of the ICF wall. Thus, on concrete curing, the integrated framing assembly coheres with the structure on all sides, providing greater integrity than is attainable with other bucking methods.

This aspect (among others) restricts the suitability of IFAs for residential or smaller, light commercial jobs. On such smaller projects, large-scale structural stability is not as necessary as it is for heavily used, high-traffic buildings such as schools, hospitals, or barracks with multiple floors, hundreds of openings, and the need to serve as a community shelter in times of emergency. IFAs' ability to increase structural integrity makes them ideal for these larger commercial jobs.

Unique among bucking methods and particularly useful for commercial construction, is IFA's ability to meet any architectural design for sidelites or mullions in the frame, as well as the fact they can be used in interior load-bearing ICF walls. This potential is exemplified by the largest scheduled ICF building in North America, the Joseph Warren Middle and High School. Located in Bowling Green, Ky., this project demonstrates how integrated framing assemblies can increase jobsite productivity.

The Bowling Green project also shows why IFAs are suited for large projects in terms of financial cost. A single integrated framing assembly can cost two to three times more than other methods, but a large school project reaps the benefit of increased productivity.

Increased jobsite productivity

At 30,658-m^2 (330,000-sf), Joseph Warren Middle and High School will be the largest ICF building on the continent at the time of its completion. Designed by Sherman Carter Barnhart and set to open in September [2009], the school employs many innovative IFAs, including radius assemblies and view-window assemblies as large as 7 x 7.5 m (22.7 x 24.7 ft).[4]

As the school has almost 500 integrated framing assembly openings (497 total, 224 of which are door assemblies), it demonstrates the enhanced onsite productivity these systems afford large, commercial projects.

Under traditional methods of blocking out door and window openings, each opening typically requires contractors to field-fabricate the buck and then install it before pouring concrete into ICF blocks.[5] Once the concrete cures, the buck—if made of wood or significantly repositioned during the curing process, as often happens—may need to be replaced.

Buck replacement is regularly necessary because concrete shifts as it consolidates and wood and vinyl bucks are not strong enough to keep the opening plumb and true. Further, wood bucks often need to be replaced because architects typically do not want organic products as part of the permanent structure of a large, commercial building.

After ensuring the dimensions of a post-cured opening, the contractor then installs a frame in the opening, followed by a door or window. Thus, as Figure 1 shows, traditional ICF bucking methods can require up to twice as many contractor tasks as those needed for an IFA at a single door or window opening.

As IFAs are the bucking method and the frame, factory-fabricated, delivered to the jobsite tagged for specific openings, and therefore ready to receive doors or aluminum window frames with no onsite hardware preparation, they streamline the installation process. Consequently, they significantly reduce the number of necessary contractor tasks for an entire project.

Using the openings at Joseph Warren as an example, Figure 2 shows IFAs require less than half—497 versus 1218—the total jobsite contractor tasks that a traditional bucking method may need. Therefore, IFAs directly maximize jobsite productivity.

Installation is not the only area in which IFAs enable greater jobsite productivity. They are engineered to co-ordinate with multiple subcontractor trades, providing smoother—and earlier—transitions to subsequent phases of construction.[6] For example, IFAs include standard drywall returns on the interior, which co-ordinates with drywall subcontractors. They also involve standard closure returns that facilitate the interface between brick and the air space cavity, thus co-ordinating with masonry subcontractors.

Energy efficiency

Although a distinct advantage, increased jobsite productivity is not necessarily the most attractive feature for Canada's commercial market. Due to the country's cold weather climate, IFAs are especially beneficial because of the energy efficiency they afford, a primary goal in most new construction.

In general, ICF buildings are more energy-efficient than alternatives of stick-frame houses,[7]or concrete masonry units in commercial buildings, due to the thermal insulation of the EPS, or sometimes XPS, insulating concrete form blocks. These products have already been classified as 'green' for several years due to their ability to help projects earn points under the Canada Green Building Council's (CaGBC's) Leadership in Energy and Environmental Design (LEED) program.

The precise number of points ICFs contribute varies from jobsite to jobsite, depending on which credits an architect designs the building to attain. ICFs typically help a project earn 10 to 12 LEED points, but can earn up to 15 to 19 points. A recent student residence for Hamilton's McMaster University cites the forms for assisting in attaining LEED Platinum status (a total of 52 LEED points).[8] Also worth noting is that 'high-performance wall systems' combining ICFs, IFAs, and impact-resistant coatings provide the highest possibility of LEED credits in a load-bearing wall due to the significantly enhanced structural stability.

Integrated framing assemblies further increase the energy efficiency of ICF buildings. The ICF block is stacked around the IFA and concrete is therefore poured into the sides of the framing assembly itself, surrounding the angled alignment flange. When the concrete cures, it creates a tightly sealed thermal envelope. Consequently, air infiltration is minimized and heat retention is maximized. (Conversely, in warm climates, cool air retention is kept at a maximum.)

Thermal breaks

As integrated framing assemblies are made of steel, their energy efficiency may seem questionable. One would expect that steel, as a conductor, would transfer the outside cold to the interior.

In milder climates, like that of the mid-western United States—where perhaps most of the large, commercial projects utilizing IFAs are—this question is less relevant. However, Canada's cold climate makes it an extremely important issue here.

To address cold weather concerns, IFA designers and engineers have produced thermal break assemblies. In these IFAs, a specially designed strip of rigid polyvinyl chloride (PVC) runs the course of the assembly and prevents cold (or heat) transfer from the exterior to the interior of the building, and vice versa. This proprietary thermal break technology enhances the energy efficiency of IFAs.

Conclusion

Insulating concrete forms generally present significant advantages to the large, commercial construction market. Integrated framing assemblies specifically address otherwise problematic door and window openings on these projects—their innovative technology not only increases jobsite productivity, but also contributes to the overall energy efficiency gained by using ICFs. The latter benefit is especially relevant for Canadian construction, further heightened by the new thermal break IFAs. This system prevents cold and heat transfer while allowing buildings to benefit from the structural stability of galvanized steel assemblies.

Notes

[1] Peter Shawn Taylor notes the advantages of ICFs in "The House That Scott Built," *Canadian Business Online* (February 27, 2006).

[2] With particular relevance to the residential market, see Pieter A. WanderWerf's *The Concrete House: Building Solid, Safe & Efficient with Insulating Concrete Forms* (Sterling, 2007). Of particular interest is the picture of the ICF house that survived Hurricane Katrina on page 23.

[3] See Randy Wilkerson's article, "Taking Your ICF Business Commercial," in the October/November 2008 issue of *ICF Builder*.
[4] The radius frame is half a circle, while view-window assemblies are simply massive 6.1 x 6.1-m (20 x 20-ft) windows. These types of frames are used often with typical hollow metal on jobs that did not involve insulating concrete forms. IFAs allow architects to put these types of frames on ICF jobs, which was previously problematic given the nature of the poured concrete construction method.
[5] A limited number of manufacturers of traditional ICF bucks will factory-fabricate and ship to a jobsite.
[6] On the relevance of the quickened construction pace, which IFAs create for the door and hardware industry, see these authors' article, "Integrated Framing Assemblies: A New Bridge for ICF Construction and the Door and Hardware Industry," *Doors & Hardware* 72.9 (September 2008): 36–40.
[7] See Pieter VanderWerf's *Energy Comparisons of Concrete Homes versus Wood Frame Homes* (Portland Cement Association, 1997).
[8] See Brian Baker's article, "Insulated Concrete Forms on Rise: Hamilton Student Residence is Setting a Precedent," in the December 5, 2006 edition of *Daily Commercial News and Construction Record.*

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