



Introduction to Design and Construction utilizing Insulated Concrete Forms (ICF's)

Commercial & Institutional Buildings

Facilitated by:

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Regional Sales Manager, Fox Blocks

Presenting to: Building Green with Concrete Workshop Date: October, 21, 2015



<u>ICF</u> Wall Assembly = Concrete, Steel + Recycled Plastic and EPS

+







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ICF Recycled Content

- Chair for Horizontal Rebar
- Strength to withstand Concrete Head Pressure
- Furring System for Finishes





Ratio of high density polypropylene (Ties and Brackets) to foam weight of ICF is indicator of strength and value of system



Average Recycled Content By Weight: 4" Block = 48.5% 6" Block = 49.3% 8" Block = 55.2% 10" Block = 56.4%

Airlite Plastics Recycling



ICF Foam = EPS



Polystyrene Plastics Invented in 1839

1951: Invented the technology of *expanding* the **Polystyrene (Styropor®) Expanded Polystyrene (EPS)** is utilized in building construction for perimeter and cavity wall insulation to keep buildings comfortable and increase energy efficiency



EPS Fun Facts

- Returns in energy savings 150 times the BTU's used during manufacturing
- Typically R-4 Per Inch insulating qualities
- 100% Recyclable
- No CFCs, HCFCs, Formaldehydes
- Will not facilitate mold or mildew growth
- Stable in high moisture, high and low temps, not subject to rot
- Not a food source for insects
- Continuous lifecycle energy performance versus single use products



One 600 lb 5' square tote of EPS produces one 53' trailer load of ICF







2015 Fox Blocks Manufacturing





ICF Typical Core Sizes





ICF Shapes



ICF Shapes & Sizes







Fox Buck, 4" Riser, Energy Stick and Curb Block



Energy Stick



One or Two layers Usually to the exterior side of wall to bring mass to interior

side

ICF Advantages



- 1. Design Flexibility
- 2. 5 in 1 System
- 3. Fewer Building Site Materials & Fewer Sub-Trades to Schedule
- 4. Speed of Construction
- 5. Superior Strength & Building Security
- 6. Superior Thermal Performance
- 7. Reduction of Building HVAC & Annual Maintenance Costs
- 8. Healthy Indoor Environmental Air Quality
- 9. Provides Sound Suppression (High STC Rating)
- 10. Compatible with ALL Finish Materials
- 11. Sustainable Products Green Building Performance
- 12. USGBC LEED or other Green Building Program "Contributor or Enhancer" in many various categories



ICF Design Flexibility













ICF Markets - Commercial





60% of ICF market is Commercial, Institutional, Public Works, etc. Insulated thermal mass providing a sustainable building envelope solution

ICF Markets - Municipal



ICF Markets - Municipal



• Municipal

Hatfield Township Building

Office

Hatfield, PA

Schools







"Like the cathedrals of olde...ICF construction *delivers* on the promise to withstand the test of time." JOHN MINIERI, Desctor of Real Properties & Factore, Discourse of Provide States



ICF Markets – Places of Worship

- Theaters
- Worship
- Big Box
- Municipal
- Office Church of the Holy Spirit Harleysville, PA
- Schools



ICF Markets – Multi Family



Royal Beach Condominiums, Wildwood Crest, NJ

- Theaters
- Worship
- Big Box
- Municipal
- Office
- Schools











ICF Markets – Multi Family

54 Frost Street, Brooklyn



- Worship
- Big Box
- Municipal
- Office
- Schools







ICF Markets – Multi Family



Fulton Street South, Brooklyn

- Theaters
- Worship
- Big Box
- Municipal
- Office
- Schools





ICF Markets - Hotel





Hotel - Motel & Multi Unit Multi Story Residential Condos

ICF Markets - Hotel



THAT IN A REAL PROPERTY INTA REA

and SUITES

NN



- Municipal
 - Sleep Inn Dunmore, PA
- Schools

• Office





Texas Tech University Lubbock Wednesday March 2013 Under Construction 5 story Student Housing first phase multiple buildings

Why – Build Ability

Basements Houses **Grade Beams Frost Walls** Multistory Condos Demising Walls Schools Laboratories Fire Walls Agriculture **Truck Shops** Manufacturing Sound Walls Theaters Auto Mall Mixed Use Wine Barrel Rm Habitat for Humanity Churches Car Wash

Commercial Institutional now 60% of market



Texas Tech University Dorms Lubbock TX 2014



Texas Tech University Lubbock Wednesday December 2013 Under Construction 5 story Student Housing first phase multiple



ICF Markets – Student Housing



Student Housing-Dormitory Design & Construction: EKU





ICF Markets - Student Housing





- Theaters
- Worship
- Big Box
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ICF Markets - Student Housing





- Theaters
- Worship
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- Schools

ICF Markets - Student Housing



- Theaters
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ICF Markets – Student Housing



- Theaters
- Worship
- Big Box
- Municipal
- Office
- Schools





ICF Markets - Commercial



- Theaters
- Worship
- Big Box
- Municipal
- Office
- Schools









JORDAN COMMONS 17 SCREEN MEGAPLEX SANDY, UT

"Originally designed in CMU we switched to ICF due to the speed of this building material – orisite the ICF was going so last we had to scale down the ICF crew from 20 masons to 7. This came in under the CMU budget nicely and on schedule."

EVERETT SMILEY Project Manager Salaan Ivo, Gerverd Contractors Design Sold



We switched to ICF due to uptront construction cost and schedule savings. The demising wall sound attenuation is second to none for sound containment. We have built our last three megaplex's with ICF and these larger buildings are giving us better energy performance. One case study shows a 14,000 sq.



 larger ICF megaplex is delivering 46% better energy savings than the smaller CMU building.*

WILLIAM ADAMANY, JR. Vice President, AGT Enterprises

WEST VALLEY MALL 15 SCREEN MEGAPLEX SALT LAKE CITY, UT

AGC Utah Retail Project of the Year Winner

"We built this 15 screen Megaplex Project with 38' to 56' Fox Blocks ICF walls - we were pleased with the pours and the speed. We had no bulges or blow-outs with the Fox Blocks ICF; it's a very strong block. The Fox T-block was a deciding factor on product choice."

MIKE CHALFANT ICF Forman MS Matorry ICF Contactors

CORAL CLIFFS 8 SCREEN MEGAPLEX CINEMA, HURRICANE, UT THANKSGIVING POINT 8 SCREEN MEGAPLEX CINEMAS, LEHI, UT

"After completing design with two ICF Theetre projects, we have found it easier to work with and detail than around CMU module.

Easter to work with and bear than around Uwo I mode ICF is more flexible and openings can be placed more freely without regard to a CMU module. Energy code requirements have easily been achieved without the added cost of furing and insulation. Both projects were under tight construction schedules we could not have met without the ICF."

RICHARD D. JUNKINS ALA Naylar Wentworth Land Architects



HARKINS PHOENIX 14 SCREEN MEGAPLEX, PHOENIX, AZ

PROJECT INFO 125,000 square feet of ICF walks were completed in 15 weeks, ICF walks to 44 feet, with interior demising walks to 34 feet.







Frank Theaters, 13 Plex Cineplex Odeon, 9 Plex CineMajic Atlantic 15 Plex Jordan Commons, 17 Plex Reel Deel Movie Theaters, 4 Plex Coral Cliffs Cinema, 8 Plex Odgen Megaplex, 13 Plex Warren Theatres East, 12 Plex The District, 20 Plex Grand Cinema, 4 Plex Legacy Crossing, 17 Plex Eagle Ranch, 4 Plex Thanksgiving Point Addition, 8 Plex Select Theatres, 8 Plex Penn Cinema, 14 Plex Cascade Theatres, 4 Plex Westown Movies, 12 Plex City Lights, 14 Plex Allen Theatres, 10 Plex Harking Theatres 18 Play

Fairchild Cinemas, 6 Plex Harkins Theatres, 16 Plex IMAX Single, 1 Plex Harkins Theatres, 18 Plex Nova Scotia, 8 Plex Harkins Theatres, 14 Plex Pasco, WA, 12 Plex Harkins Theatres, 14 Plex Star Cinema, 16 plex Harkins Theatres, 16 Plex Star Cinema, 14 Plex Spotlight Theatres, 8 plex Desert Star, 10 Plex Casper Theatres, 10 Plex Desert Star Addition, 5 Plex Megaplex Theatres, 15 Plex Thanksgiving Point, 8 Plex Megaplex Theatres, 12 Plex Redstone Cinema, 8 Plex

JORDAN COMMONS 17 SCREEN MEGAPLEX SANDY, UT

"Originally designed in CMU we switched to ICF due to the speed of this building material – onsite the ICF was going so fast we had to scale down the ICF crew from 20 masons to 7. This came in under the CMU budget nicely and on schedule."

EVERETT SMILEY Project Manager Sahara Inc. General Contractors Design Build







Salt Lake City West Valley Mall IMAX Megaplex Theatre completed

ICF Market - Commercial





• Theaters

Daycare

- Worship
- Big Box
- Municipal
- Office
- Schools



14,000 s/f Conditioned Space

ICF Markets – K-12 Schools



K12 Schools, Auditoriums, Gymnasiums

Ross-Tarrant Architects: This project includes the site development and construction of a new, 600-student high school on a property in Springfield, KY previously used as farmland. The 99,000 SF construction will include both one and two-story areas, and will be comprised of concrete foundation, **exterior ICF bearing walls,** interior CMU partitions, bar joists and steel decking, with both thermoplastic membrane roofing and metal roofing panels. The base-bid HVAC system will consist of a boiler and cooling tower, with add-alternate for a geothermal well field. Plumbing, fire protection, and electrical are also included.

- Worship
 ASHRAE (American Society Heating Refrigerating Air Conditioning Engineers) along with the US Dept. of Energy, AIA, IESNA, and USGBC have authored the <u>Advanced Energy Design Guide for K-12</u> <u>School Buildings</u>: This guide provides a design template for new schools nationwide to achieve 50% energy savings above national standards. Within Chapters 3 and 5 the design guide cites ICF case studies and envelope recommendations. Because over 50 ICF schools have been built within the State of Kentucky, several case studies came from within the region. Mass walls proved most effective. Within the mass wall category ICF walls outperformed all others.
- Office

Theaters

Schools



ICF Market – K-12 Schools





High School – Lansdale, PA

Architect: Lederach Associates



ICF Market – K-12 Schools





KAPPEN AQUATIC CENTER

Overbrook School for the Blind, Philadelphia, PA

HIGHLIGHTS

- Nation's First LEED Platinum Certified
 Natatorium
- 43 % more energy efficient than conventional construction



ICF Market – K-12 Schools





ICF Market - DoD



Federal/Military Buildings are subject to comply with a master specification document called the Unified Facilities Guide Specifications (**UFGS**). The UFGS provides all branches of military and Federal Government clear guidelines for construction specifications. Updated and posted as of February 23 2012, this guide now includes ICF Specifications within:

• Theaters

Division 3 Concrete Section 03 11 19.00 10 Insulating Concrete Forming.

- Worship
- Big Box
- Municipal

(D1) ICF WALL AND FOUNDATION ELEVATION "C"

- Office
- Schools

DoD: USACE & NAVFAC

Division 3 Concrete Section 03 11 19.00 10 Insulating Concrete Forming



US Army Corps of Engineers₀

• Worship

Theaters

- Big Box
- Municipal

Schools

• Office BARKLEY ELEMENTARY SCHOOL FORT CAMPBELL, KENTUCKY

PROJECT NUMBER: AM 000028 READY TO ADVERTISE

SOLICITATION NUMBER: W912QR-13-R-0037



MCAS P444 Training & Simulator Facility: Fox Blocks Detail from sheet S-303





TYPICAL INTERSECTION DETAIL

(WT-1) SHOWN (WT-2, 3, 4) SIMILAR



ICF Testing & Code Approvals



Look for the Miami-Dade County Approval Seal









National Fire Protection Association

The authority on fire, electrical, and building safety







ICF First Course Layout



• First course placement start at corners, rebar dowel locations to meet bays between form system OC webs, cut forms to length as needed.







ICF Bracing Alignment



ICF Openings - Buc





Accessory Buck Companies:

- Stala (steel frame buck)
- Gorilla Buck (wood foam)
- Insulbuck (foam plastic)
- Westra Ind (foam Buck" material includes wood, LSL, Vinyl, and Steel Frame



ICF Wall Openings





ICF "Buck" or "IFA" material includes; Wood, EPS, Vinyl, and Steel Frame





proper consolidation

match block lineup

Fully insulated with the same type 2 EPS as Fox Blocks

Fox Buck Numbers			
Available Sizes	6"	8*	10"
Total Width	11.25"	13.25*	15.25"
Total Length	48"	48"	48*
Bundle Quantity	10	10	10



ICF "Buck" material includes recent upgrades to foam plastic hybrids

ICF Embeds

Continues and

Fox Blocks ICF Wall Systems











ICF Thru Wall Penetrations







Sleeve thru foam prior to concrete placement for utility installations

ICF Concrete Placement





ICF Concrete Specifications



- Recommended concrete mix design for ICF's
 - 4" ICF 3/8" maximum aggregate;
 - 6" ICF 3/8"-1/2" maximum aggregate;
 - 8" ICF 1/2"-3/4" maximum aggregate
 - 3,000 psi minimum (Typical) for the walls
 - (2,500 psi minimum for the footings)
 - Slump
- » 4" ICF 6" to 7"
 » 6" ICF 5.5" to 6.5"
 » 8" ICF 5" to 6"
 » 10" ICF 5" to 6"
 » 12" ICF 5" to 6"

Mid Range Water Reducer/Plasticizer and Fly-ash Mix Designs encouraged

ICF Concrete

Per ACI Cast in Place Concrete Walls – 4 ft hour lifts to wall height desired

nor nour dov

Floor & Roof Connections





ICF Utility Installation





ICF Finish Compatibility

- Drywall •
- Hardened Materials ullet
- **Brick & Stone** • Masonry
- Sidings
- Synthetic Stucco •
- **Cementitious Stucco**











ICF Interior Finishes





ICF Hardened Coatings



- Hardened Coatings with High PSI-Fire Resistance
- Surecrete
- Gigacrete
- Dryvit
- BASF
- Permacrete





ICF Hardened Coatings





PERFORMANCE BENEFITS

Single coat applications from 1/8" to 1/4" Provides Tough protective finish over ICF and SIP's Impact resistance (ASTM C1629) High abrasion resistance (ASTM D4977) Zero flame spread and smoke developed (ASTM E84)

Non combustible building material (ASTM E 136)

Smooth or textured finishes – readily accepts paints

Applied by conventional spray pumps or hawk and trowel

Exceeds EPA and CA indoor air quality & VOC standards (AQS, Report No. 157763)

Environmentally sustainable without the addition of crystalline silica

Mold and mildew resistant (ASTM G21)

ICF Stucco Finish









ICF Brick Finishes





ICF Stone Finishes





Natural Stone





Public Works Municipal Admin Building NM

ICF CSI SPECIFICATION










Typical ICF Details - Footings











Typical ICF Details - Roof





SCALE: N.T.S.



ICF Details - Hambro





ICF Details – Hollow Core







ICF Man-Hour Rates

- No heavy lifting or transporting of equipment required...
- Labor pool can be quickly trained to become certified ICF installers.
 - No beauty metal forms to transport strip and





1 ICF Straight Form Unit weighs 5 lbs delivers 5.33 s/f of wall. CMU equivalent wall

s/f requires 6 units weighing 140 lbs (mortar not included)

1 ICF Bundle = 84 Lbs delivering 64 Sq Ft of Wall. CMU equivalent is

ICF Man-Hour Rates



* 13,500 SF commercial building

•Time to Build findings from 2007 National Construction Estimator, validated by Means Commercial Cost Data 2007,

approved by estimating departments

of Weis Builders, Ralph Lewis Construction Compares speed of building exterior walls that are ready for exterior and interior finish

50.00 45.00-40.00 35.00-30.00 25.00-20.00 15.00-10.00-5.00 0.00-CMU (6") ICF (6") Wood (2x6 Wood (2x6) Tilt-up Steel Framed (6" w / Batt w/ Sprayfoam) w ith Insulation Sprayfoam)

Days to Build (50MH/day)

ICF Budget - Costing



2015 Budget costing per gross square foot of ICF wall surface area installed – subcontractor bid rates. \$3.50 - \$4.00 Insulated Concrete Forms \$2.50 -Concrete, **Rebar**, Bucks, Hardware \$3.50 Boom Pumping, Bracing, Shipping \$2.50 -\$3.50 Labor, Insurance, Sub & Gen markup \$4.50 -\$7.00

Installed ICF Walls, embeds set (supplied



ICF – SUSTAINABLE?

<u>YES</u>

- **Safe-Secure-Long Lasting Materials**
- **Recycled Materials and Recyclable** ٠
- **Energy Efficient & Return on Energy** ۲
- **Reduced Materials Waste**









American Concrete Institute® Advancing concrete knowledge







Southface













ICF Interior Air Quality (IAQ)



- Controlling indoor air reduces reactions to respiratory allergies, asthma, and other related health concerns.
- ICF's contain no CFC's HCFC's Formaldehydes or off-gassing
- Air handling and filtration components more efficient
- Dust and blown particulates minimized due to low air infiltration
- No Mold or Mildew
- American Lung Association Clean House designate
- Insulation and webbing material completely inert
- Higher IAQ results for healthy learning environment

ICF Safety & Security



- Superior Fire Rating
 - 2 to 4 Hour UL fire rated walls
 - Lower flame spread index than wood
 - Lower Toxicity when compared to other construction materials
- Structural Strength
 - Structural concrete engineered for use in areas with high seismic conditions
 - Hurricane & Tornado Resistant Wind Loads
 - Design strength to easily exceed *wind loads* required by local codes
 - Design strength to easily exceed seismic loads required by local codes

ICF Fire Ratings

Some ICF's have UL listings up to a 4 hour fire rating (FRR)

Third Party Testing & Performance-Expanded Polystyrene (EPS): ICF Flame Spread / Smoke Development Index

<u>Flame Spread Index (FSI)</u> is less than 25 Max. per Code is 75

Smoke Development Index (SDI) is less than 450 Max. per Code is 450





ICF Sound Reduction by 80%



Most ICF walls rated at STC 51 – 52 with $\frac{1}{2}$ " drywall

ICF Energy



Superior Energy Efficiency

- ICF Structures exhibit 75% Reduction in air infiltration
 - or an average air leakage or infiltration rate of 0.05 (average air changes/hour)
- Many Form Unit R-Values = R24
- Effective Performance R-Value of R-40+
- Cost Reduction due to downsizing of HVAC system
- Annualized Utility Cost Reductions
- Peak Hour energy use reductions



The "ICF Effect" R-Value



temp thru footing into walls



Insulated Thermal Mass



- Moderates internal temperature swings
- Increases occupant comfort
- Reduces energy requirements
- National average energy savings 46%

"A wood framed wall would have to be insulated to a level exceeding R50 in many cases, in order to perform at a level equivalent to an ICF wall." CTL LABS- Skokie, IL







- 30-60% savings in heating and cooling costs.
- ICF Buildings HVAC systems are typically DOWNSIZED 20% 25%



LEED 3.0 Strategy Guidelines For Building



Envelope to Optimize Energy Performance

Cre	dit	Pts	Descriptior	n Measurement	Strategy
EA c1	Optimize Energy Performance	1-10	Achieve increasing levels of energy performance above the baseline in the prereq std to reduce environmental and economic impacts associated with excessive energy use	OPTION 1 - WHOLE BLDG ENERGY SIMULATION - (1-10pts) demonstrate % Improvement in the proposed building performance rating compared to the baseline performance rating per Building Performance Rating Method in Appendix G of ASHRAE/IESNA Std 90.1-2004 OPTION 2 - Prescriptive Compliance Path (4 pts) - For office bigs under 20,000 sf comply with the prescriptive measure of ASHRAE Advance Energy Deesign Gude for Small Office Buildings 2004. Identify climate zone bidg is located and comply with all recommendations. OPTION 3 - Prescriptive Compliance Path (1 pt) - Comply with the Basic Criteria and Prescriptive Masures of the Advanced Buildings Benchmark Version 1.1. Identify climate zone bidg is located and comply with all recommendations.	Design bidg envelope & systems to maximize energy performance. Use Computer simulation model for Option 1. REDUCE DEMAND: Optimize building form & orientation, reduce internal loads thru shell & lighting improvements, & shift load to off-peak periods. HARVEST FREE ENERGY: Use daylight, ventilation cooling, solar heating & power, wind energy, service water heating & power generation. INCREASE EFFICIENCY: More efficient envelope, lighting, & appropriately sized HVAC system. RECOVER WASTE ENERGY: Exhaust air energy recover, graywater heat recovery, and cogeneration.

Credit EA1 19 points available. To secure maximum contribution :

"Design building envelope to maximize energy performance"

"More Efficient Envelope"

"Reduce internal loads thru shell improvements"



ME Group Omaha, NE ICF branch office – LEED Platinum ICF

LEED 3.0 – EA 1



Ener	gy & Atmosphere	35	Points
Y Prereq 1	Fundamental Commissioning of the Building Energy Systems	Required	
Y Prereq 2	Minimum Energy Performance: 10% New Bldgs or 5% Existing Bldg Renovations	Required	
Y Prereq 3	Fundamental Refrigerant Management	Required	
Credit 1	Optimize Energy Performance	1 to 19	
	12% New Buildings or 8% Existing Building Renovations	1	
	14% New Buildings or 10% Existing Building Renovations	2	
	16% New Buildings or 12% Existing Building Renovations	3	
	18% New Buildings or 14% Existing Building Renovations	4	
	20% New Buildings or 16% Existing Building Renovations	5	
	22% New Buildings or 18% Existing Building Renovations	6	
	24% New Buildings or 20% Existing Building Renovations	7	
	26% New Buildings or 22% Existing Building Renovations	8	
	28% New Buildings or 24% Existing Building Renovations	9	
	30% New Buildings or 26% Existing Building Renovations	10	
	32% New Buildings or 28% Existing Building Renovations	11	
	34% New Buildings or 30% Existing Building Renovations	12	
	36% New Buildings or 32% Existing Building Renovations	13	
	38% New Buildings or 34% Existing Building Renovations	14	
	40% New Buildings or 36% Existing Building Renovations	15	
	42% New Buildings or 38% Existing Building Renovations	16	
	44% New Buildings or 40% Existing Building Renovations	17	
	46% New Buildings or 42% Existing Building Renovations	18	
	48% New Buildings or 44% Existing Building Renovations	19	

LEED Primary ICF Contributions are in Credit Category EA-1, with significant % gains over energy code baseline performance and resulting

www.ashrae.org





Advanced Energy Design Guide for K–12 School Buildings

Achieving 50% Energy Savings Toward a Net Zero Energy Building

Developed by:

American Society of Heating, Refrigerating and Air-Conditioning Engineers The American Institute of Architects Illuminating Engineering Society of North America U.S. Green Building Council U.S. Department of Energy



Insulated Concrete Form Exterior Wall Assembly



Construction of an Insulated Concrete Form Wall

Alvaton Elementary school, a 70,000 ft² facility in Bowling Green, Kentucky, was the first school in the state to utilize an insulated concrete form (ICF) exterior wall assembly in lieu of the more traditional block/brick wall assembly. Since this school was completed in 2005, ICF has become a common exterior wall construction technique used in approximately 50 other education facilities in the state.

ICF exterior wall construction was originally chosen by the district to improve the thermal performance of the envelope. After one year of successful operation, the energy use intensity (EUI) was the lowest known for any school in Kentucky at that time.

While the ICF wall assembly bid was more expensive than that of traditional exterior wall systems, several surprises became apparent once construction began. First, construction was significantly faster which allowed the contractor to improve the project schedule. Second, while a traditional block wall



www.ashrae.org



Integrated Design Process

PRINCIPLES OF INTEGRATED DESIGN

Integrated design is a method of design and construction that uses an interactive team approach for all phases of a project's management. Integrated design in some form is necessary to achieve at least 50% energy savings over the minimum code requirements of ASHRAE/IESNA Standard 90.1-2004 (ASHRAE 2004). In an integrated design, all parties work together through all phases of design and construction to maximize efficiency of the project and to yield coordinated, constructible, and cost effective results. This approach increases project productivity, provides higher performing buildings, and protects construction budgets by reducing unnecessary change orders.

Integrated design in school projects fosters unique opportunities to build connections between the school community, the school facility, and the school curriculum and to provide connection between the built environment and student achievement. School districts may take advantage of the design and construction process as a student learning experience. When construction is complete, the building can serve as a teaching tool for environmental awareness and energy conservation as part of an integrated project-based curriculum. If thoughtfully applied, an integrated design process can help cultivate improved school leadership and an enhanced school environment to improve student performance.

The efficiency and quality of the design and construction is obtained through the following team interactions and processes:

Issue a Request for Proposal (RFP) to

- define energy design and performance goals and expectations;
- define education programming to connect the facility to operations, school core curriculum, design and construction processes, and the community; and
- identify the project team and stakeholders (especially school district leadership, administration, faculty, facilities staff, and students).
- Establish early involvement of all design and construction team members. Include operations and maintenance staff as part of the owner's team.
- Establish initially agreed upon and documented common goals, including operational base line performance benchmarks.
- · Use the building as a teaching tool

How to Implement Recommendations



Recommendations are contained in the individual tables in Chapter 4. "Design Strategies and Recommendations by Climate Zone." The following how-to tips are intended to provide guidance on good practices for implementing the recommendations as well as cautions to avoid known problems in energy-efficient construction.

ENVELOPE

EN5 Walls—Mass (Climate Zones: all)



Richardsville Elementary School Source: Sherman Carter Barnhart Architects

ICF exterior wall construction was originally chosen by the district to improve the thermal performance of the envelope. After one year of successful operation, the energy use intensity (EUI) was the lowest known for any school in Kentucky at that time.

Case Study – Warren County Schools - KY



RICHARDSVILLE ELEMENTARY SCHOOL

Richardsville Elementary School, a 74,000 ft², two-story school that accommodates 500 students, is the culmination of 10 years of energy successes for Warren County Public Schools in Bowling Green, KY. Envisioned as a net zero energy building, the school design focused on achieving an energy consumption goal of 17 kBtu/ft²/yr.

An integrated design process was used that involved participants including school district officials, building users, the architectural/engineering design team, the state department of education, and the local power generation company. In order to design and operate a net zero energy school within a public school budget, all of these entities had to understand the vision and be willing to implement strategies to make energy reduction feasible and make a solar power generation system affordable.

A leader in reducing energy consumption, the Warren County School District's first step was to hire a district energy manager whose task was to educate and empower the staff on building operation. Successive construction projects over an eight-year period showed a continuous improvement in energy consumption. With a focus on better thermal envelopes, improved geothermal system designs, and efficient building operation, the district employed new construction techniques to improve building energy efficiency.

Thermal Envelope

Insulated concrete form (ICF) was used for the wall assemblies because of its improved thermal performance, reduced air infiltration, and high speed of construction. Richardsville further improved the thermal envelope by making the building a two-story rectangular shape to reduce exterior wall and roof area.

The Road to NET ZERO

Figure 3-2 Energy Use Reduction in Projects over an 8 Year Period



How does your school measure up?

	k/Btu/sf/year ASHRA 50 kBtu/sf/year k/Btu/sf/year E 50% Higher Utility Bills
Benchmark US Schools (ASHRAE 90.1)	0 5 10 15 20 25 k/BTU 35 40 45 50 55 60 65 70 75 80
energy Star Rating	50
Warren East Middle (Addition/Renovation)	43 (\$134,950 Annual Savings)*
Drakes Creek Middle (Addition/Renovation)	43 (\$134,950 Annual Savings)*
Hearn Elementary School	36 (\$164,401 Annual Savings)*
Alvaton Elementary School	35 (\$167,259 Annual Savings)*
North Middle School	34 (\$170,116 Annual Savings)*
Plano Elementary School	28 (\$193,413 Annual Savings) *
Richardsville Elementary	18 (\$223,744 Annual Savings)*

Building Components of Net Zero Richardsville Elementary – Warren County, KY





Richardsville Elementary School







Spicks in the spice of the spic

Energy Life-Cycle of Buildings

- Embodied energy for materials acquisition, manufacturing and *construction* accounts for < 2% of total energy
- Occupant energy-use accounts for 98% of life-cycle energy



Fox Blocks ICF Q&A





Insulating Concrete Forms (ICF)

Facilitated by:	Brian Medford – Regional Sales Managers, Fox Blocks
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Presented to:Building Green With Concrete WorkshopDate:Oct 21, 2015

www.foxblocks.com www.youtube/foxblocksairlite.com