

Maryland Schools + ICF

22nd Maryland Concrete
Conference
March 22, 2022

BALTIMORE CITY
PUBLIC SCHOOLS

G+P
ARCHITECTS

NUDURA
INTEGRATED BUILDING TECHNOLOGY



Photo courtesy of CMTA Engineers

Two Replacement Schools



NEW Holabird
ES/MS

NEW Residential
Development

NEW Graceland Park
O'Donnell Heights ES/MS

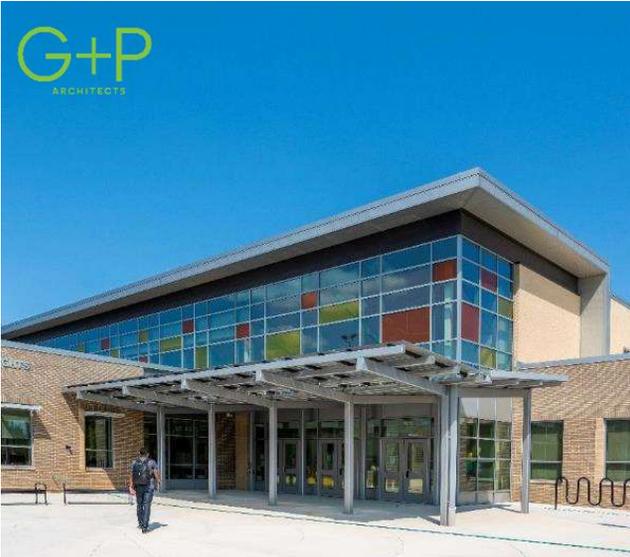
Dundalk Ave

I-95



rendering

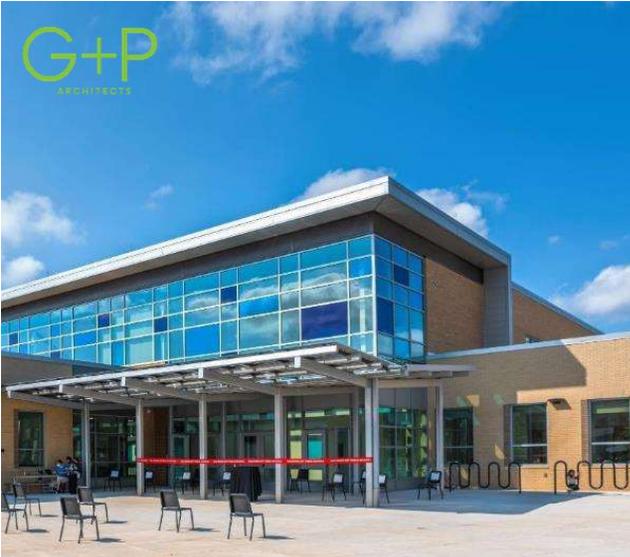
Quick Facts



Graceland Park/O'Donnell Heights ES/MS
Baltimore City Public Schools

Size: 94,000 sf
Completion: 2020, Kids Returned 2021

Net Zero Energy – Emerging
LEED Platinum Certified



Holabird Academy ES/MS
Baltimore City Public Schools

Size: 94,000 sf
Completion: 2020, Kids Returned 2021

Net Zero Energy – Emerging
LEED Platinum Certified



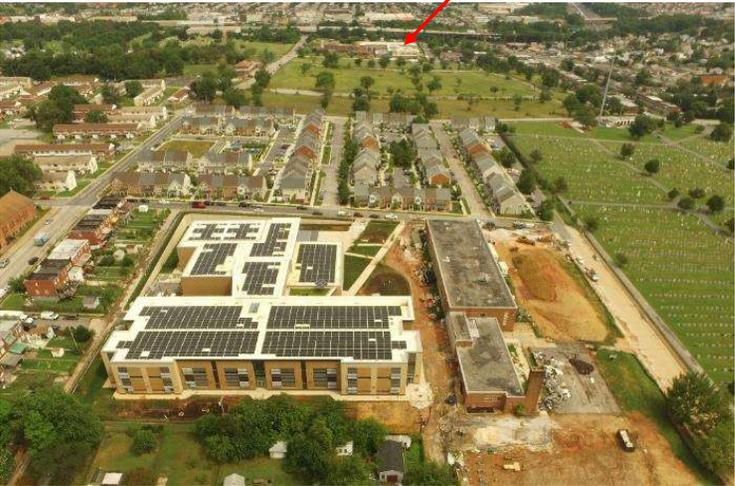
Graceland Park/O'Donnell Heights ES/MS Aerial Views



Holabird Academy ES/MS Aerial Views



Hey, there's Graceland down the street!



ICF Learning Curve

Questions we asked:

1. Experience with ICF (school?)
2. Experience with Maryland? BCS?
3. Experience with Net Zero Energy goal?
4. Experience with CMR and/or CMA?

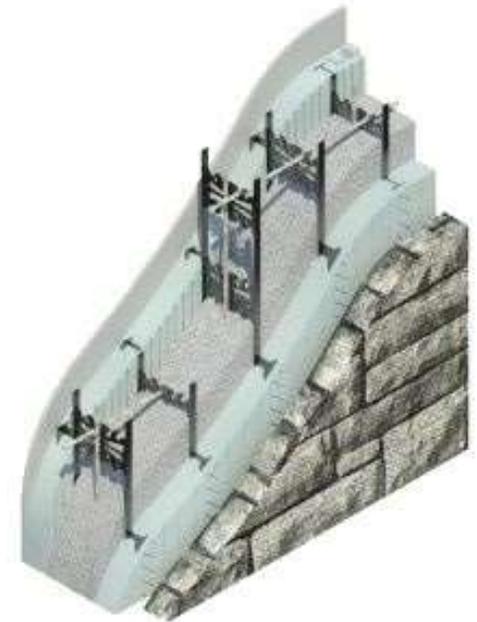
Hot Topics

- Need a local Contractor forum for ICF
- Need to find local partnerships – find a local concrete contractor willing to joint venture with ICF installer
- Typically separate concrete flatwork and footings contractor versus walls – two separate division 3 sections
- Construction sequence and timing is biggest challenge
- Storage space needed on site
- Load bearing versus cladding – affects critical path
- CMR – allows CM power and control over specialist system and supplies

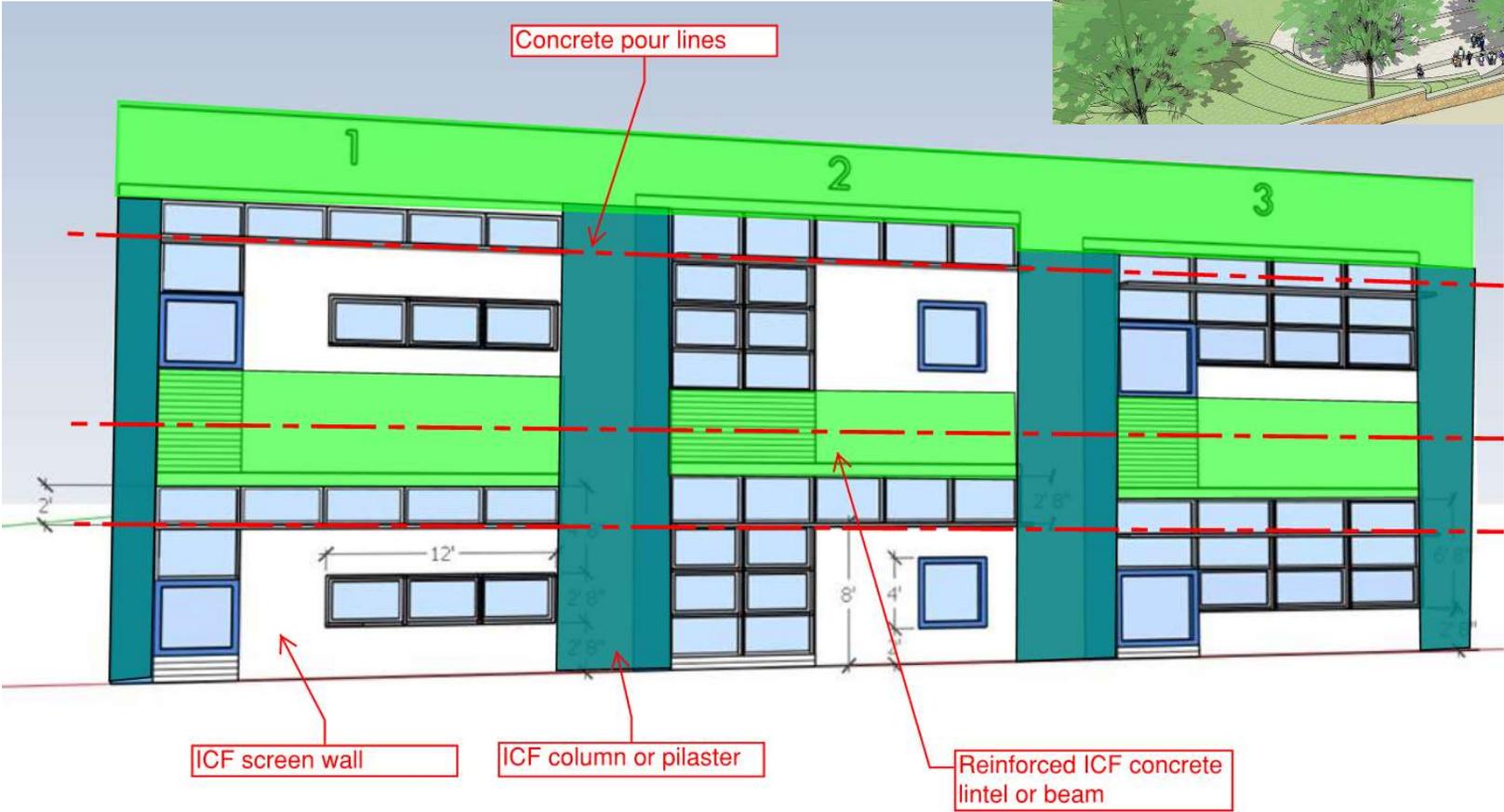
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CONTACT	Johnny Longfellow (o) 202.463.8200; © 571.259.5832 jlongfel@heery.com Rene Adams	Greg Ramirez (d) 240.599.4664; © 240.393.1254 gramirez@hessconstruction.com	Randy Reisner (Chantilly, VA) (d) 703.825.2265; © 202.345.5054 randall.riesner@whiting-turner.com Irene Knot (Baltimore, MD, K-12) © 443.677.6634
Experience with ICF	Yes, completed Discovery ES as CMA for APS May be CMA for APS again for Patrick Henry ES. Discovery ES: ICF was \$19/sf and cheaper to masonry backup. Now, it would likely be \$21-\$22/sf and comparable to masonry. Anything over 30' tall is complicated and not economic for ICF. Discovery = LTF (Texas installer for ICF)	No Fact finding to put together response to RFP for Arlington's Patrick Henry ES - reached out to local concrete contractors in area and ICF manufacturers (Brian Medford of Fox Blocks, Andy Horgan of Nudura, Paul Kumatzee of Amvic Building System and Andy Lennox of Logix ICF). Going to meet with Andy Horgan of Nudura week of June 13, 2016 about BCS.	Yes - all over country esp. in TX and FL Won CMR role for new Arlington Public School's ICF at Jefferson ES. (Working with Andy Horgan of Nudura). Going to meet with Andy Horgan of Nudura week of June 13, 2016 about BCS.
Experience with MD		Yes	Yes - but not Baltimore City Schools
Delivery Recommendation	CMA - Not necessarily interested in acting as CMR for BCS (or any other system).	CMR - teaming approach with local installers recommended	CMR - design assist recommended. Allows CM and owner the control over specialist systems and supplies.
Net Zero Energy Experience		No	Yes - largest NZE in country, many projects
Miscellaneous	Success depends on ICF contractor. Can be as fast as a steel-framed structure if there are qualified contractors who can do quality commercial work. Discovery ES issues: large, expansive openings, rebar coordination, scheduling complications). In Heery's opinion, steel is fastest, then ICF, and masonry slowest. Goal: find a local concrete contractor willing to joint venture with ICF installer. Post Discovery ES, APS is starting another ICF job. Heery is reaching out to local contracting community to create a forum for ICF. If non-load bearing, then cladding is off the critical path. Miller-Long and Clark weren't interested in ICF bidding/procurement so had to go with outside ICF installer. Have to work off the slab (2 courses above grade) for bracing and scaffolding. Need to require coordinated shop drawings for ICF, HVAC, Elec, Plumbing and openings in walls. Need full-time inspector for rebar checking drawings in field at Discovery (ECS). Laid out all openings rebar every day. 20-25' wide openings have more rebar issues than typical widths. Also had	Addressing local contractors in the area - trying to find local partnerships. Coming up with Pros/Cons/Impact to schedule. Believes the biggest challenges will be around construction sequence and planning. ICF product will occupy a lot of space on site for storage and contractors will have to work around eachother. Lessons learned from subs: Hess wants to take local subs to get them certified with ICF (concrete, electrical, plumbing). Need to prep them about financiability (moving up from residential scale to commercial scale requires being able to withstand 30-45 days for payment). Prices regionally are going through the roof for all trades. Another lesson learned - need to dimension plans from concrete, not inside face of insulation (easier to coordinate).	We are working with WT on Ross Boddy Rec Center (Mo Co) and NOVA CC Woodbridge Phase III and Workforce Development projects.

We studied ICF a lot before committing to this system

	MASONRY WALL	ICF WALL
WALL CONSTRUCTION		
	G+P typical wall: 1' 3-1/4" Total	ICF (based on Nudura): 1' 6-1/2"
	7-5/8" CMU (8" block)	5/8" Gypsum board
	2-1/2" Spray Foam (Air+Vapor)	13-1/4" ICF (2-5/8" EPS foam + 8" concrete + 2-5/8" EPS foam)
	1-1/2" Air Cavity	1" Air Cavity
	3-5/8" Brick	3-5/8" Brick
PROS	We already have a library of tried and true details	Consistent air infiltration reduction - minimal air leaks
	Can leave block exposed on interior and paint	Simplification of wall construction (air barrier/insulation/backup all-in-one)
	Experienced bidding pool of contractors	Apparently slightly less in cost/SF than masonry wall (due to labor)
		reduction of structural columns on exterior walls (bearing)
CONS		hot knife for electrical boxes/conduit in foam = easy install
	less "tight" as a building envelope	Learning curve for detailing at G+P and CEI, as well as Setty
	Slightly less r-value in wall assembly	ICF units exposed to the building interior must be finished with approved 15-minute thermal barrier, such as 1/2" gyp board (per IRR report)
	Multiple subs doing masonry/air barrier/etc.	
		Not a lot of experienced school construction contractors in area - Westra Industries started Discovery ES's construction with Fox Blocks. Scheibel did a small private school project (10,000) but doesn't have experience as CM in Maryland
	potential increase in bearing weight on footings	
	stringent MBE requirements may make this challenging	



ICF Bearing Wall Studies



Classroom Wing



Construction Photos



- R-25 Wall Insulation with ICF (Insulated Concrete Form) Wall
- Reduced Air Infiltration and Air Exchanges with concrete bearing wall encased in two layers of insulation

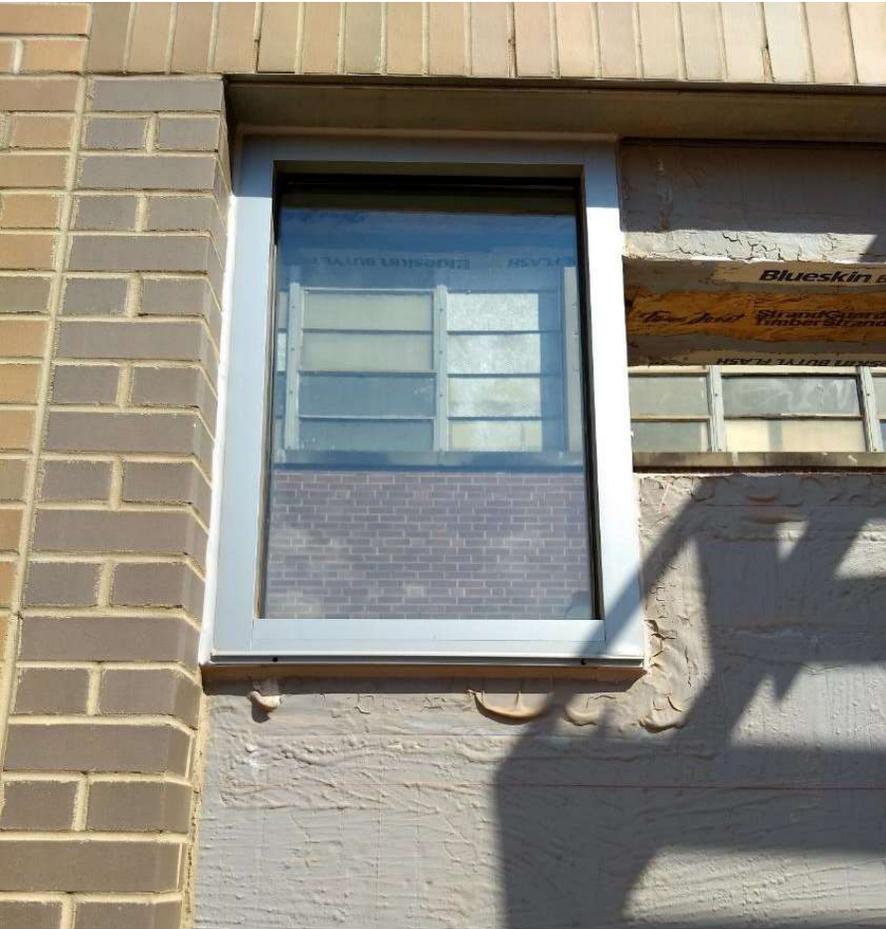
- Penetrations sealed with sealant



Storage and Installation

- Easy to store on site because they folded up
- Easy to install in wet late winter/spring conditions – quick wall construction saved time in schedule





Air Barrier Application

- Spray on better than roll on or troweled
- We specified systems that were compliant with the foam blocks
- Clean surfaces before applying air barrier





Baltimore City Public Schools - Graceland Park EMS 240
Kamau landiatayero - April 10 2019

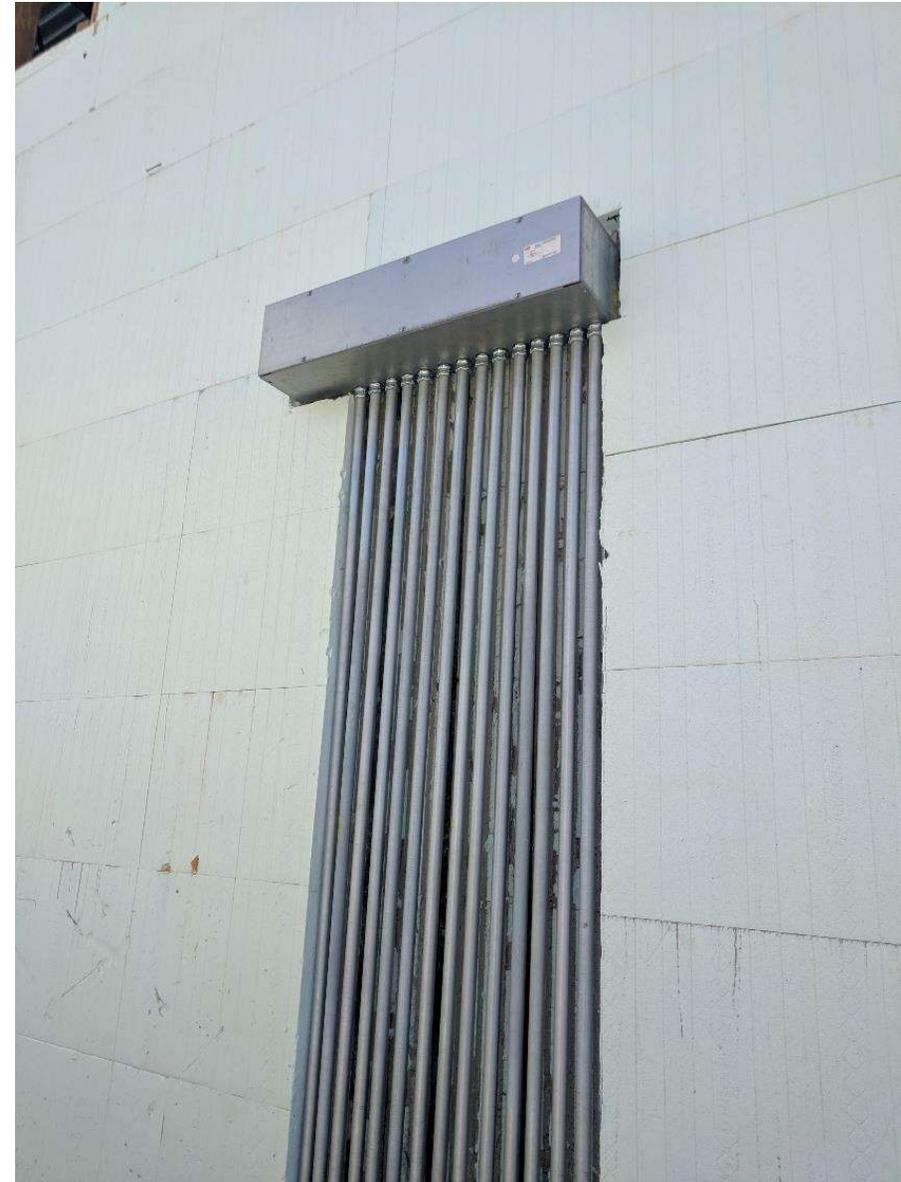




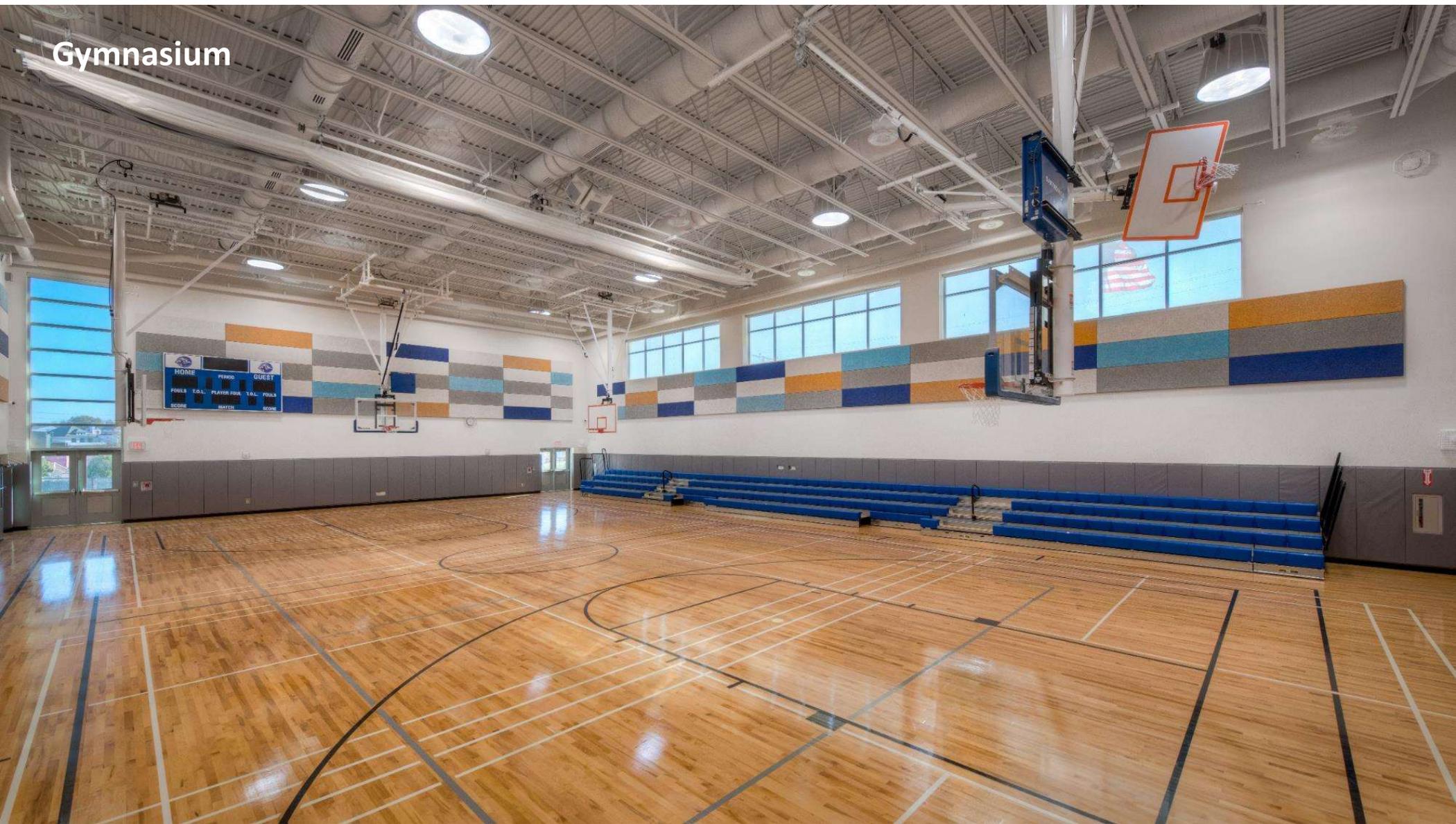
Utility Coordination and Installation in ICF



- Demystified installation methods for utilities in pre-bid and pre-con meetings (hot knife and foam sealant)
- HVAC/Plumbing have to coordinate with rebar prior to concrete pours



Gymnasium



Collaborative Learning Space



Collaborative Learning Spaces and Classrooms



Cafetorium and WonderWall



Solar Lab



Successful Air Tightness/Infiltration Testing

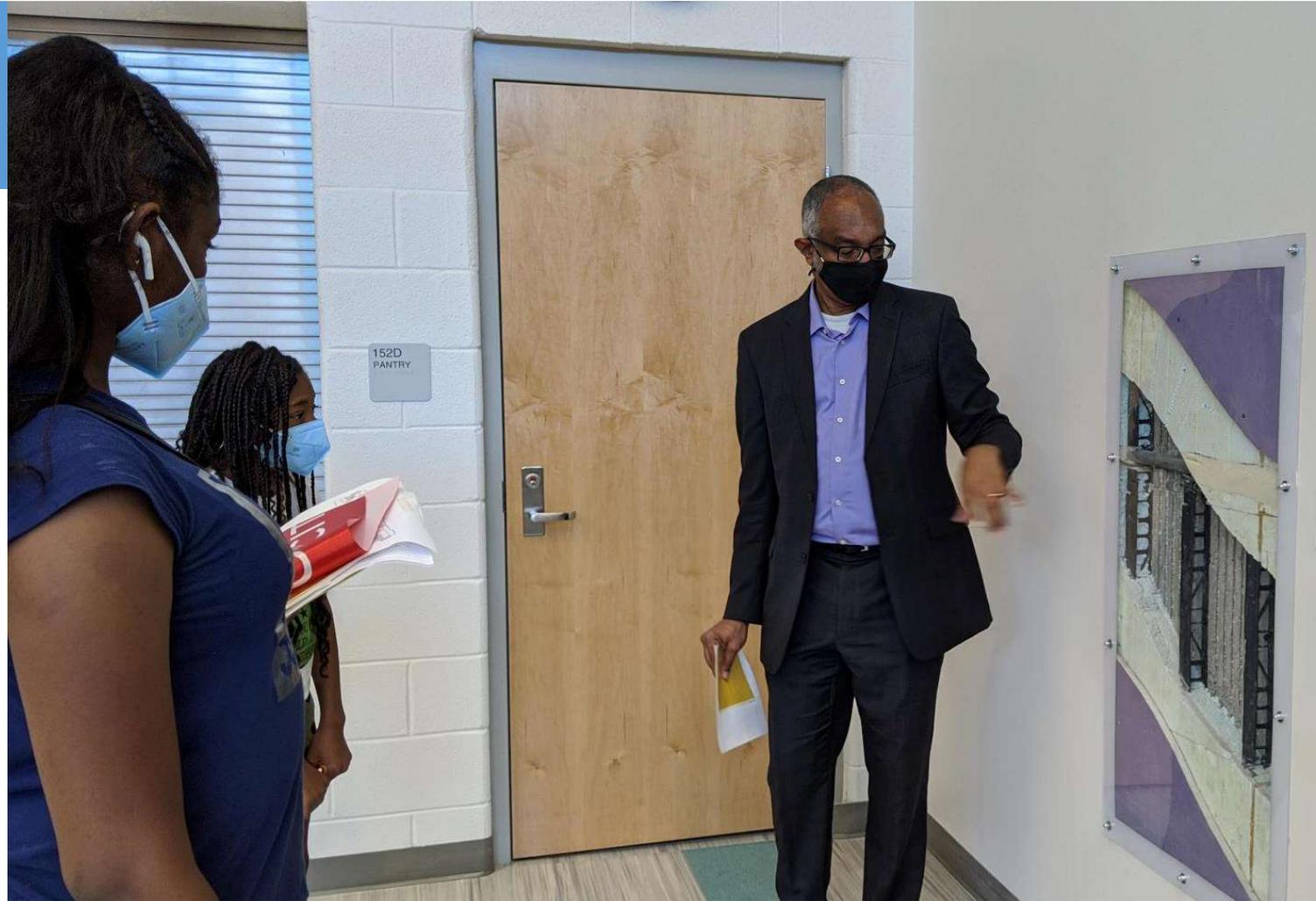


Results tested at 0.0585 CFM at 75 Pa
First Cost Savings at \$100,000
Designed to 0.25 CFM
Typical Building (IECC): 0.40 CFM
Thermal Imaging Resulted with No Issues

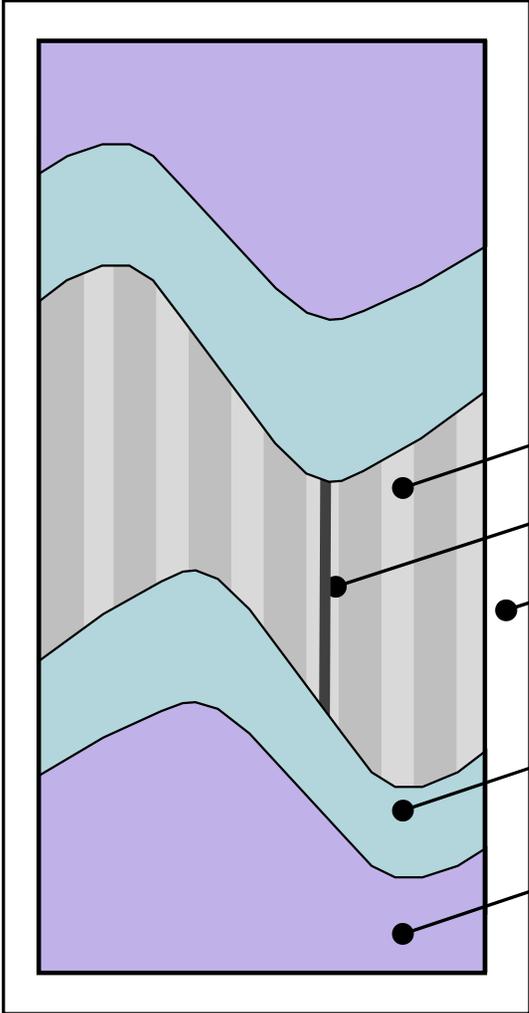
Graceland ES/MS + Holabird ES/MS

Student/Staff Engagement at Both Campuses

Exposed ICF wall construction with cutaway windows



Signage



Cutaway of Wall Structure

These layers make up the walls of the perimeter of the school and the Gymnasium. They are very thick with insulation and concrete and prevent hot or cold air from passing through. This makes your school more energy efficient.

- Concrete wall structure
- Reinforcing web in ICF block
- Painted gypsum board under acrylic panel. Paint is low-VOC (volatile organic compounds)
- Unfinished wallboard made from gypsum board
- ICF (insulated concrete form) block made from expanded polystyrene (EPS) foam

Signage

Four exterior signs in the site educate visitors, students, staff, and parents about what makes this school green

what makes your school **net zero energy?**


=


energy used by school renewable energy produced on-site





Solar shades on the south-facing windows control glare and reduce the heat absorbed into the building, which saves energy on lighting and air conditioning.



North and south **building orientation** make it easier to control the sun's glare and heat with solar shades.



The **energy dashboard** tracks how much energy the school uses and how much energy it produces.



All of the lighting is **Light Emitting Diode (LED)** which is very energy-efficient and lasts a long time, lowering ongoing and replacement costs.



Insulated concrete form (ICF) walls keep heat inside in the winter and outside in the summer using two layers of insulation and concrete.



Carbon dioxide sensors and monitors make sure there is the right amount of fresh air in the school.



A **Dedicated Outdoor Air System (DOAS)** ensures good ventilation and indoor air quality. Depending on how many people are in a room, the amounts of air flow and outside air will vary, which saves a lot of energy.



The **geothermal system** uses the earth's constant temperature deep below ground to help heat or cool the building, which reduces energy costs.



Photovoltaic panels (PV) on the roof and entry canopy collect the sun's energy and convert it to electricity - enough to power the school all year.

what is net zero energy?

A net zero energy (NZE) building uses very little energy and produces the energy it needs from on-site renewable sources, like solar panels. Every year, the amount of energy used equals the amount of energy produced. This saves money and reduces greenhouse gas emissions from energy produced by burning fossil fuels. Some features that contribute to conserving and producing energy are described here.

The US Green Building Council awarded this building its highest LEED certification, Platinum, because in addition to being NZE, it is also green and sustainable - it was built with many local and healthy materials and uses less water than a regular school.



BALTIMORE CITY PUBLIC SCHOOLS

Energy Dashboard

Touchscreen monitors at the Lobby Wonder Wall and the second floor Energy Lab allow students, teachers, and visitors access real time energy consumption and generation data, and navigate around 360-degree views of classrooms, exterior, gym, and mechanical spaces

It can be a virtual reality experience with a personal device and/or goggles.



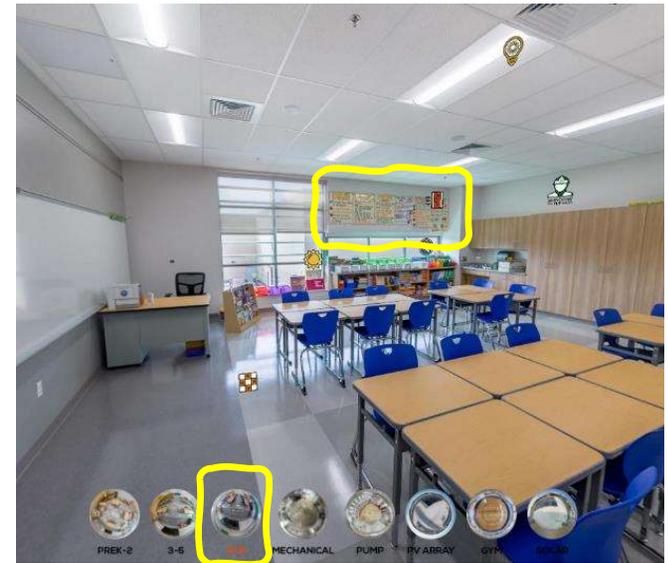
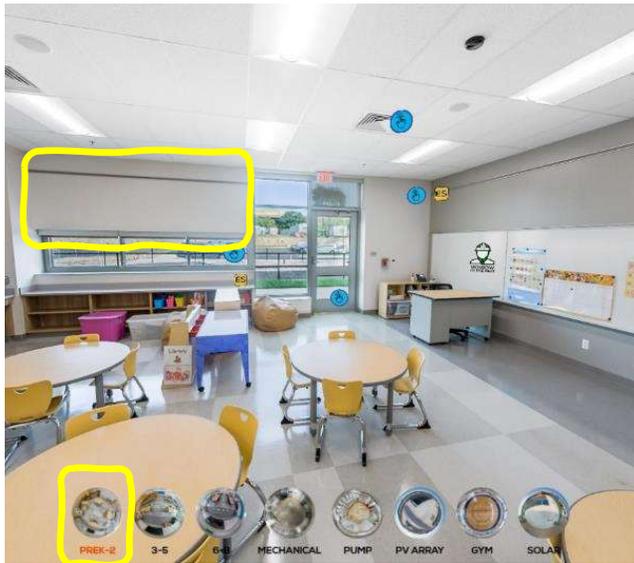
Visit the touchscreens

View on a personal device

Explore on a computer



Age-Specific Content Three Classrooms PreK-2, Grades 3-5, and Grades 6-8 are highlighted in the virtual tour. The same features are identified with Baltimore Badges (icons that when clicked, pop up more information in terms and diagrams that are aligned with the ages of the students in that classroom). The goal is to help grow the lessons with the students as they grow up in the school.



ICF Walls

How are the walls in this school like a coat?

In the winter, the walls of your school are like a jacket and keep the cold air outside. In the summer, the walls do the opposite and keep the hot air outside.

What would happen if there were holes in your coat? Would the same thing happen if there were holes in the walls?

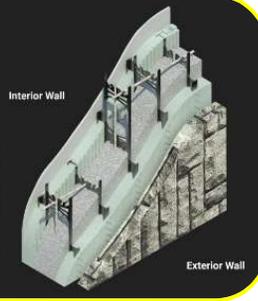


ICF Walls

How do the walls keep us warm in the winter and cool in the summer?

The walls have two layers which make them thick and reduce how much heat travels through them. Like wearing a winter coat over a sweatshirt, the extra layers keep the warm air inside in the winter and the warm air outside in the summer. This saves energy!

Why is it important to reduce how much heat travels through the walls?



Interior Wall

Exterior Wall

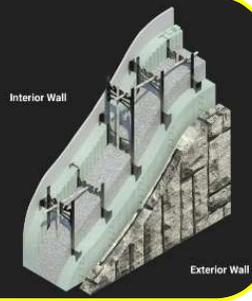
ICF Walls

How do the walls help conserve energy?

Imagine the walls of your school were made with giant Styrofoam®, LEGO® blocks. Now imagine those foam blocks were hollow inside, stacked high, and filled with concrete. If you can imagine all that, then you understand how the walls of the schools were built using Insulated Concrete Forms (ICF). This double layer of insulation prevents air from traveling from inside to outside, or from outside to inside. The wall is also sealed with a special foam.

There is no metal that goes through the entire wall, so no heat is lost through conduction. This means we use less energy to heat and cool the school, which saves money and reduces our carbon footprint.

What do you do at home to reduce your carbon footprint?



Interior Wall

Exterior Wall



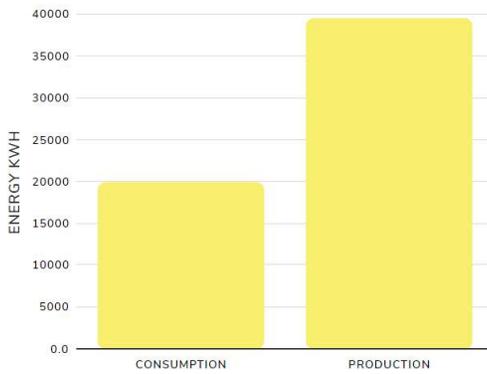
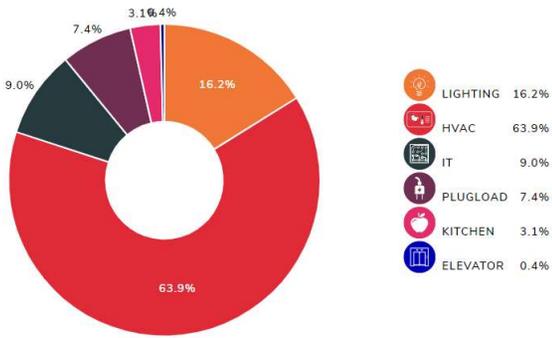
GRACELAND PARK-O'DONNELL HEIGHTS

BALTIMORE CITY PUBLIC SCHOOLS

MONDAY AUGUST 16, 2021
4:55:08 PM

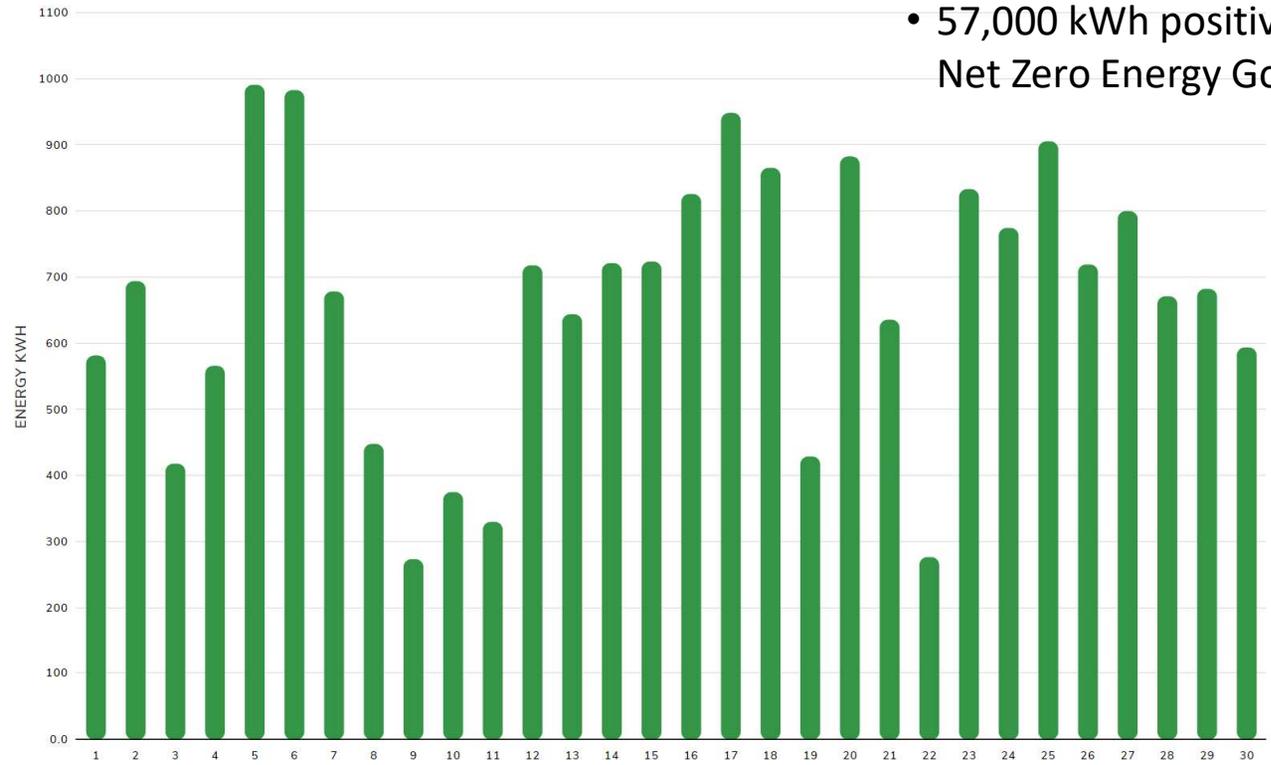
MONTH ▼ BUILDING ▼ EXPORT

< JUN 2021 >



BUILDING DEMAND

3.7 KW **10.9 KW** 30 KW
LOW **CURRENT** HIGH



• 57,000 kWh positive to Net Zero Energy Goal

What does this data mean?

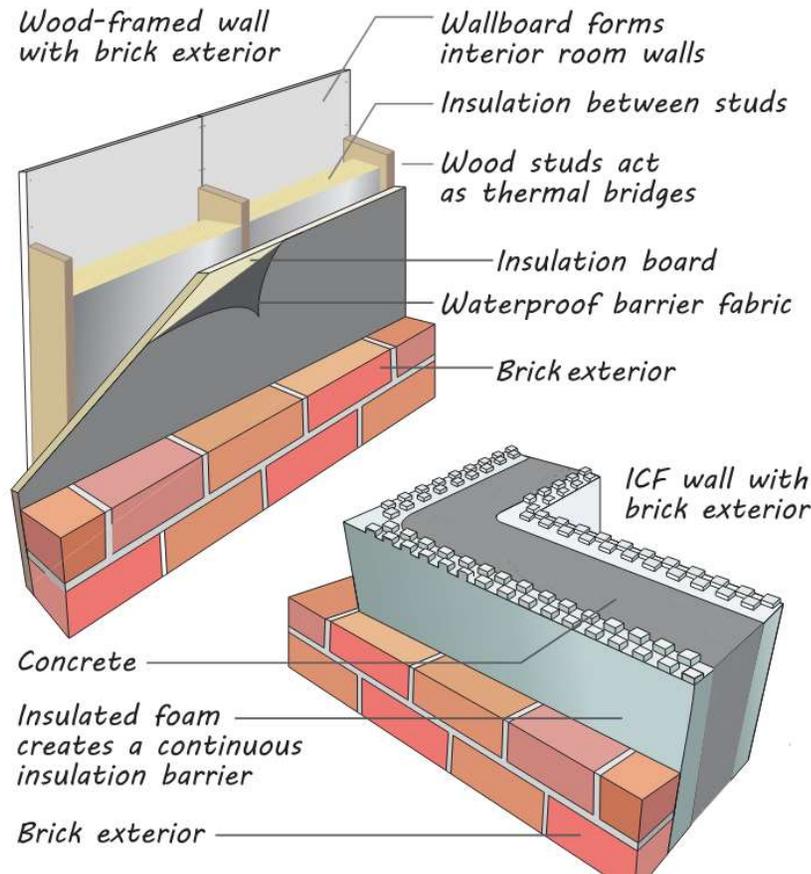
This shows the total amount of energy used to operate Graceland Park-O'Donnell Heights this month. This means all energy required to heat, cool, and light the building, store and prepare food, operate technology, and power everything plugged into outlets.



Bilingual NZE Stories

Flyers highlighting NZE strategies:

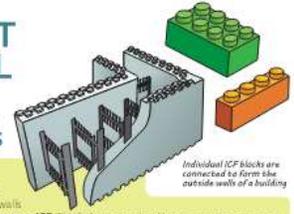
- Insulated Concrete Form (ICF) walls
- Geothermal
- Water
- Solar
- Waste
- Materials



THE PATH TO YOUR NET ZERO ENERGY SCHOOL

A net zero energy building uses little energy and produces all the energy it needs each year from renewable sources on its site, like rooftop solar panels.

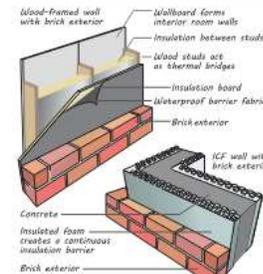
Insulated Concrete Form Walls



Imagine the walls of your school were made with giant Styrofoam®/Lego® blocks. Now imagine those foam blocks were hollow inside, stacked high, and filled with concrete. If you can imagine all that, then you understand how the walls of the Groeland and Holabird schools were built using **insulated concrete forms** or **ICF**. This helps your school become net zero energy.



Why did **architects** design your school with giant concrete-filled foam blocks? The first word in ICF is **insulated**. When something insulates, it protects. Together, the walls, roof, foundation, doors, and windows of a structure make up the **building envelope**. Just like a winter coat keeps your body heat inside and protects you from cold outside, the building envelope protects the interior spaces from temperature changes and weather outside. Remember that heat likes to move from warmer to cooler spaces or objects until they reach **thermal equilibrium** – the same temperature. ICF walls make a strong building envelope that prevents heat from leaving the building in the winter and entering it in the summer. This means the heating and cooling system doesn't have to work as hard to deliver warm or cold air into your classroom to keep you comfortable. The ICF walls help make your school more **energy efficient** so it uses less electricity and fossil fuels, saves money, and protects our environment and health!



Most buildings are constructed with wood or steel beams called **studs** that are screwed together to make a frame. Stud wall construction has layers of insulation and waterproofing materials to prevent heat from escaping or entering the building. ICF walls are different. Think of an ICF wall as a peanut butter sandwich with standing upright. The two slices of bread are the foam blocks and the peanut butter is the concrete inside. The blocks and concrete fit together to become one solid, dense wall with no layers or spaces for hot or cold air to pass through. This helps insulate the building.

In a framed building, the insulation between the studs keeps heat inside during winter and outside during summer. But heat is still lost when it travels through the metal or wood studs themselves because these materials conduct heat better than the insulation material. This is called **thermal bridging**, which is the movement of heat through a material that is more conductive than what's around it. In an ICF building, there is no thermal bridging because there is a continuous layer of insulation on both sides of the concrete. Just like you would have a hard time crossing a big river without a bridge, heat has a hard time passing through a wall without a thermal bridge. This helps keep the air inside your classroom comfortable and constant with less help from the heating and cooling system which reduces energy use. ICF walls are also very strong and help protect the building and people inside from outside noise and strong storms like hurricanes and tornadoes.



Metric:

Along with other energy efficiency measures, the ICF walls help your net zero energy school use 95% less energy for heating and 89% less energy for cooling than a typical school.



Reduce & Conserve Natural Resources

Action & Resources:

Resources: This energy savings supports the Baltimore City Public Schools Sustainability Plan goal: Reduce & Conserve Natural Resources.

Actions: You can save energy at home by keeping doors and windows closed while the heat or air conditioning is on. Help the adults you live with stop heat from escaping from your home by caulking windows or adding weather stripping around doors and other drafty areas in the spring and fall, when the outdoor air is comfortable, you can turn off the heating and cooling system and open the doors and windows for fresh air.



Keywords:

Insulated concrete forms, architects, insulate, building envelope, thermal equilibrium, energy efficient, stud, thermal bridge.



ICF Samples



GREEN DAY OF SERVICE
Calling all Students, Teachers, and Parents!

JOIN US!
Saturday
October 15, 2016
9:00 am - 2:00 pm

Graceland Park's Chalk Art Festival We need you to join us for a fun day of chalk art and painting a sundial on the sidewalk at the front of the school.

Also, learn more about the environmentally-friendly and Net Zero Energy design of your new school that will start construction in Spring 2017.

Wear clothes that can get dirty, bring your creative juices and let's make the sundial beautiful!

Graceland Park - O'Donnell Heights
6300 O'Donnell St.
Baltimore, MD 21224

Made by G-P
THE GREEN BUILDING PARTNERSHIP