



**NRG Continuously Insulated CMU**



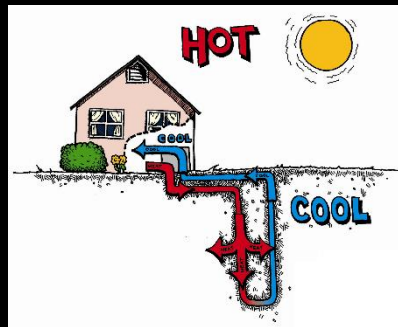
**Zero Energy Ready  
Building**



**renewable  
system**



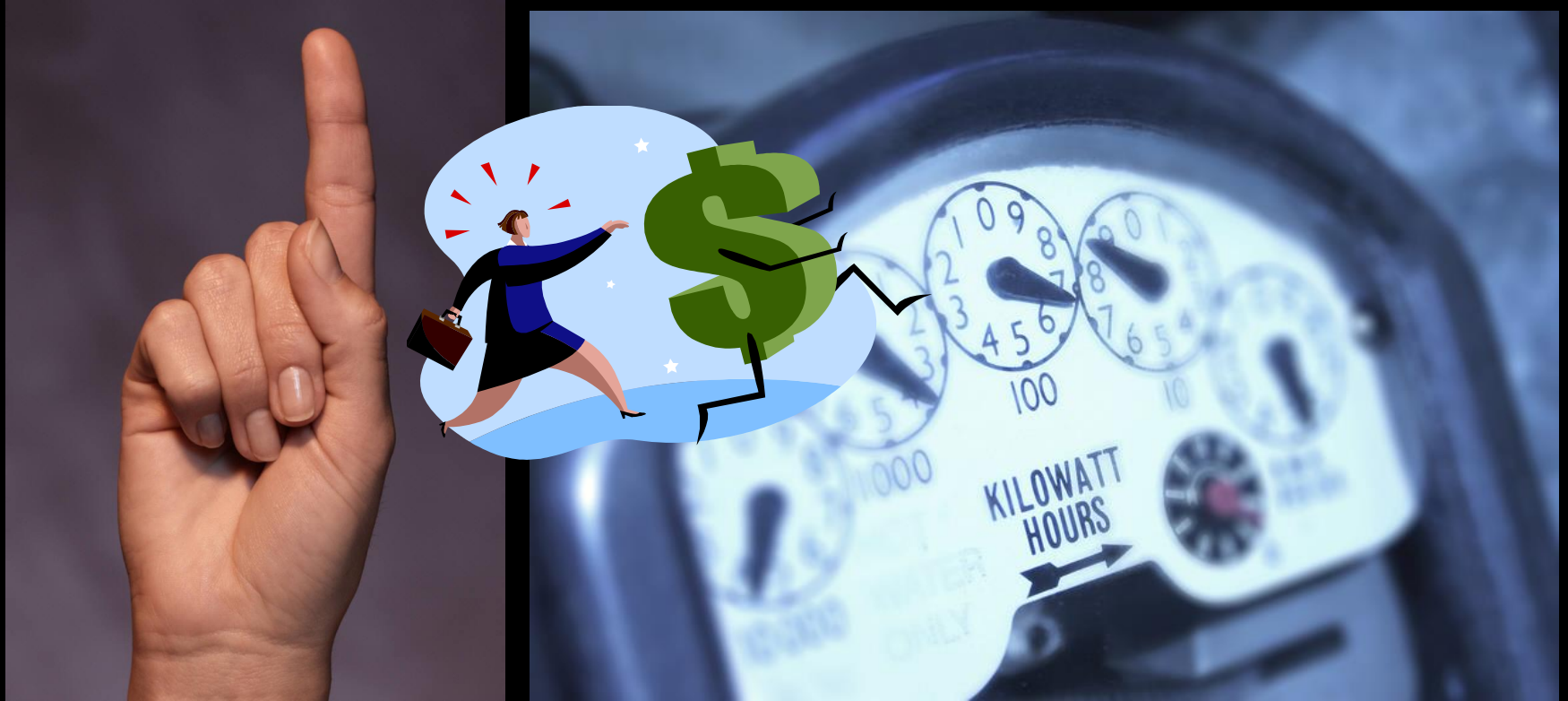
**ZERO Additional  
Energy Required**



**Today, it is possible to design and construct affordable buildings that use so little energy, that a small renewable system can meet their energy needs. The US Department of Energy (US DOE) has a term to describe these high performance buildings: Zero Energy Ready (ZER).**



**Not only do high performance buildings make business sense and are good for the environment, but your customers demand them.**



**Building energy efficiency is the number one driver for corporate sustainability decisions, according to ninety-three percent of nearly three hundred corporate sustainability professionals surveyed.**

# **#1: ENERGY CONSERVATION**

**“The single most important aspect of green should be energy.”**

**“In my experience every dollar spent on conservation technologies saves two or more dollars on sexy equipment such as geothermal. In fact, I’ve come to the conclusion that we can get far enough with conservation that the PV rarely makes sense<sup>2</sup>—except as a social statement.”**

**Joseph Lstiburek, PhD., Building Science Expert  
Building Science Corporation**

**<https://buildingscience.com/documents/insights/bsi-018-westford-house>**

# Executive Order 88



In fact, many state and local governments require increased energy efficiency. In New York State, Executive Order 88 signed by Governor Cuomo requires that the most energy efficient and cost effective materials shall be used in NY State funded projects.

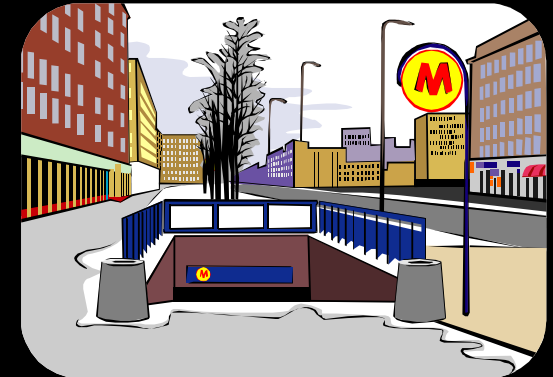
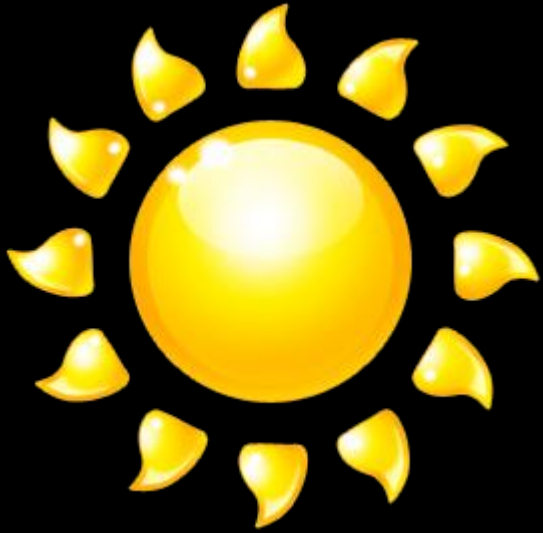


**One  
← panel  
costs  
less  
than  
many →  
panels.**



**Zero Energy Ready buildings follow the first rule of energy efficient design: reduce the building energy load through passive means.**

**Better passive design produces buildings that require smaller renewable systems to reach zero.**



**In addition to siting and shape considerations, sustainable passive design requires the intelligent use of sustainable building materials.**



## **Materials: Wood Frame or Masonry ?**



**Wood Frame: Low mass  
Short thermal lag time**



**Masonry : High mass  
High heat capacity  
Abundant thermal storage  
Long thermal lag time**

**Masonry: good.**



**Discard Incandescent**

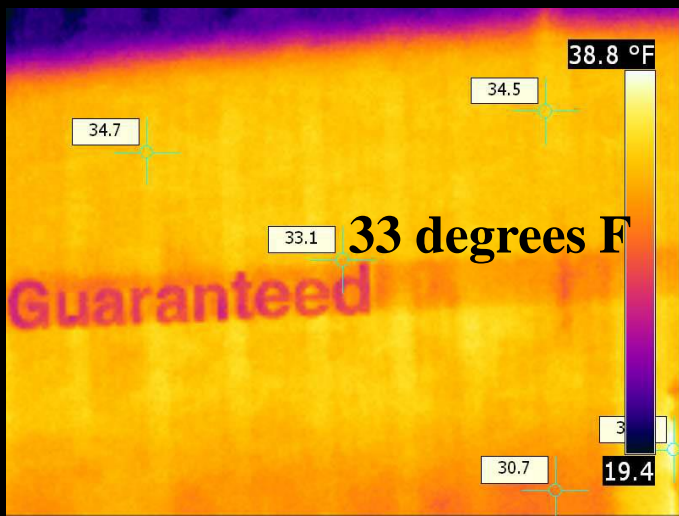
**30 mpg**

**CICMU's: better**

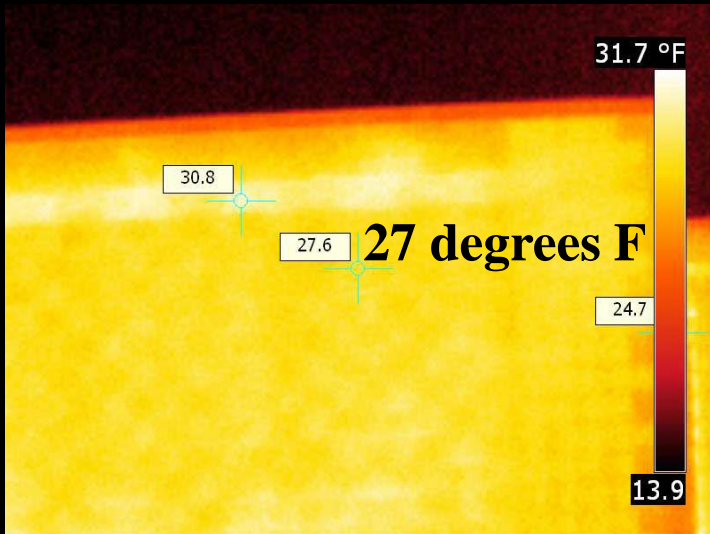


**Install LED**

**60 mpg**



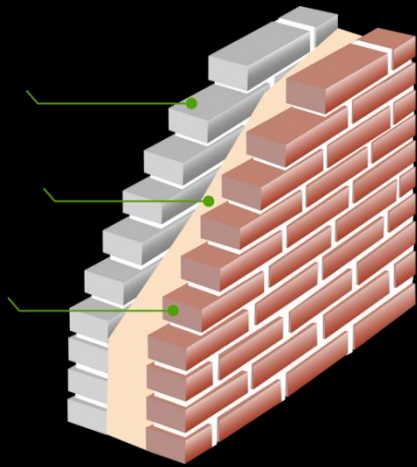
Standard block wall Walmart Store, Chicago, East Wall , 15 degrees F, 1/12/2009 1:40 pm



CICMU wall Marquardt School, Chicago, West Wall 15 degrees F, 1/12/2009 3:15 pm

**Thermal bridging shows in standard block wall (top). Also, warmer exterior wall (top) in cold temp means more heat escaping from standard block wall.**

## Insulated Thermal Mass Walls



**Cavity wall**



**Concrete sandwich panel**



**Continuously insulated concrete masonry unit**

**Insulated thermal mass walls are exceptionally energy efficient, durable, secure, fire safe, quiet, comfortable, and low maintenance.**



## **INNOVATIVE TECHNOLOGY**

### **Continuously Insulated Concrete Masonry Units (CICMU's)**

**The Advanced Energy Design Guides recommend a cost effective and energy efficient mass wall strategy that holds true for all climate zones and all building types.**

**Quote from the AEDG's:**

**“The greatest advantages of mass can be obtained when insulation is placed on its exterior.”**



**When continuous insulation is placed exterior to thermal mass (called “insulated thermal mass”), the insulation creates a “building within a building”, where interior walls absorb and store large amounts of energy.**

**The insulation holds the energy within the building and limits exterior influence.**

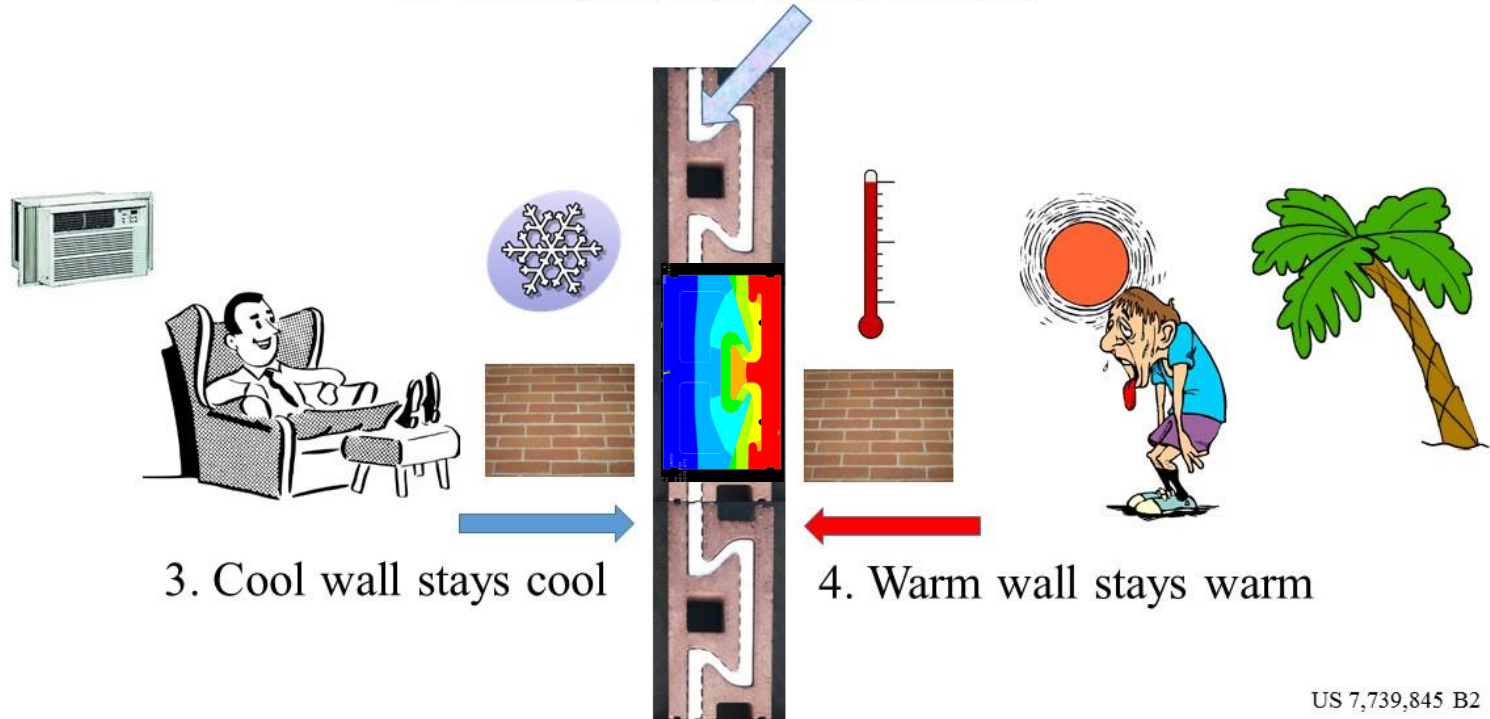
## **Thermal Lag Time**

**Time required for a material to reach a new constant rate of heat gain or loss.**

- **Continuously Insulated CMU's have a long thermal lag time.**
- **Building interiors stay warm or cool longer, without adding energy.**
- **Relative thermal lag times:**

<b>CICMU Wall</b>	<b>50 Hours</b>
<b>Standard Block Wall</b>	<b>12 Hours</b>
<b>Conventional Insulated Stud Wall</b>	<b>2 Hours</b>

1. Concrete Absorbs and Stores Energy
2. Insulation slows heat transfer



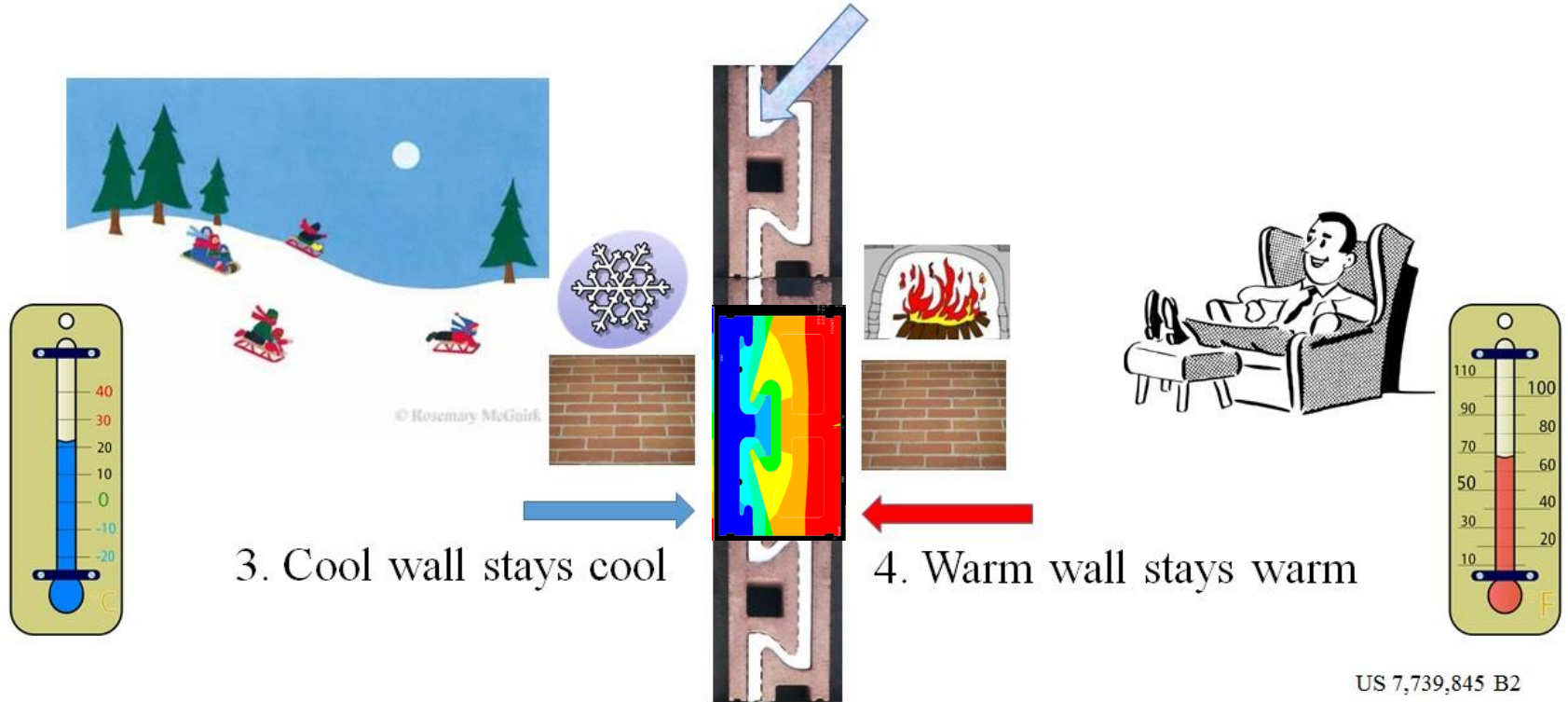
US 7,739,845 B2

**In the summer, the interior insulated thermal mass absorbs heat from the interior spaces, and moderates indoor air temperature swings.**

**At night, windows can be opened to allow heat to escape. The building can be precooled during time of off-peak utility rates, saving both money and energy.**

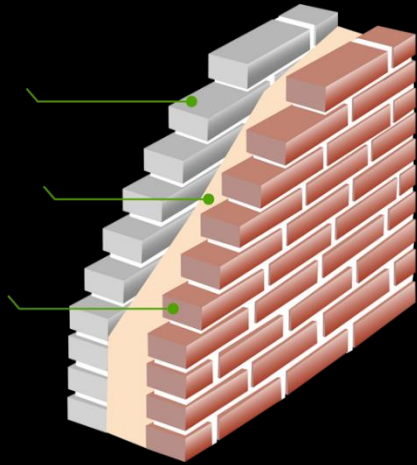


1. Concrete Absorbs and Stores Energy
2. Insulation slows heat transfer



**Year round, insulated thermal mass increases thermal comfort by sustaining the indoor temperature, particularly during mild seasons (spring and fall), during large air temperature changes (high solar gain), and in areas with large day-night temperature swings.**

# Insulated Thermal Mass Walls



**Cavity wall**

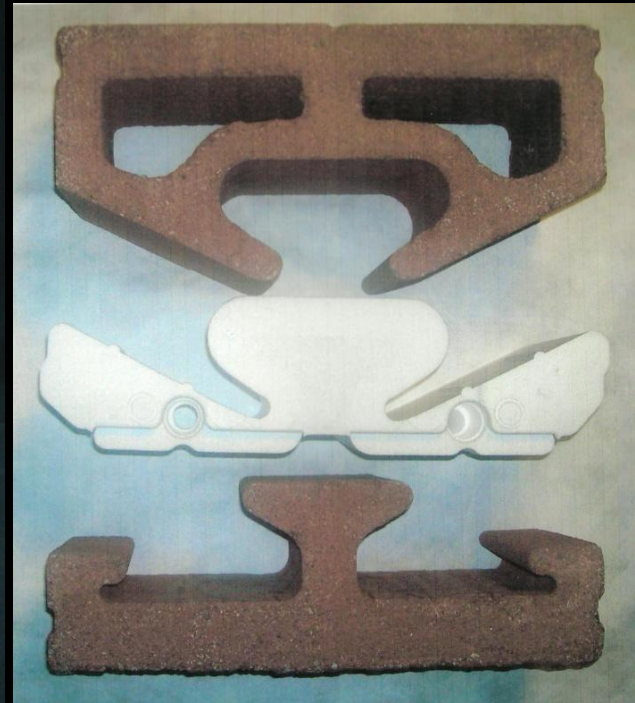


**Concrete sandwich panel**



**Continuously insulated concrete masonry unit**

**Continuously insulated cmu's are less expensive per square foot of installed wall than cavity walls with insulation and concrete sandwich panels.**



**Continuously Insulated Concrete Masonry Units (CICMU):**  
continuous insulation exterior to thermal mass, aka “insulated thermal mass”.

**A CICMU delivers architectural finish exterior, effective R-value of R-22, and an impact resistant masonry interior finish.**

## CICMU COST



**A Fall 2016 quote from a large masonry contractor experienced in CICMU installation quoted a DC area 150k sq. ft. arena CICMU project at **\$22 per sq. ft. of installed 12” CICMU wall.****

**CICMU prices and costs for CICMU installation vary by region.**

# Types of Insulated Concrete Masonry Units



**Core  
stuffed**



**Partially  
webbed**



**Continuously  
insulated**

**There is a substantial performance difference between insulated cmu's and continuously insulated cmu's, due to the amount of thermal bridging in core stuffed and reduced webbed cmu's.**

# Non-Continuously Insulated Concrete Masonry Units



**Core stuffed**



**Partially webbed**



**In the core stuffed and partially webbed insulated cmu's, there is significant thermal bridging, so there is no continuous insulation.**



**According to the US office of Energy Efficiency and Renewable Energy website:**

**“Note that even though filling the block cavities and special block designs improve a block wall's thermal characteristics, it doesn't reduce heat movement very much when compared to insulation installed over the surface of the blocks either on the exterior or interior of the foundation walls.**

**Field studies and computer simulations have shown that core-filling of any type offers little fuel savings since the majority of heat is conducted through the solid parts of the walls such as block webs and mortar joints.”**



**Some Insulated CMU's claim a higher steady state R-value than Continuously Insulated CMU's. In one case, a reduced webbed block claims a steady state R-value of R-27, since they jam insulation around the webs. Yet, the partially webbed ICMU is not as energy efficient as the CICMU, since the CICMU has no thermal bridges.**

**The CICMU has a higher effective R-value, which is a measure of real world performance. More on that in a bit.**

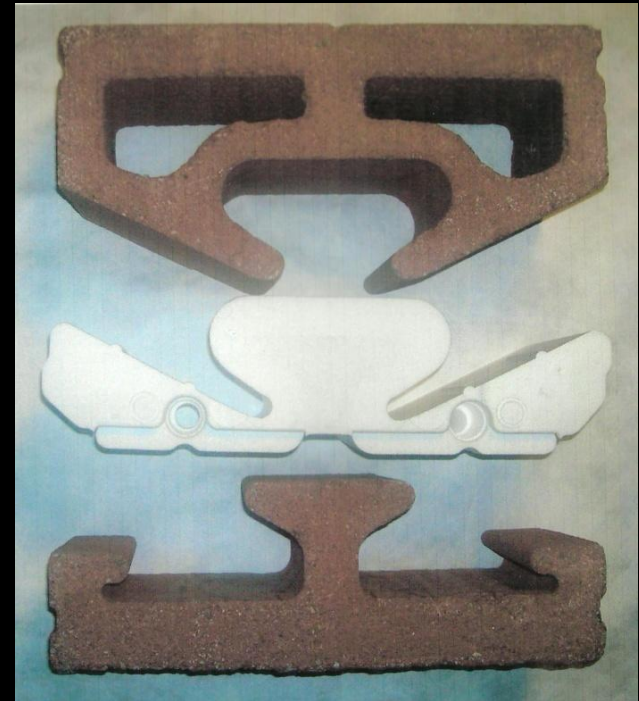




**At left, you can raise steady state R-value by stuffing voids with EPS, and not save much energy or money, since the energy travels through the webs.**

**At right, the CICMU delivers true continuous insulation.**

## Continuously Insulated Concrete Masonry Units



**Continuously Insulated Concrete Masonry Units CICMU's have zero thermal bridges.**



**DOE definition of Continuous Insulation (CI):**

**“Insulation that runs continuously over structural members and is free of significant thermal bridging; such as rigid foam insulation above the ceiling deck. It is installed on the interior, exterior, or is integral to any opaque surface of the building envelope.”**

**<https://www.energycodes.gov/glossary/continuous-insulation-ci>**



**As shown, CICMU walls incorporate standard blocks and half blocks in some parts of the wall.**

**This small amount of thermal bridging in CICMU walls does not significantly affect thermal performance, so CICMU walls meet the DOE definition of Continuous Insulation.**



**Options for continuous insulation at openings and corners.**





Since continuous insulation with zero thermal bridging in CICMU's delivers substantially better thermal performance than core stuffed or partially webbed insulated cmu's, **CICMU's and ICMU's should never be considered "as equal" in specs.**

**Designers can avoid contractor substitution by specifying continuously insulated cmu's.**



**What is the difference between effective R-value and steady state R-value?**

**This 12” CICMU has a steady state R-value of about R-13.9 with an effective R-value of about R-22, depending on the climate zone.**

## Steady State R-Value



Steady state R-values give a snapshot in time of a wall's performance under laboratory conditions. R-value is a measure of resistance to heat flow through a medium.

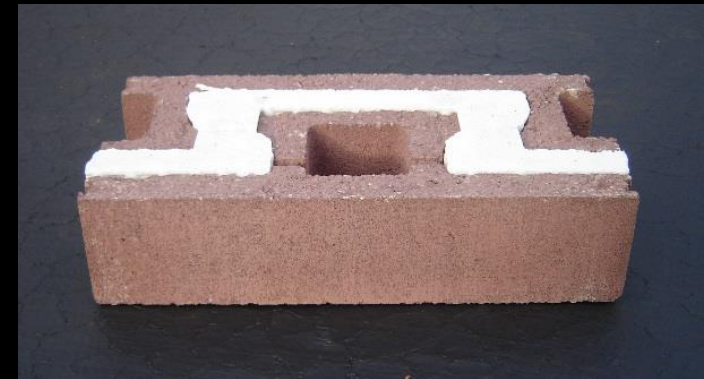
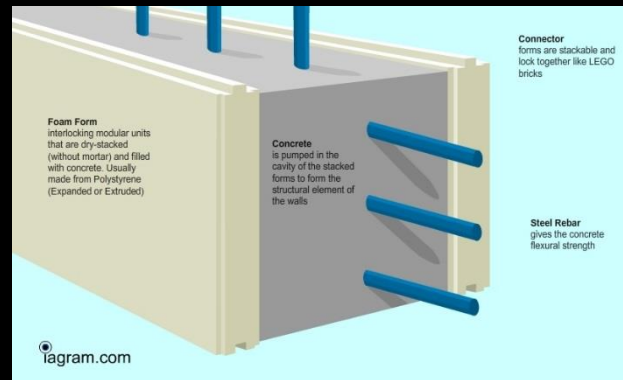
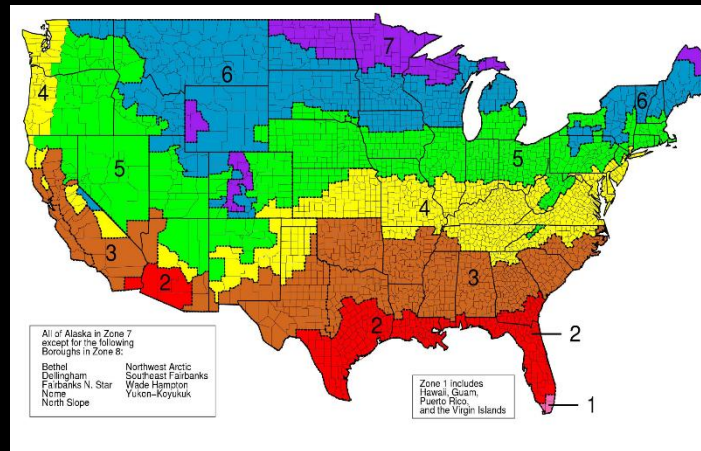
Since concrete has excellent thermal storage properties, steady state R-value does not always accurately reflect real world thermal performance over time and across climate zones.



**DBMS  
Dynamic  
Benefits  
for  
Massive  
Systems**



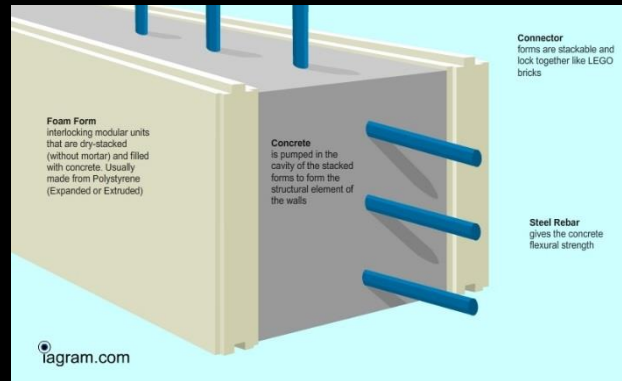
**Dynamic Benefits for Massive Systems, also known as effective R-value, measures thermal performance over four seasons in different climate zones. Since mass walls have large thermal storage capacity, they will perform differently (generally much better than) than their steady state R-value.**



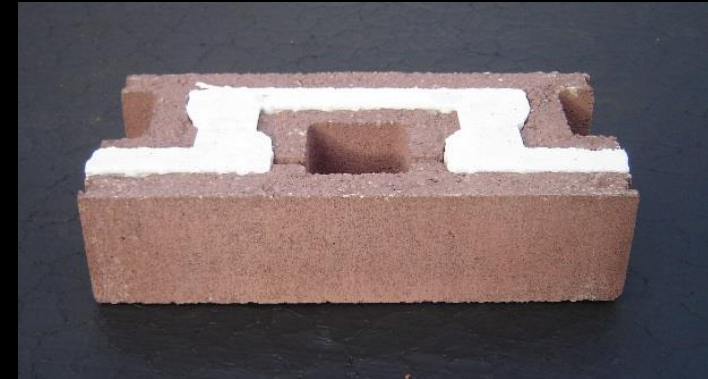
**Oak Ridge National Laboratory (ORNL) research confirms that insulation placement within the wall affects its thermal performance.**



**Interior  
insulation**



**Concrete between  
insulation layers**



**Insulation between  
concrete layers**

**Walls with the same steady state R-values have different effective R-value based on insulation placement within the wall, and climate zone.**



**An R-12 steady state R-value interior insulated wall delivers an R-17 effective R-value in a Denver climate zone (see red line on the following graph). The insulation blocks the effects of the thermal mass.**

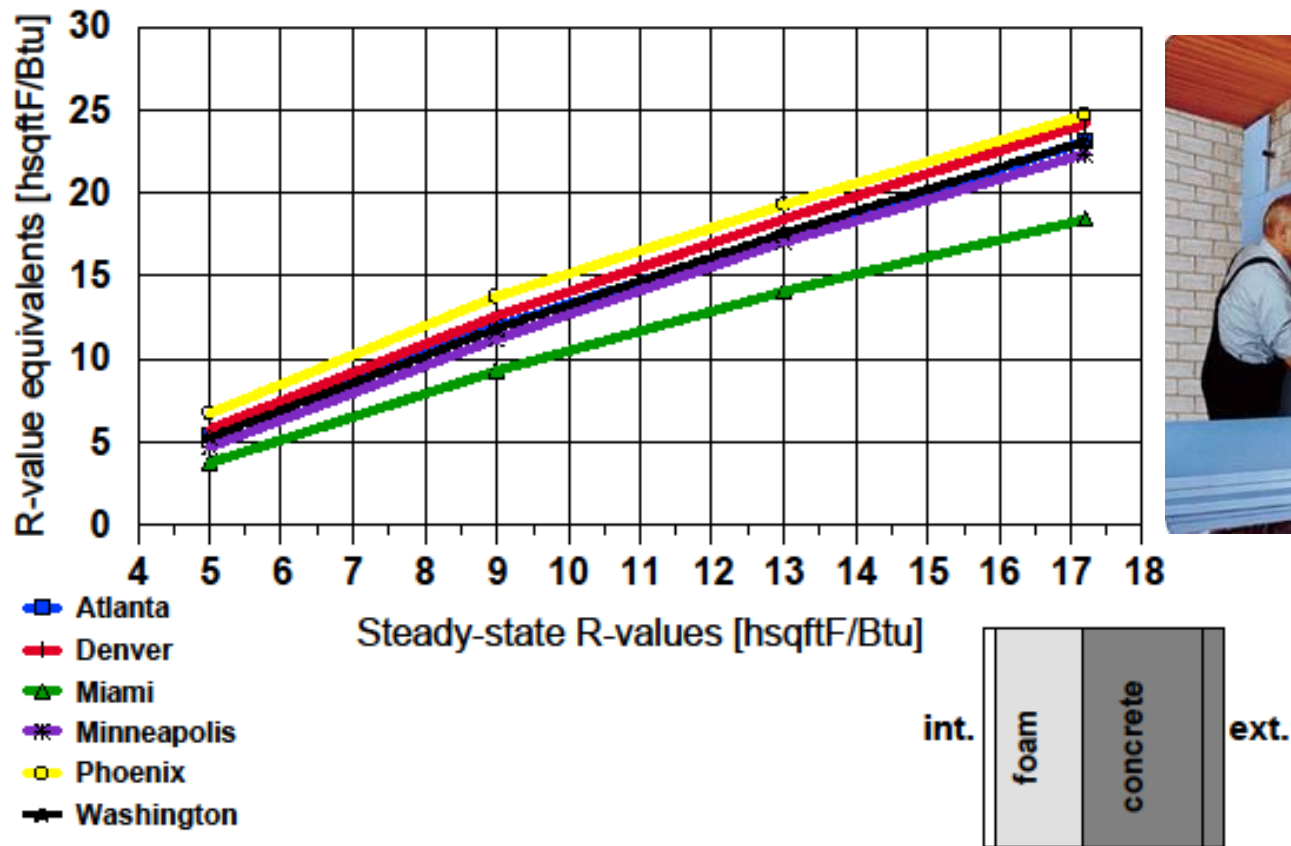
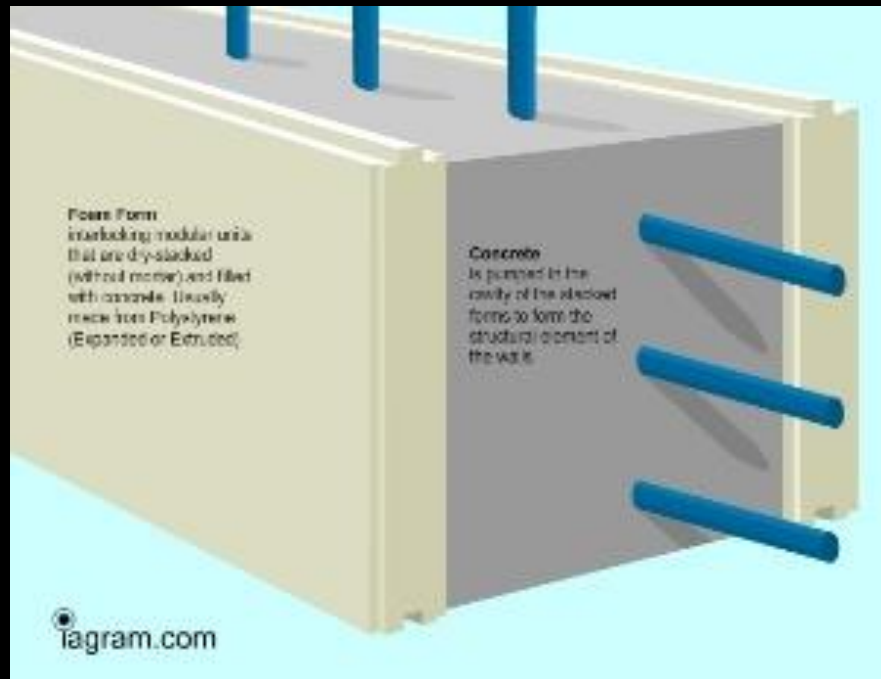


Figure 9. Dynamic R-value equivalents for massive walls with insulation located on the interior side and thermal mass on the exterior side.



**Steady state R-12 (ICF) interior and exterior insulation mass wall delivers an effective R-value of R-18 in a Denver climate zone (see red line on the following graph).**

**The insulation blocks the effects of the thermal mass.**

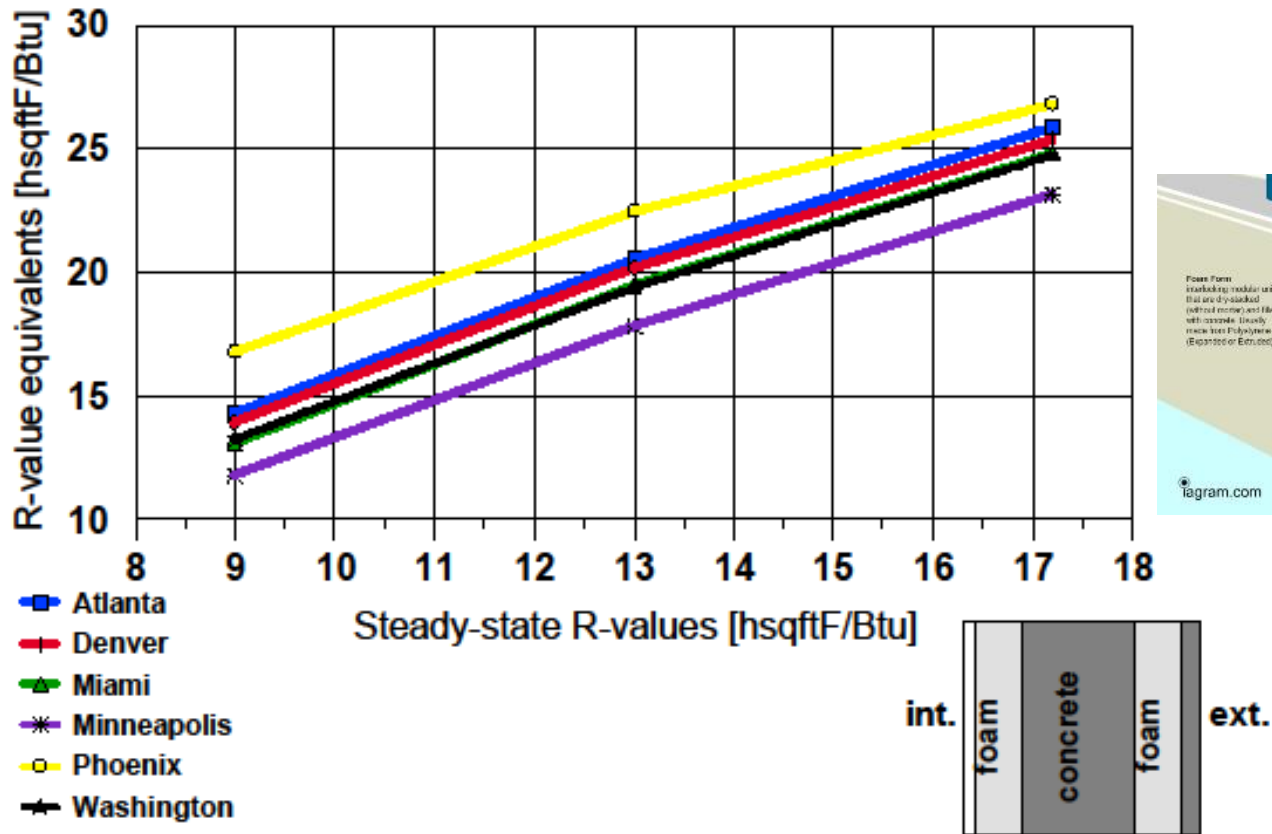
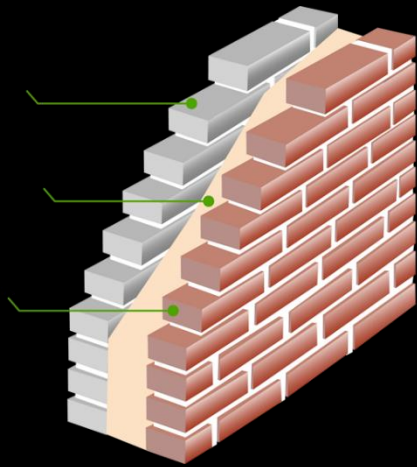


Figure 7. Dynamic R-value equivalents for massive walls with massive core and insulation located on both sides.

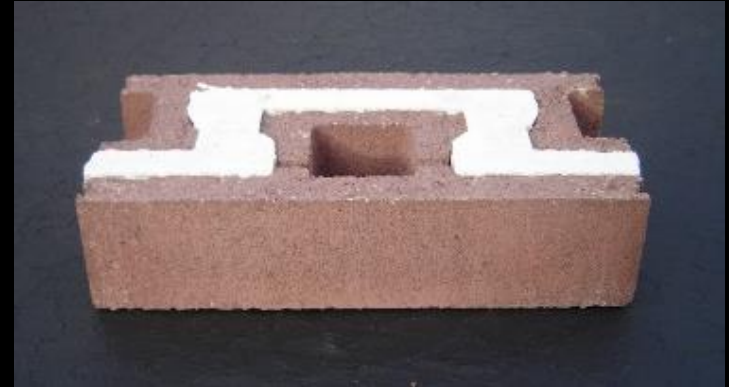
## Insulated Thermal Mass Walls



**Cavity wall**



**Concrete sandwich panel**



**Continuously insulated concrete masonry unit**

**A steady state R-12 R-value wall with insulation between interior and exterior thermal mass delivers an effective R-value of R-22 in a Denver climate zone (see red line on the following graph).**

**The thermal mass makes direct contact with building interior, so it improves thermal performance.**



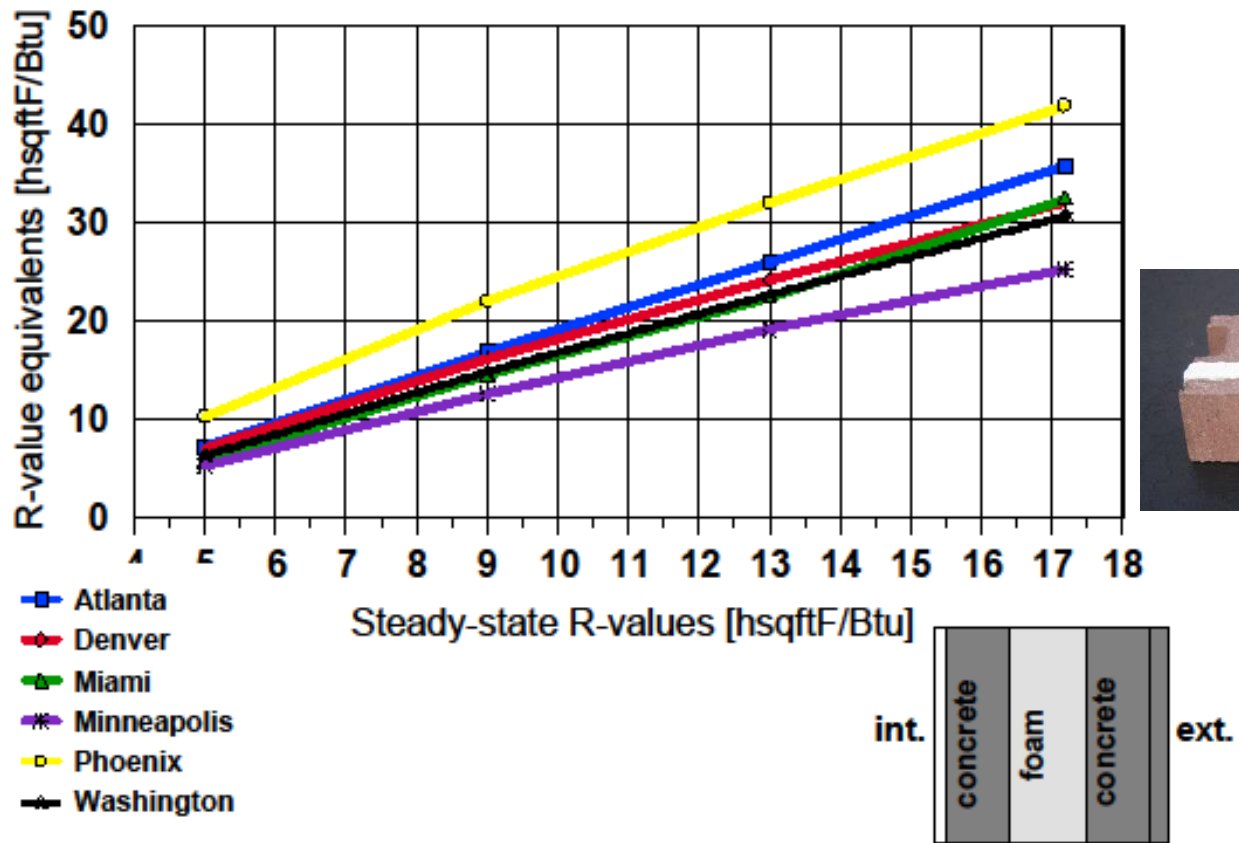
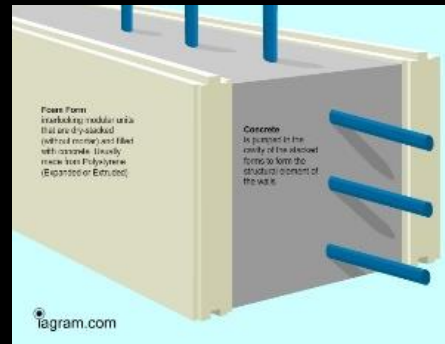


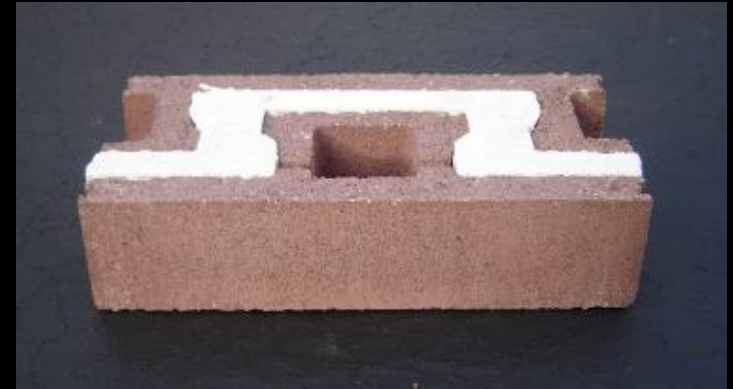
Figure 6. Dynamic R-value equivalents for massive walls with foam core and concrete layers located on both sides.



**Conventional  
mass  
wall  
Good  
R-12 = R-17**



**Concrete  
between  
insulation  
wall (ICF)  
Better  
R-12 = R-18**



**Insulation  
between  
thermal mass  
wall  
BEST  
R-12 = R-22**

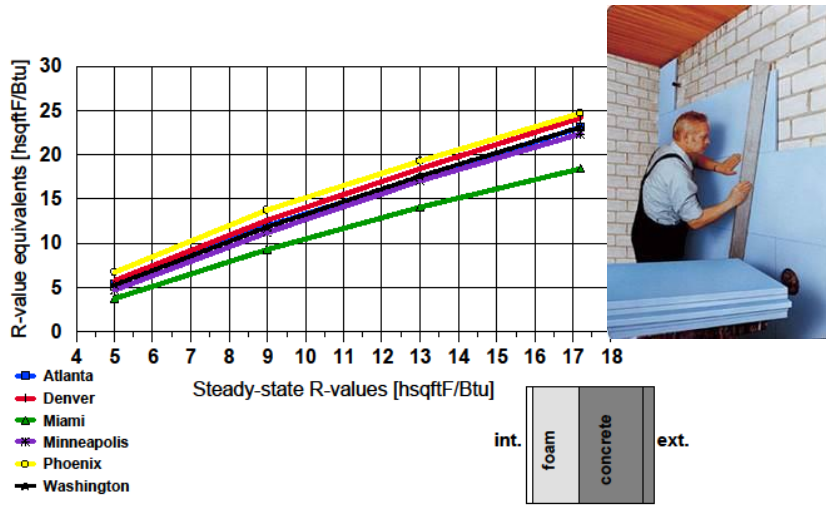


Figure 9. Dynamic R-value equivalents for massive walls with insulation located on the interior side and thermal mass on the exterior side.

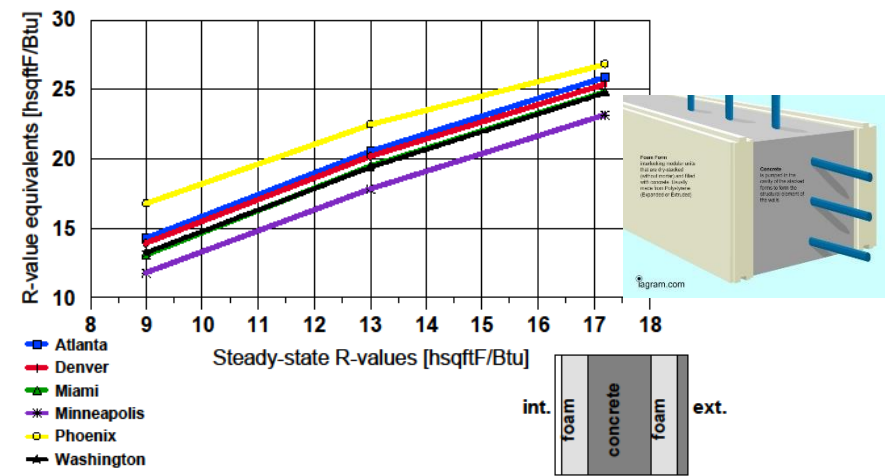


Figure 7. Dynamic R-value equivalents for massive walls with massive core and insulation located on both sides.

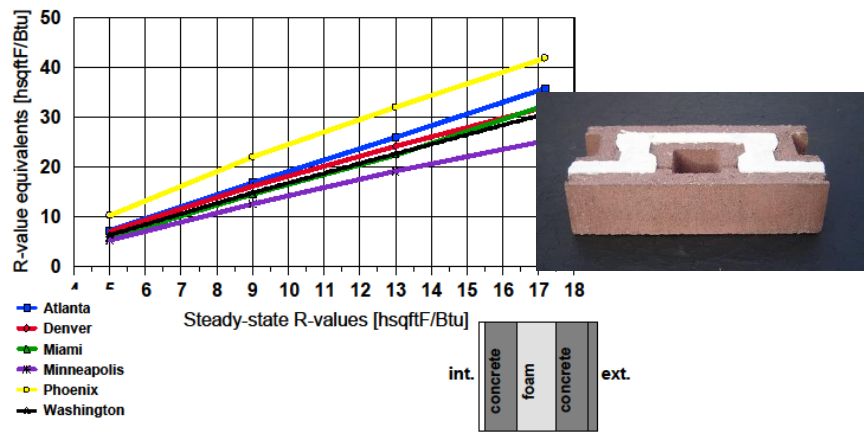


Figure 6. Dynamic R-value equivalents for massive walls with foam core and concrete layers located on both sides.

# Climate Zone 5

## Steady State:

Conventional R-12:  
ICF R-12:  
CICMU R-12:

## DBMS:

R-17  
R-18  
R-22

**Climate Zone 5**  
**Steady State R -Value:**

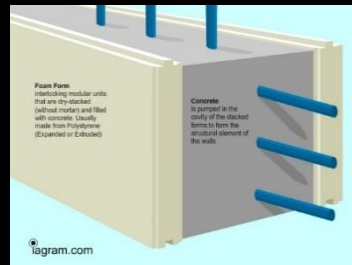
**Effective R-value**  
**DBMS:**

**Conventional R-12:**



**R-17**

**ICF R-12:**



**R-18**

**CICMU R-12:**



**R-22**



**Sustainable material: Continuously Insulated Concrete Masonry Unit:  
How is a CICMU sustainable?**

**It is storm resistant, durable, fire-safe, secure, and has low embodied energy.**

**Compared to clay-fired bricks, medium density concrete block contains about twenty five percent of the embodied energy of common brick, and only about one third the carbon. ('Cradle-to-Gate' comparison of embodied energy , from manufacture until the product leaves the factory gate.)**



**Concrete is completely recyclable, and can be made from recycled materials, including fly ash, which is a by product of coal burning.**



**Concrete is usually produced within a short distance from where it will be used, so transportation and associated fuel costs are minimized. Many times, block is shipped less than a hundred miles.**



**The EPS (expanded polystyrene) insulation in an CICMU is sustainable.**

**EPS is an inert material, (98%) air, with no chemicals off-gassed or leached during use or disposal.**

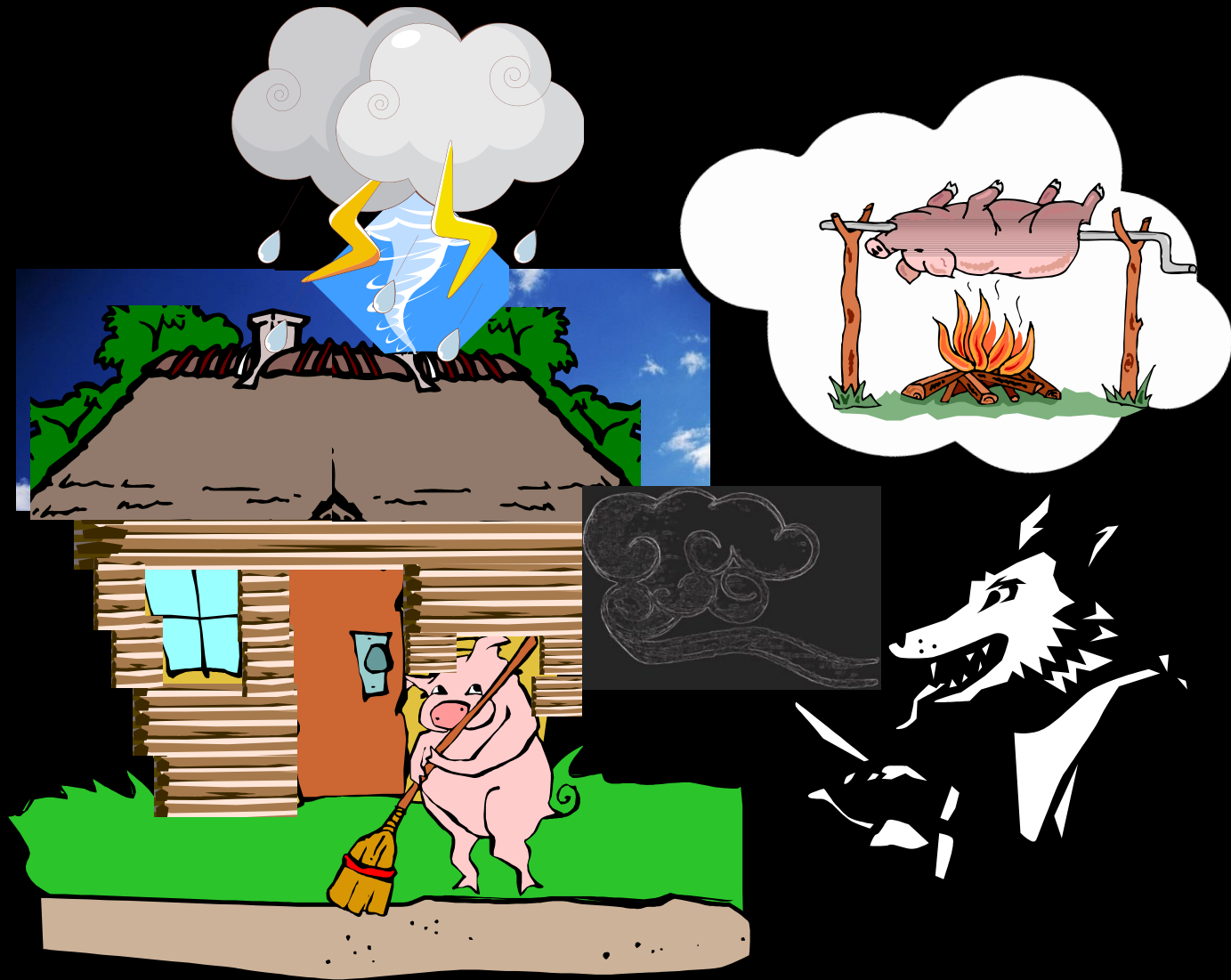
**EPS is unaffected by conventional types of mortar, plaster and concrete, has stable thermal resistance over time, and is recyclable.**

**EPS is a semi-permeable vapor retarder, and allows drying from the middle of the wall, outward in both directions.**





**Affordability does not always incorporate sustainability.  
The first little pig's affordable house was not a sustainable house.**



The second little pig learned a lesson, but still built with materials not suitable to withstand environmental hazards. **Today, far too many people rebuild with wood frame construction after fires, tornadoes, and hurricanes.**



**The third little pig used sustainable materials and a small renewable system. He lived happily ever after in a CICMU Zero Energy Ready Home.**



**What is the best measure of a wall's thermal performance?**

**The ultimate measure of energy efficiency is delivered each month as a utility bill.**

**Real world performance: Energy intensity, measured in Btu's per sq. ft.**

**Let's take a look at a couple CICMU buildings, one in climate zone 6, and one in climate zone 5.**



**Don Reed's 6800 square foot grocery store, in Genesee, PA. A few miles south of the NY state line. Erected 1994, using 10" CICMU's. Climate zone 6.**



**Multicolored blocks offer many aesthetic options.**

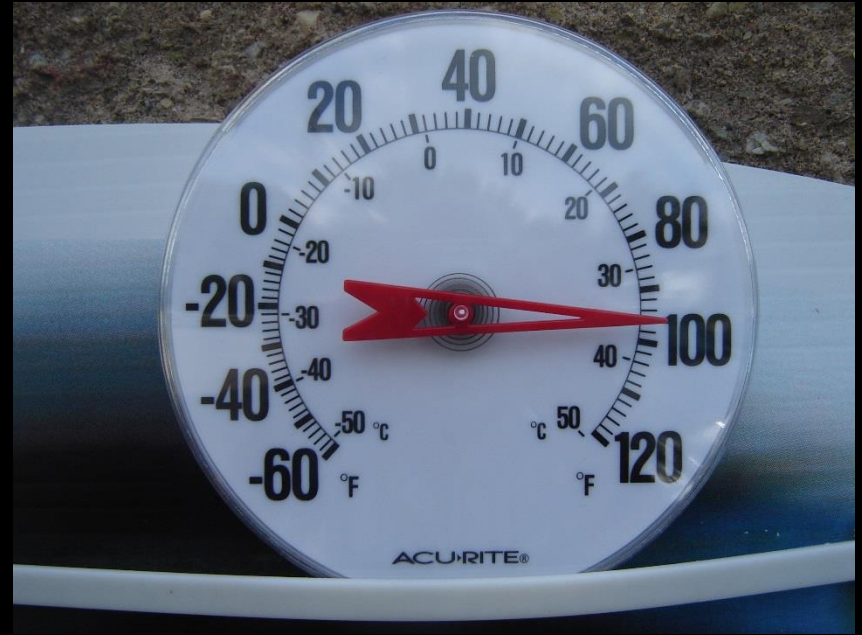


**Don Reed's store offers a place for the community to gather and chat and eat. You can buy everything from fishing lures and hunting supplies to a full range of groceries, fresh meats, and a deli that makes hot and fresh pizza and subs.**



**Air conditioner supports were installed for a roof mounted unit, but the AC unit was never installed or needed. The owner decided to wait and see how the block performed.**





**The block performed pretty well. Here is picture taken on August 11, 2010, a very hot and humid day, where the outside temp was 96 degrees.**

**In the middle of the inside of the store, less than twenty feet from the main door that had been opening and closing all day, guess what the temperature is at 3pm.**



76 degrees, a difference of 20 degrees.



**HVAC energy cost is 33 cents /sq ft annually. 2009 prices, about 70 cents less than the Department of Energy's Commercial Building Energy Consumption Survey (CBECS) would estimate.**



**Entire building heating cost less than \$200/ month, savings of \$400 per month compared to CBEC survey estimates.**



**Single wall mounted unit heats the market .**



**Reduced capacity HVAC systems provide substantial material savings.**



**Standard block used to wrap steel safety columns look identical to CICMU's.**



**Continuously Insulated CMU's provide quiet building interiors, even in high traffic locations. The 10" CICMU has a sound transmission class rating of 53, on par with acoustic block.**





**Don Reed's HVAC energy savings 1994-2016:**

**\$400 / month x 12 months x 22 years= 105,600 dollars.**

**No air conditioner needed, saved another \$10k.**

**The installed cost of the 5500 sq ft of insulated block wall in 1994 was \$82,000, just a shade under \$15/ sq ft. The wall was completely paid for, labor and materials, in fifteen years through energy savings.**

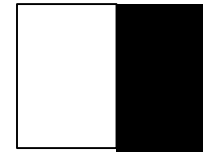
**Total savings to date of \$115,600, plus insulated block produced a secure, quiet, fire-safe, low-maintenance building.**

Compare Don Reed's actual store to eQuest energy model projections for Don Reed's store, built to LEED 3.0 standards.

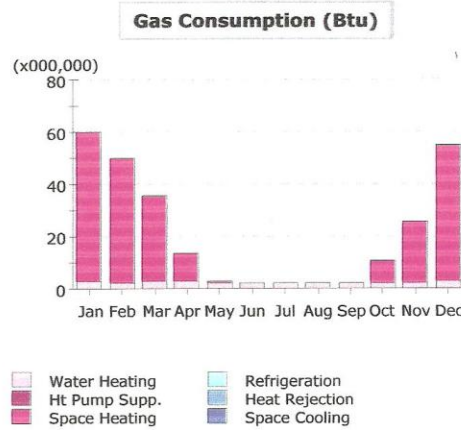
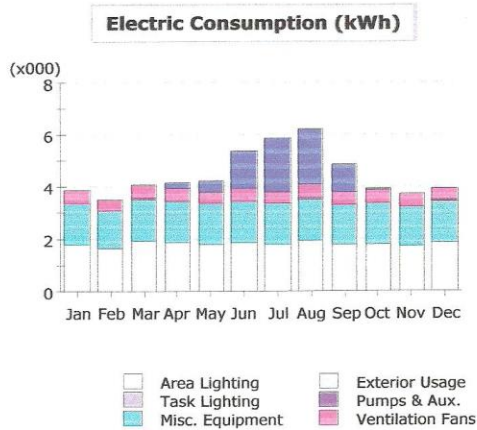
Energy model walls are R-54: 10" block exterior, 10" EPS (2.5 density at R-5 per inch) interior.

R-54 wall

10" insulation interior



10" block exterior



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.02	0.19	0.42	1.44	2.02	2.20	1.08	0.10	0.03	-	7.49
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	0.47	0.43	0.50	0.49	0.47	0.49	0.47	0.50	0.47	0.47	0.45	0.49	5.67
Pumps & Aux.	0.04	0.03	0.03	0.02	0.01	0.01	0.00	0.00	0.01	0.03	0.03	0.04	0.26
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	1.55	1.42	1.62	1.56	1.55	1.56	1.55	1.62	1.53	1.55	1.50	1.58	18.59
Task Lights	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.13
Area Lights	1.78	1.63	1.91	1.84	1.78	1.84	1.78	1.91	1.77	1.78	1.71	1.84	21.53
<b>Total</b>	<b>3.84</b>	<b>3.52</b>	<b>4.09</b>	<b>4.11</b>	<b>4.24</b>	<b>5.34</b>	<b>5.83</b>	<b>6.24</b>	<b>4.87</b>	<b>3.94</b>	<b>3.72</b>	<b>3.96</b>	<b>53.68</b>

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	57.70	47.84	32.59	10.65	0.68	-	-	-	0.21	8.77	23.47	52.58	234.49
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	2.58	2.45	2.86	2.70	2.43	2.34	2.12	2.18	2.03	2.12	2.18	2.52	28.50
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	<b>60.28</b>	<b>50.29</b>	<b>35.45</b>	<b>13.35</b>	<b>3.11</b>	<b>2.34</b>	<b>2.12</b>	<b>2.18</b>	<b>2.23</b>	<b>10.89</b>	<b>25.65</b>	<b>55.11</b>	<b>262.99</b>

Don Reed' store has a drop ceiling with a 30" air gap, metal roof, two inches of rigid, foam, rubber, and gravel on top. Projected energy: Heating: 234.49 million Btu's = 228103.11 cu ft of gas divided by 6800= 33.5 cu/sq ft. Cooling: 7490 kilowatt hours = 25556.9 cubic feet of natural gas = 3.75 cu ft/sq ft

**R-54-walled energy model projected heating and cooling cost:**

**53 cents per sq ft.**

**Reed's actual heating/cooling cost:**

**33 cents sq ft (28 cu ft/sq ft)**



**Don Reed's General Store**

**10" ICMU actual gas utility heating bill**

**=**

**Climate Zone 6**

**33 cents per sq ft**

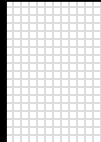
**eQuest energy model built to LEED 3.0  
with R-54 walls**

**=**

**53 cents per sq ft**

**R-54 wall**

**10"  
insulation  
interior**



**10"  
block  
exterior**



**Table C27. Natural Gas Consumption and Conditional Energy Intensity by Census Division for Non-Mall Buildings, 2003: Part 1**

	Total Natural Gas Consumption (billion cubic feet)			Total Floorspace of Buildings Using Natural Gas (million square feet)			Natural Gas Energy Intensity (cubic feet/square foot)		
	New England	Middle Atlantic	East North Central	New England	Middle Atlantic	East North Central	New England	Middle Atlantic	East North Central
All Buildings*	73	343	512	1,465	7,716	9,570	49.5	44.4	53.5
<b>Building Floorspace (Square Feet)</b>									
1,001 to 5,000	Q	41	68	Q	417	729	Q	99.5	93.6
→ 5,001 to 10,000	Q	31	43	Q	482	654	→	64.8	66.0
10,001 to 25,000	Q	45	90	Q	931	1,681	Q	47.9	53.6
25,001 to 50,000	Q	39	70	Q	894	1,422	Q	47.4	49.5
									47.2
									52.7
									44.1
									44.4
									54.6
									Q
									152.9
									100.6
Inpatient	Q	37	38	Q	306	287	Q	120.3	131.2
Outpatient	Q	Q	Q	Q	Q	Q	Q	Q	Q
Lodging	Q	Q	39	Q	Q	507	Q	Q	77.5
Retail (Other Than Mall)	Q	13	29	Q	269	485	Q	48.2	59.2
Office	Q	72	84	Q	1,887	1,929	Q	38.2	43.7
Public Assembly	Q	12	35	Q	602	550	Q	Q	64.2
Public Order and Safety	Q	Q	Q	Q	Q	Q	Q	Q	Q
Religious Worship	Q	Q	29	Q	Q	624	Q	Q	46.3
Service	Q	Q	44	Q	Q	723	Q	Q	61.5
Warehouse and Storage	Q	24	34	Q	913	1,259	Q	26.0	26.7

**Don Reed's store uses less than half the natural gas of comparable buildings in the same climate zone: 28 cu ft./ sq. ft. vs 64 cu ft./ sq. ft. (CBECS: Commercial Buildings Energy Consumption Survey.)**



**Ridgewood Bible Church 38,000 sq. ft. Climate Zone 5**

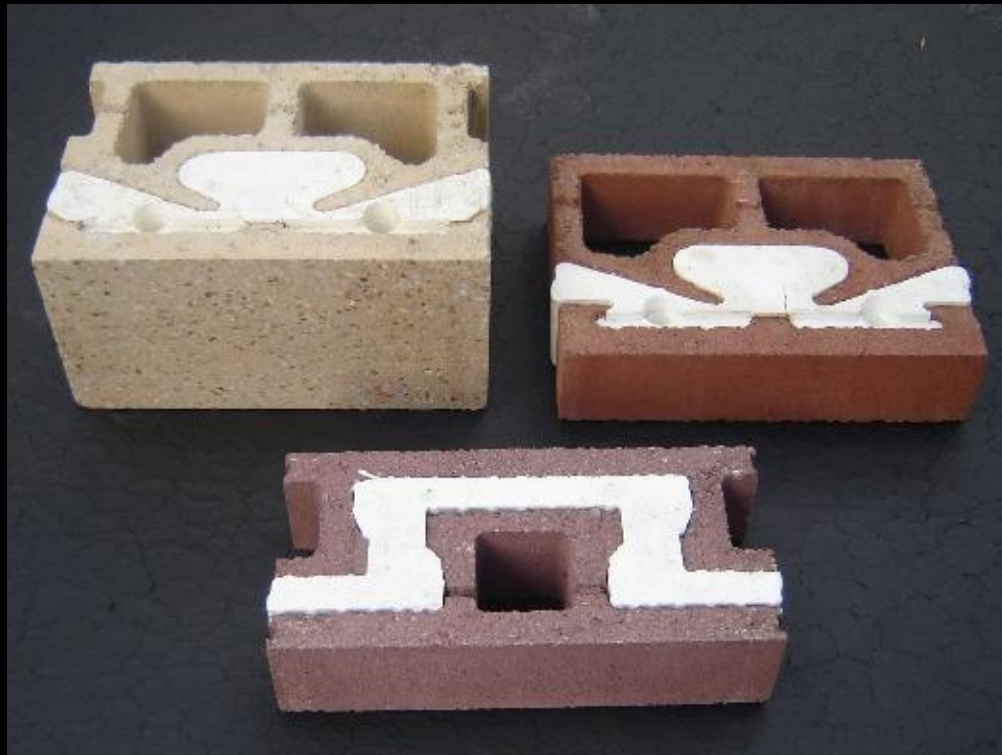
**12" CICMU actual gas utility heating bill 25 cents per sq ft**

**eQuest energy model built to LEED 3.0  
with R-54 walls projected use: 64 cents per sq ft  
CICMU building uses less than half**



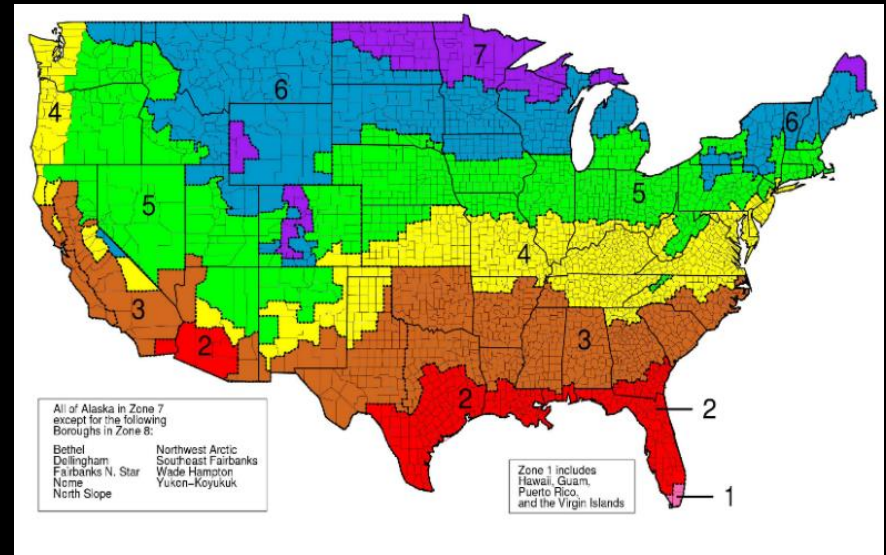
<b>Actual heating bill</b>	<b>Jan 2010 to Dec 2010</b>	<b>\$ 9,529</b>
<b>ENERGY Model Projected Annual heating bill</b>	<b>2010 rates</b>	<b>\$24,320</b>
<b>Utility provider preconstruction estimate:</b>		<b>\$24,000</b>
<b>Annual Energy Savings over R-54 energy model</b>		<b>\$14,791</b>





**The bottom line is that whether compared to energy models of high performance buildings, or compared to energy use in existing buildings, CICMU buildings can use substantially less energy.**





**The Advanced Energy Design Guides: across all climate zones, “...the greatest advantages of mass can be obtained when insulation is placed on its exterior.”**



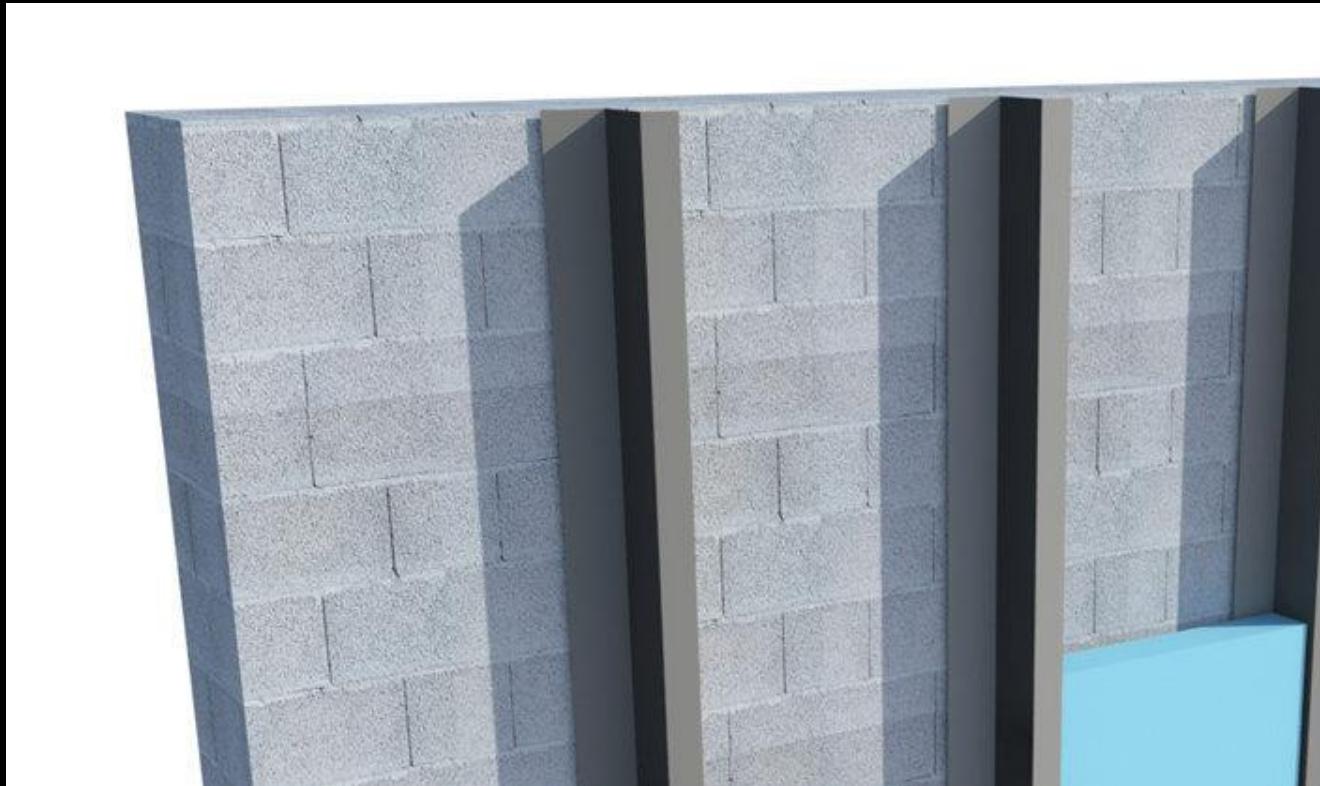
**CICMU's cost and performance compared to conventional block wall with steel stud and batt insulation in climate zone 5.**



**8" block  
steel stud with 3 5/8"  
batt insulation**



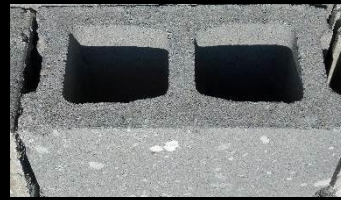
**12" CICMU wall**



**Thermal bridges of steel studs and use of batt insulation between the studs substantially diminishes the thermal performance of the wall assembly.**

**According to one PhD-holding building science expert, effective R-value of a block wall with steel studs and R-15 batt insulation is about R-4 in climate zone 5.**

**Compare that with about R-22 for a 12" CICMU.**



**8" block**

**12" ICMU**

**10,000 sq ft building**

**7000 sq ft of wall**

**8000 masonry units**

**@\$2.00**

**@\$7.00**

**\$16,000**

**\$56,000**

**Steel stud with 3 5/8 in.  
batt insulation**

**@3.50 per sq ft x 7000**

**Installed**

**\$24,500**

**HVAC unit**

**\$63,000**

**\$47,250**

**(Reduced capacity for CICMU)**

**Total Materials**

**\$103,500**

**\$103,250**

**Conventional and CICMU cost about the same, , but CICMU delivers better thermal performance, about 50 cents per sq. ft. operating savings annually for life of building. \$25,000 after five years, \$50,000 after ten years. For the same price as inefficient, the owner can have a better building with a lower cost of ownership.**



**CICMU buildings are less expensive than steel framed with brick veneer buildings with interior insulation, and have better thermal performance.**

**The insulation in steel frame with veneer buildings places the insulation on the wrong side of the thermal mass.**



## NEW STUDENT HOUSING

This new apartment-style dormitory will accommodate 507 students in 124 apartments. Each apartment will have four single bedrooms and a full kitchen. The complex will have common space for activities and a laundry facility. The new building allows the college to meet increasing demand for on-campus housing. This project is estimated to be completed by spring 2011.

[www.buffalostate.edu/construction](http://www.buffalostate.edu/construction)

**Buffalo State**  
State University of New York



**Conventional construction involves many steps: framing, insulating, veneer.**



**CICMU walls can eliminate some trades and simplify scheduling.**



**The mason shows up and installs CICMU's.**





**The CICMU walls go up.**

# 4500 sq ft House, Houston, TX



**The roof goes on.**



**The furniture goes in.**



**Allen Senior Housing, Jamaica, NY**



**CICMU 12,000 sq. ft. office building  
uses split face gray with half high block**





**CICMU school addition and gymnasium.**



**CICMU Small office with garage.**





**CICMU big box retail.**

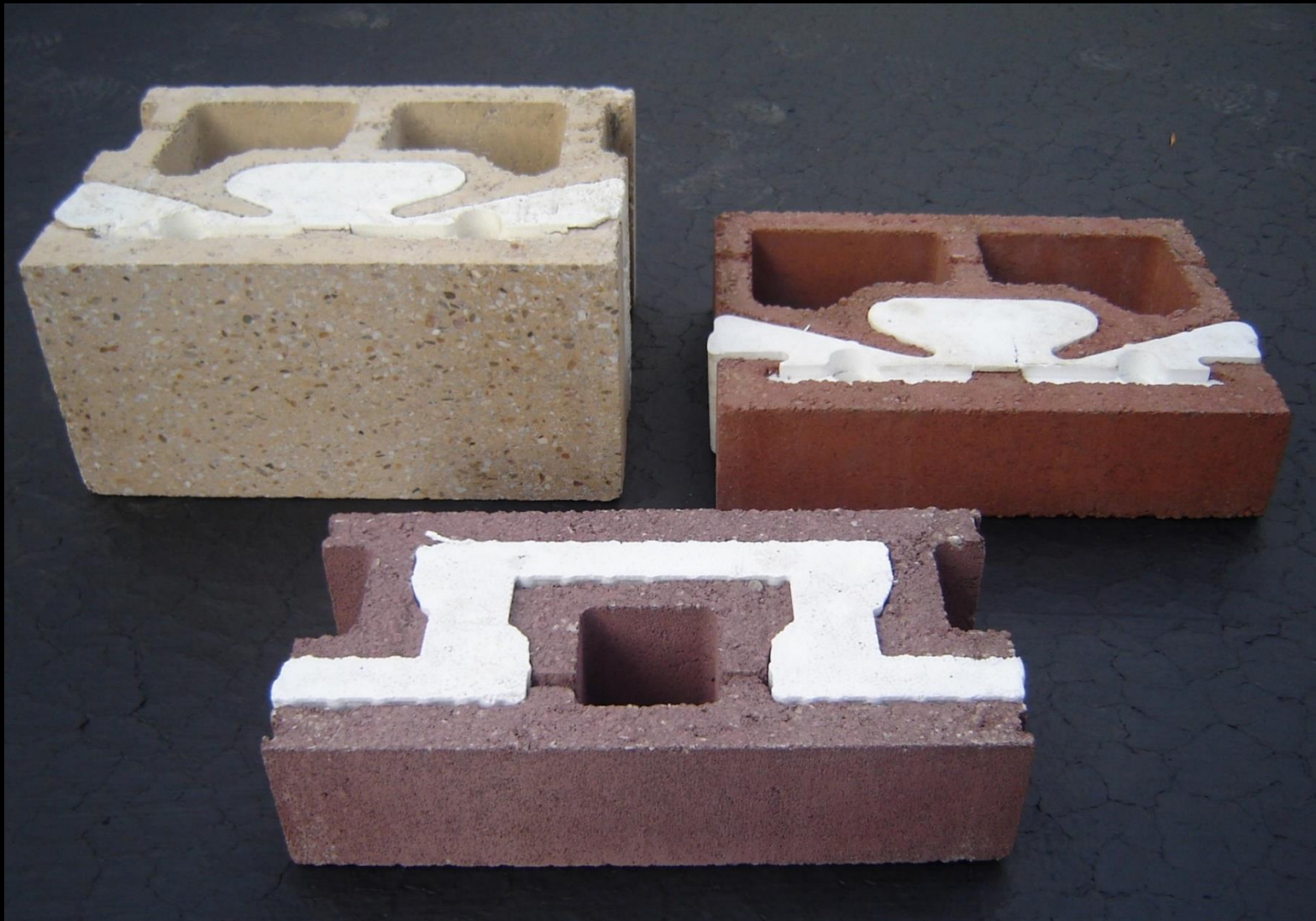




**CICMU religious facility.**



**Continuously Insulated Concrete Masonry Unit: Cost Effective Energy Efficiency**



**Insulated thermal mass delivers massive benefits: energy efficient, comfortable, secure, low maintenance, quiet, durable, attractive.**

**Remember the first rule of energy efficient design?**

**Reduce the building energy load through passive means.**

**Three examples of designs that could be simply improved:**

**1. Walgreens**

**2. Walmart**

**3. School Districts**

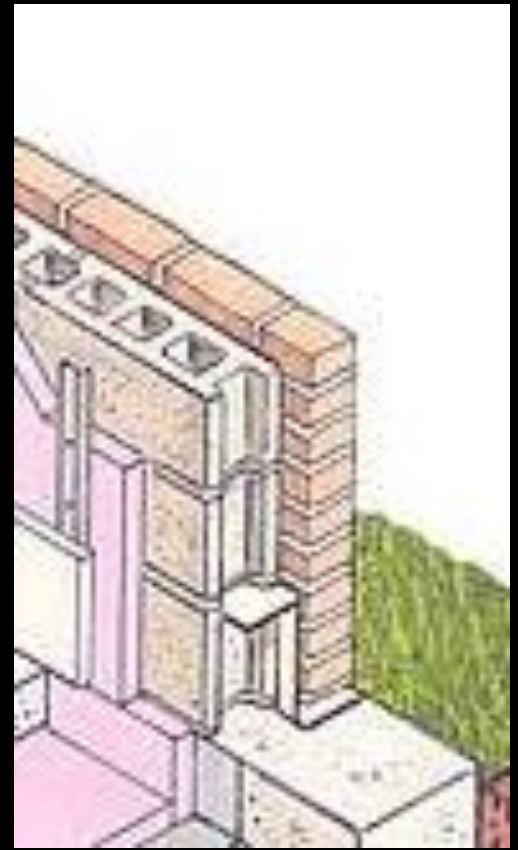


Walgreens won an award for a net zero building that used cavity walls with insulation on the wrong side of the thermal mass, similar to the walls in the store above.

Walgreens has over 8000 stores, and they are making waves by being the first drug chain to put up a net zero energy building .

Thomas Connolly, Walgreens vice president of facilities development, said, “We are investing in a net-zero energy store so we can bring what we learn to our other stores and share what we learn with other companies.

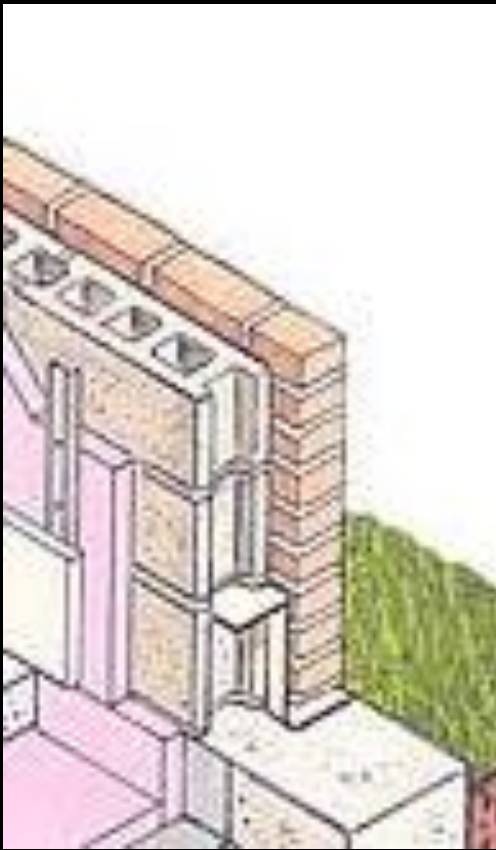
Because we operate more than 8,000 stores, anything we do that reduces our carbon footprint can have a broad, positive impact on the nation’s environment.”



“Designers cut energy consumption in a variety of ways, but the nature of a retail store is to get people in and out of the building to shop, not button the building up tightly to reduce heating and cooling demands. Doors are opened and closed many times a day. The Walgreens net zero building has typical block and brick walls and an insulated metal deck roof. Although air sealing and insulation levels are relatively modest, the project makes up for it with its oversized renewable energy package. The rated 225 kW capacity of the PV panels is 20 times as much as a typical net-zero energy house.”

Source: Scott Gibson, Green Building Advisor





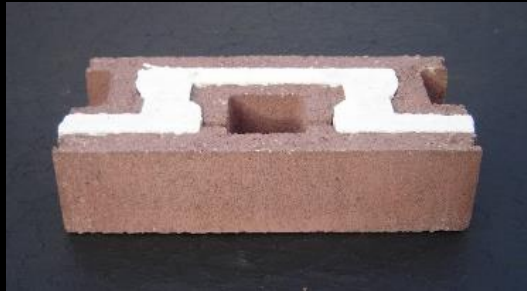
## Room for Improvement:

Since Walgreens' doors open and close many times per day (like Don Reed's grocery store), a CICMU wall would be much more effective than a conventional mass wall with interior insulation.

The thermal lag of the interior mass would then moderate temperature swings.



Conventional  
mass  
wall  
Good  
R-12 = R-17  
effective  
in climate  
zone 5



Insulation  
between thermal mass  
wall  
BEST  
R-12 = R-22  
effective in climate zone 5



Walmart store is a big box with thermal mass walls. Typically they use mass walls with interior insulation or perlite insulation in the cavities.

Walmart designers say that they over-insulate the roof, so they are not concerned with temperature swings of the mass walls.



Does this strategy ignore the energy storage potential of the approximately 50,000 sq. ft. of thermal mass of the walls?

**Room for improvement:** using CICMU's would allow Walmart to take advantage of the energy storage capacity in those walls.



**Perlite filled**



**Core stuffed**



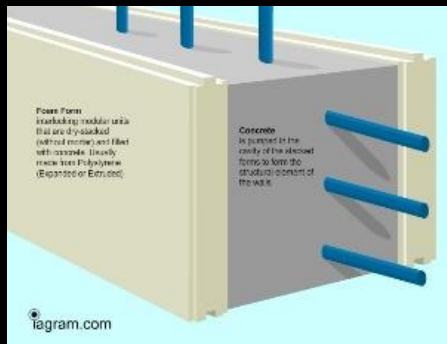
**Reduced webbed**

**REMEMBER?**

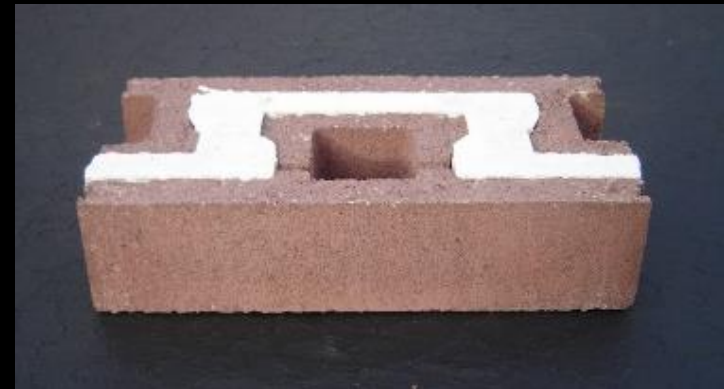
“...Field studies and computer simulations have shown that core-filling of any type offers little fuel savings since the majority of heat is conducted through the solid parts of the walls such as block webs and mortar joints.”

Kentucky is a zero energy schools pioneer, setting a template by using a number of energy conservation measures (ECM's). Many of these schools use ICF's rather than CICMU's.

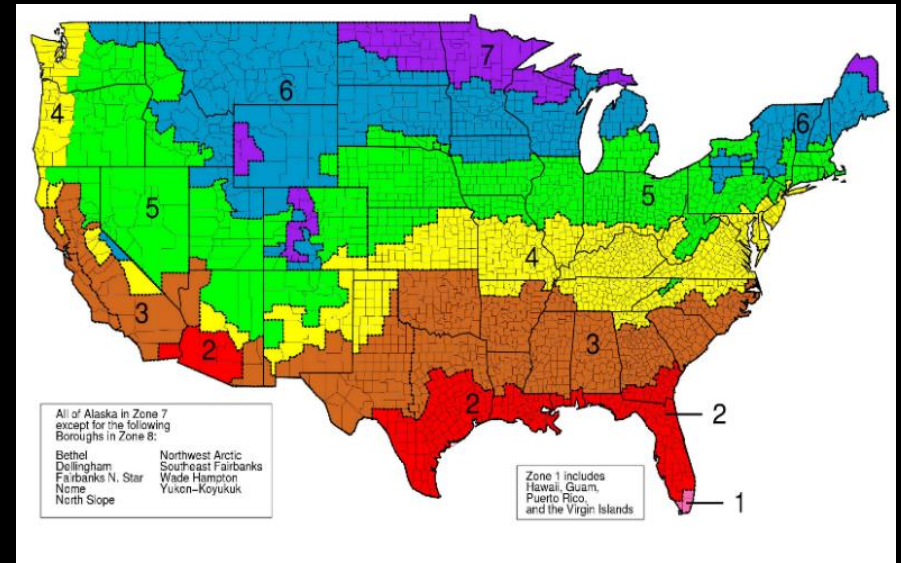
**Room for improvement:** CICMU's are more energy efficient and cost less than ICF's per sq. ft. of installed wall.



Concrete  
between insulation  
wall (ICF)  
Better  
R-12 = R-18 effective



Insulation  
between thermal mass  
wall  
BEST  
R-12 = R-22 effective



The Advanced Energy Design Guides recommend a cost effective and energy efficient mass wall strategy that holds true for all climate zones and all building types.

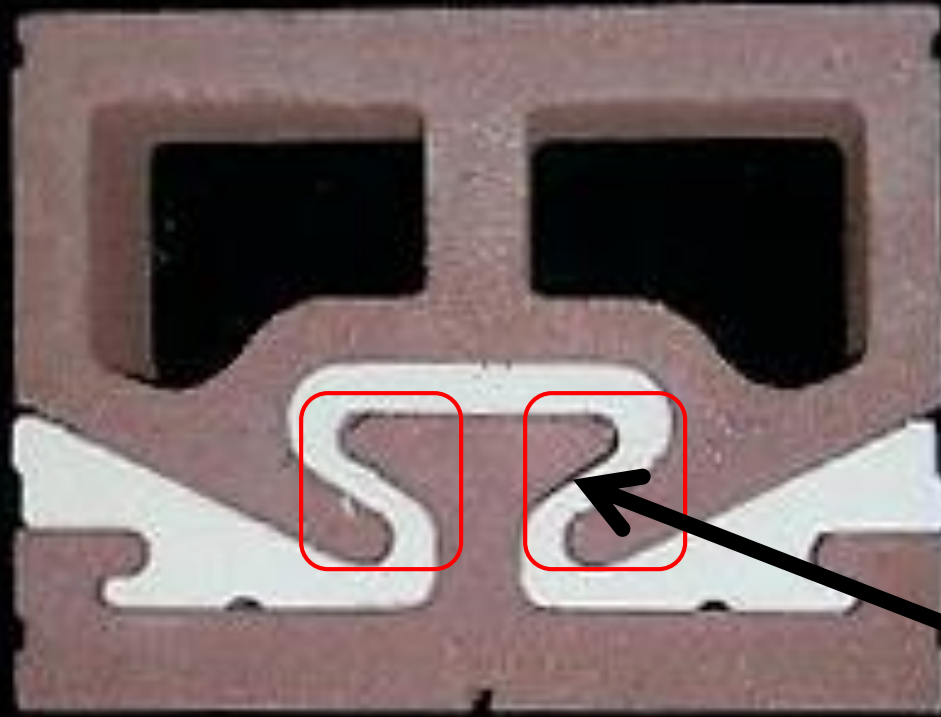
Quote from the AEDG's:

“The greatest advantages of mass can be obtained when insulation is placed on its exterior.”

## About CICMU's ;

- Can be produced on existing equipment, using custom molds, by most block-manufacturers.
- Sturdy as regular block.
- Fire resistant.
- Moisture and mildew resistant.
- Installs like conventional block.
- Arrives at the job site ready to use.





**Modified dovetail maintains structural integrity.  
Even if the insulation was not present, the interior  
block would not fall away from the exterior.**



## Lower Construction Costs

Single wythe CICMU's eliminate secondary steps:

- ✓ re-scaffolding
- ✓ additional insulation
- ✓ exterior/interior finishes.

Construction schedules are accelerated.

Walls and insulation are complete when the mason is done, providing substantial labor savings.



## Multiple Finishes

**CICMU's are made in standard dimensions with any architectural finish so it can be interspersed with conventional CMU for ease of construction.**





**Half-high brick-look CICMU used on campus of National Historic Site.**

## Environmentally Safe

**Maximum thermal stability  
and environmental safety:**

- **EPS inserts will hold the required insulation value and form if moisture is introduced.**
- **EPS inserts are non-toxic and contain no formaldehyde.**
- **EPS inserts use no hydro-fluorides during manufacturing.**



## CICMU's Reduce Noise

- **Sound Transmission Class (STC) of 53+.**
- **Shuts out street sounds.**
- **Closes in manufacturing noise.**





How tall can CICMU walls go? Much higher than empirical tables will tell you. Read the article: [Designing Tall Masonry Walls by David Biggs, P.E.:](http://www.structuremag.org/wp-content/uploads/2014/08/C-Str-Design-Biggs-May08-4-10-rwf1.pdf)  
<http://www.structuremag.org/wp-content/uploads/2014/08/C-Str-Design-Biggs-May08-4-10-rwf1.pdf>

When constructing a template for others to follow, it is crucial for designers to use good building science as a foundation.

Energy efficient buildings can dramatically and positively transform the economy and individuals lives.

Imagine if each person who now struggles to pay a utility bill could instead use that money for a purpose that could help them improve their individual circumstances.

As designers, your actions have life-altering implications for this and future generations.



Take the challenge: Design an affordable Zero Energy Ready building for your next project.

