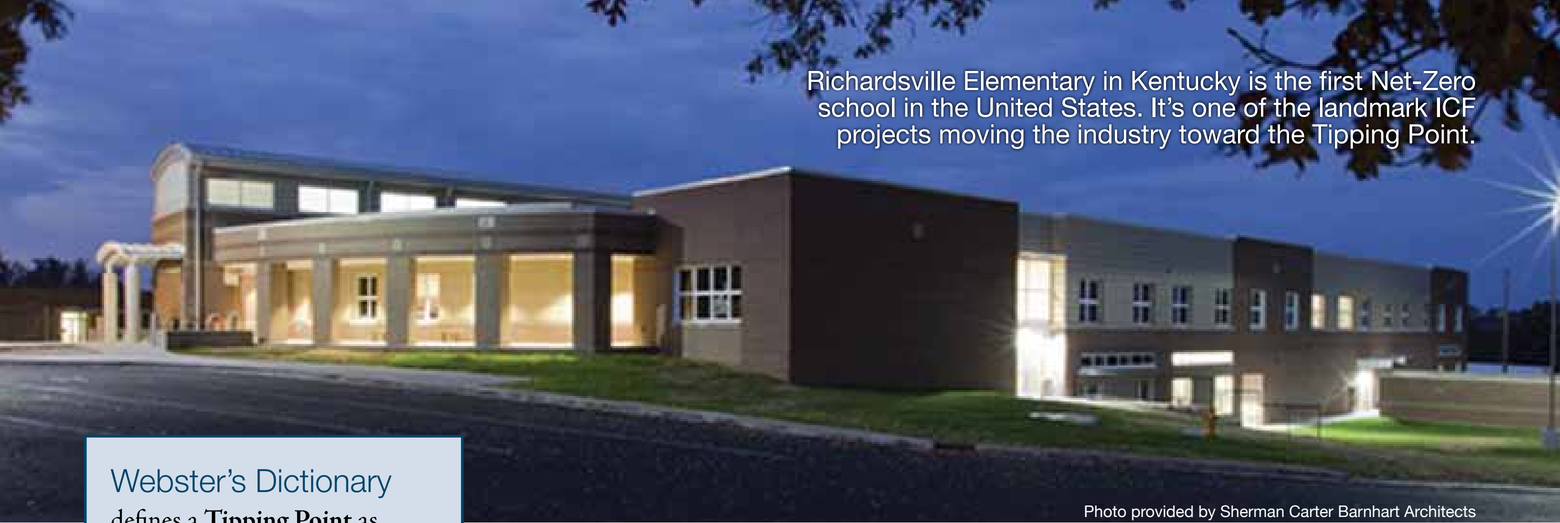


Richardsville Elementary in Kentucky is the first Net-Zero school in the United States. It's one of the landmark ICF projects moving the industry toward the Tipping Point.

Photo provided by Sherman Carter Barnhart Architects

**Webster's Dictionary** defines a **Tipping Point** as the culmination of a buildup of small changes that effects a big change.

**Wikipedia** defines a **Tipping Point** as the event of a previously rare phenomenon becoming rapidly and dramatically more common or accepted.

# The ICF Tipping Point

*by Cameron Ware*

A hundred years ago people laughed at those crazy enough to actually move their outhouse from their backyard to inside their home. Who would do such a crazy thing? Then, after a tipping point, almost overnight the backward ones were those who didn't have indoor plumbing!

If you've worked with Insulated Concrete Forms (ICFs) long, you know that for years now, it has always seemed that building with ICF was just about to explode. We expected the phone to ring off the hook because only a hillbilly without any data would build conventionally. Well, I'm going to knock on wood and say that the planets are aligned and we are finally there. Yes, the ICF Tipping Point is here. Why?

Three different gauges of ICF acceptance—the education of design professionals, code changes, and landmark projects—all indicate that this technology is on the verge of skyrocketing growth.

## Architects and Engineers Understand the ICF Value Proposition

Whenever I provide an "AIA Lunch-n-Learn" I always ask the architects to raise their hands if they are familiar with ICF. Only a few years ago, few if any hands were raised. Today, although we still have obstacles to overcome, the average architect knows what ICF is and a little bit about its value proposition.

Your typical large architectural firm still has millions of dollars invested in established and proven details that are not ICF. But the architect's customer is increasingly educated, demanding and involved. Thus, as architects design and build more ICF buildings, ICF-associated details and knowledge are maturing and becoming an asset and a differentiator. Momentum is being generated. Customers are seeking architects that understand the thermal envelope. Granted, walls are only part of the synergy of technologies necessary to build the best building. Back in college we all learned that the walls were only a small contributor to the envelope and most heat transfer occurred through the roof and windows. This focus provided significant attention and corresponding technology improvement in roof and window technology. However, these advances have left wall technology behind and thus increasing what today's improvements to walls systems can bring to the table.

The "green" focus and the problem of American dependence on foreign oil have helped too. Thus, architects holding safety and energy efficiency in as high regard as esthetics are being rewarded with more customers.

Have we been so shallow as to evaluate our track stars by their looks and not their speed? If, in reality, we are just that shallow, *building codes* are going to push us forward anyway. The International Energy and Conservation Code (IECC) is moving the entire building industry toward the straight and narrow by making it increasingly expensive to do the same old thing.

The EICC 2012 cranks this advance up another notch as continuous insulation requirements become increasingly burdensome. While not affecting ICF, other walls systems that dominate the market today such as Concrete Masonry Unit (CMU) and light gauge steel are going to have to go to costly extremes to achieve code compliance.

I've recently seen some aggressive Department of Energy charts forecasting where these codes are going to move us over the next few years. Many would consider these objectives unattainable or unrealistic. The IECC 2009 is catching some architects by surprise but as a result they are now very much aware of the impending IECC 2012. From an energy perspective your typical ICF is a shoe-in for compliance for quite a few years to come.

## Many Top Performing Buildings Are ICF

The best performing public school in the United States utilizes

ICF construction. If you Google "Richardsville Elementary" in Kentucky, you will find that it's the first Net-Zero ICF school in the United States. Although this is correct, it is also an understatement because Richardsville is actually the first net-zero school in the United States built with any technology! ICF construction was utilized to help get it there. Richardsville represents where our construction technology is headed. This school was not built by luck or accident; it was the result of lessons learned during the construction of many schools and years of hard work.

A few years ago, many chuckled at the possibility of net-zero. Undeterred, Warren County Schools brought together the brilliant and open minded team of Sherman Carter Barnhart Architects and CMTA Engineers. Working together, they made it happen.

The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) and The Department of Energy have recently published a design guide for school construction called "*The K-12 50% Solution*". The document clearly shows how a school can reduce its energy consumption by 50% in each climate zone in the United States.

Richardsville is one of the case studies in the document and is the best performing school in the U.S. utilizing only 17 kBtu/sqft/year. To put that in perspective, the Energy Star target is 50 kBtu/sqft/year and the national average is 73 kBtu/sqft/year. Richardsville's numbers represent an improvement of over 75% from the national average. This monumental performance is crucial to our understanding of what is really "Green," because throwing money at solar panels and wind turbines is *always* secondary to the advantages of the envelope. The cost of secondary systems such as solar are not likely to pay for themselves with or without government subsidy if the envelope is not considered first. (See ICF Builder Magazine: "*The Best Green Dollar*" June 2011 p. 25-26).

It is worth noting that according to the ASHRAE document, the majority of the best performing schools in the U.S. utilize mass wall systems. If you look very closely at this document (the value of which I cannot overemphasize) you will find that ICF and mass walls are the clear winners over all other types of wall systems.

Schools shown in bold below are case studies in the ASHRAE

Alvaton Elementary, completed in 2005, has used 50% less energy than most schools every year since completion.

document (I have taken the liberty of ordering these schools by performance and wall type). I've also added several Warren County Kentucky Schools whose performance is gathered from page 55 of *The K-12 50% Solution*.

Clearly, the document authors, ASHRAE, Department of Energy, and others attempted to include multiple examples of the wall types being used today. If you choose to delete the schools that either did not report results (e.g. Greenburg and Marin County) or provided only simulated results (e.g. Gloria Marshall, which likely did not yet have a full year of data) *virtually all of the low mass schools would fall off the list*.

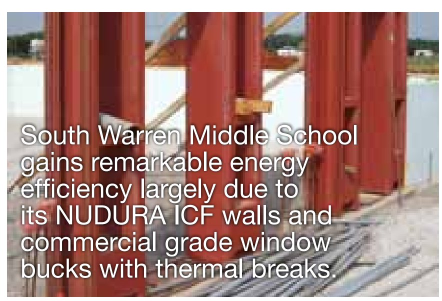
Granted, walls are only one of the synergies in a number of technologies from geothermal to daylighting. Nonetheless, this data compels one to believe that *we might find the task of Net-Zero a bit easier utilizing a mass wall system over other wall systems*. My studies on this document conclude that this is true for all climate zones.

Incidentally, when reviewing the document by climate zone you will find that mass walls are defined by a heat capacity of 7 BTU/sq.ft.°F or greater. A typical 6" core ICF wall is almost double that and your typical 8"core ICF which is more common to school construction contains significantly more than double this baseline. Furthermore, your typical ICF insulation exceeds continuous insulation requirement for mass walls in all climate zones. I point this out because it is very expensive to bring CMU up to either the heat capacity or continuous insulation R-value of ICF. (See ICF Builder: "*Convincing Architects to Spec ICF*" Feb. 2010 p. 8-12) originally titled "*The Real Competition*".

## Code Is Uncoupling R-Value from Mass Construction

Many professionals, i.e., architects, engineers and contractors, have waged a long-standing battle over the meaning and significance of R-value. I believe that incorrect understandings of R-value have been major deterrents of ICF industry growth. Why? See ICF Builder: "*R- U-Vindicated*" (Dec. 2010 p. 25-27)

There are still people out there that believe that R-value is more than just a measure of conduction and that it somehow includes convection and radiation as well. But this no longer really matters. We can stand tall because ASHRAE has recognized that R-value alone does not tell you how a wall will perform. As an example, ASHRAE's 50% Solution clearly states that a mass wall with a basic R-value performs better (in all climate zones) than a low mass wall with somewhat greater R-value.


South Warren Middle School gains remarkable energy efficiency largely due to its NUDURA ICF walls and commercial grade window bucks with thermal breaks.

| WALL SYSTEM | SCHOOL | kBTU/sqft/yr |
|---|---|---|
| MASS (ICF) | Richardsville Elementary (KY) | 17 kBTU/sqft/yr |
| MASS (CMU + insulation) | Kinard Jr. High (CO) | 25 kBTU/sqft/yr |
| MASS (CMU + insulation) | Plano Elementary (KY) | 26 kBTU/sqft/yr |
| Metal Stud (+ insulation) | Gloria Marshall (TX) | 33.4 kBTU/sqft/yr (forecasted) |
| MASS (ICF) | Alvaton Elementary (KY) | 35 kBTU/sqft/yr Built in 2005 |
| SIPS (Insulated Panels) | Greenburg K12 (KS) | (Estimate*) |
| Metal Stud (+ Insulation) | Manassas Park (VA) | 37.5 kBTU/sqft/yr |
| Metal Framed (+ Insulation) | Marin County (CA) | (Estimate*) |
| MASS (CMU + insulation) | Henry Moss Middle School (KY) | 42 kBTU/sqft/yr Built in 2002 |
| MASS (CMU + insulation) | Drakes Creek Middle School (KY) | 43 kBTU/sqft/yr Built in 2002 |
| MASS (CMU + insulation) | Warren East Middle School (KY) | 43 kBTU/sqft/yr Built in 2002 |
| ------ | Energy Star Target | 50 kBTU/sqft/yr |
| MASS (Precast + insulation) | Two Harbors (MN) | 56 kBTU/sqft/yr Built in 2005 |
| ------ | National Average | 73 kBTU/sqft/yr |

*Did Not Report, Estimated Here

Additionally, research by Oak Ridge National Laboratory (ORNL) illustrates the benefits of mass wall systems. For example, ORNL defined a strategy to define the Dynamic Benefit of Massive Systems (DBMS). When using these reports you will need to be careful that you are actually comparing apples to apples as they are often misquoted by companies wishing to establish the superiority of one mass system over another. Make sure you have similar heat capacities and R-values for systems being compared. Furthermore, one other word of caution, DBMS reports as they apply to ICF are based on ICF systems that only go up to R-17.

## Conventional Is No Longer Conventional

You should expect to see a lot more staggered stud construction in the future. Mass advantage excluded, this will allow conventional construction to reach the R-value of ICF but with a significantly increased cost. Likely, when competing against wood we will ultimately rely more on strength, sound transmission and fire rating to justify the superiority of ICF.

CMU is now more expensive than ICF in many U.S. climates because of the increased thermal performance demands. Even the cost of steel stud systems are rising fast due to the huge amount of continuous insulation now required for the system to meet code. As professionals who understand thermal performance systems, we look forward to this tipping point and the growth of a more efficient building industry in the US through increased use of ICF wall construction.

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