Hadrian

From: Colin Jessop [colinjessop@cox.net]

Sent: Wednesday, September 17, 2003 9:20

To: Ahhbaja@aol.com

Cc: panel@tridipanel.com; Skip Fralick

Subject: Re: 3-D Panel Rating

Hi Rod,

We did not do the study ourselves but we tracked down a study done by the Oak Ridge National Laboratory in Tennessee. The study is attached. Go directly to the conclusion to see the positive conclusions about high mass walls configured with a foam core and concrete on the inside and outside. The comparison with regular ICF wall systems is instructive. The report emphasizes the importance of leaving the thermal mass exposed to the interior of the building, something that ICF systems by definition cannot accomplish. It really brings into question, in my mind, the claims of ICF manufacturers of "effective R-values".

One thing I have been trying to put my finger on, and you may be able to help me with this, are the sources of the 3-D Panel system R-value claims. Were these independently tested and if so, can you help me find out who performed the tests?

I hope this helps. Feel free to call me.

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Thermal Mass - Energy Savings Potential in Residential Buildings

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ABSTRACT:
In certain climates, massive building envelopes-such as masonry, concrete, earth, and insulating concrete forms (ICFs)-can be utilized as one of the simplest ways of reducing building heating and cooling loads. Very often such savings can be achieved in the design stage of the building and on a relatively low-cost basis. Such reductions in building envelope heat losses combined with optimized material configuration and the proper amount of thermal insulation in the building envelope help to reduce the building cooling and heating energy demands and building related CO_2 emission into the atmosphere. Thermal mass effects occur in buildings containing walls, floors, and ceilings made of logs, heavy masonry, and concrete
This paper presents a comparative study of the energy performance of light-weight and massive wall systems. An overview of historic and current U.S. field experiments is discussed herein and a theoretical energy performance analysis of a series of wall assemblies for residential buildings is also presented. Potential energy savings are calculated for ten U. S. climates. Presented research work demonstrate that in some U. S. locations, heating and cooling energy demands for buildings containing massive walls of relatively high R-values can be lower than those in similar buildings constructed using lightweight wall technologies.

INTRODUCTION:
Several massive building envelope technologies (masonry and concrete systems) are gaining acceptance by U. S. builders today. It is believed that building envelopes made of concrete, earth, insulating concrete forms (ICFs), and solid wood (log) may be helpful in lowering building heating and cooling loads. For centuries, the vast majority of European and Mid East residential buildings have been built using massive wall technologies. They have made life without air conditioners relatively comfortable even in countries with hot climates such as Spain, Italy, or Greece.
Numerous historic and current field studies have demonstrated that in some U.S. locations, heating and cooling energy demands in buildings containing massive walls of high R-value could be lower than those in similar buildings constructed using lightweight wall technologies. This better performance results from the thermal mass encapsulated in the building reducing temperature swings and absorbing energy surpluses both from solar gains and from heat produced by internal energy sources such as lighting,

computers, and appliances. In addition, massive building envelope components delay and flatten thermal waves caused by exterior temperature swings.

Since all U.S. thermal building standards including ASHRAE 90.1 and 90.2 and the Model Energy Code are linked primarily to the steady-state clear wall R-value, calculating heating and cooling needs of a house built with high-mass walls is not straightforward. The steady-state R-value traditionally used to measure energy performance does not accurately reflect the dynamic thermal behavior of massive building envelope systems. This makes it difficult to convince builders, investors, code officials, etc...about the improved energy performance of massive building envelope systems. Such a situation opens the door for many companies to claim unrealistically high energy performance data for their wall technologies.

The main objective of this work is to provide a comparative study of the energy performance of massive wall technologies. Since the majority of U.S. residential buildings are built using light-weight wood-framed technologies, all energy performance comparisons in this paper are made against light-weight wood-framed buildings. An overview of several historic and current U.S. field experiments are discussed. These experiments were performed in a wide range of U.S. climates utilizing several building sizes and shapes. Theoretical energy performance analysis is presented for a series of four wall assemblies. The wall material configurations of these assemblies represent most of massive wall systems utilized in U.S. residential buildings. Theoretical and experimental results presented in this paper should enable approximate energy performance evaluations for the most popular massive wall configurations.

SOME RESULTS OF FIELD ENERGY STUDIES PERFORMED ON MASSIVE RESIDENTIAL BUILDINGS

A wide selection of historic and current field experiments are discussed in the following section. Some early experiments were initiated in late 70's as a result of the energy crisis and focused on application of passive solar techniques in residential buildings.

Passive solar designers used glazing and thermal mass to utilize solar energy and stabilize interior air temperature. A Los Alamos National Laboratory team headed by J. D. Balcomb and R. D. McFarland investigated the energy performance of several passive solar wall systems and a various thermal mass storage materials. All systems were tested in field conditions in 2.6x1.9x2.9 m (100x80x120 in.) insulated lightweight containers [J. D. Balcomb et al. - 1978]. The only thermal mass provided was by the tested solar systems. Several materials were tested as a potential energy storage during these experiments. The most common was the application of conventional masonry blocks or solid concrete walls. However, Los Alamos researchers also studied the energy performance of water and phase change materials as energy storage means. The results from these experiments

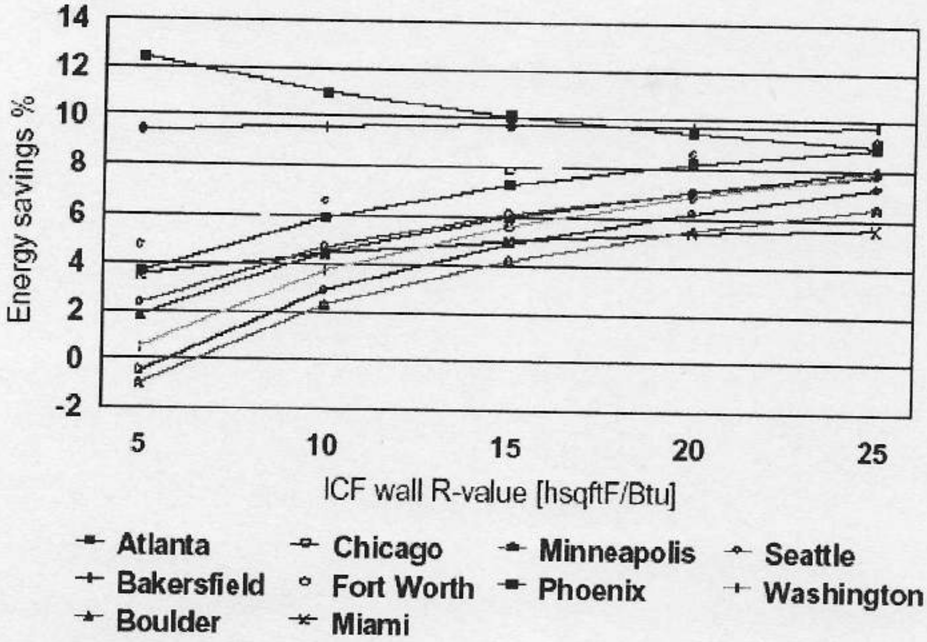

Fig.8. A potential whole building energy which can be saved in ten U.S. locations by the replacement of conventional wood frame walls by ICF walls.

This figure represents combined data from all three simulated houses. It shows the average whole building energy savings potential in houses with 74 - 279 m^2 (800-3000 ft^2) of floor area. For individual building size and shape, this data may vary within "2%. Assuming that average ICF wall R-value is between R- 2.6 and 3.5 m^2K/W (15 and 20 hft^2F/Btu), average potential whole building energy savings (ICF house v.s. conventional wood-framed house) for all U.S. locations are between 6 and 8%.

CONCLUSIONS

Experimental and theoretical analysis of the energy performance of light-weight and massive wall systems was presented in this paper. Dynamic thermal performance of sixteen wall assemblies was investigated for residential buildings and the potential energy savings were presented for ten U.S. climates. It was found that some massive building envelope technologies can help in the reduction of building annual energies.
Several comparative field experiments have demonstrated that in many U. S. locations, heating and cooling energy demands in buildings containing massive walls of relatively high R-values can be lower than those in similar buildings constructed using equivalent R-value with lightweight wall technologies.
The thermal mass benefit is a function of wall material configuration, climate, building size, configuration, and orientation. From ten analyzed U.S. locations, the most beneficial for application of thermal mass are Phoenix, AZ and Bakersfield, CA.
Comparative analysis of sixteen different material configurations showed that the most effective wall assembly was the wall with thermal mass

(concrete) applied in good contact with the interior of the building. Walls where the insulation material was concentrated on the interior side, performed much worse. Wall configurations with the concrete wall core and insulation placed on both sides of the wall performed slightly better, however, their performance was significantly worse than walls containing foam core and concrete shells on both sides.

Potential whole building energy savings, available when lightweight walls are replaced by massive walls of the same R-value, were calculated for 143 m^2 (1540-ft^2) one-story ranch houses located in Minneapolis, Minnesota and Bakersfield, California. For high R-value walls, up to 8% of the whole building energy could be saved in Minneapolis and 18% - in Bakersfield when wood-framed walls were replaced by massive wall systems. Thermal mass layers must be in good contact with the interior of the building in these walls.

Whole building possible energy savings in houses built with ICF walls were estimated as well. Three houses with 74 - 279 m^2 (800-3000 ft^2) of floor area were simulated for this purpose. It was found that for ten U.S. locations, ICF walls of R- 2.6 and 3.5 m^2K/W (15 and 20 hft^2F/Btu), the average potential whole building energy savings (ICF house vs conventional wood-framed house) can be between 6 and 8%.

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