

INDEPENDENT REVIEWS DISCREDIT COLORADO STUDY

INTRODUCTION

A 1990 study conducted at the University of Colorado at Denver (“Colorado Study”) is frequently cited to argue that cellulose insulation outperforms fiber glass insulation in the following areas: air tightness, heat loss, and energy savings. These questionable conclusions of superior cellulose insulation performance generally rely exclusively on the Colorado Study. Given that the cellulose insulation industry is relying upon a single study almost 20 years old, it is imperative that this single study provides a reasonable basis for the advertising claims disseminated by the Cellulose Insulation Manufacturers Association (“CIMA”) and over 20 different cellulose manufacturers and insulation contractors websites.

The Colorado Study purportedly conducted a side-by-side comparison of the effectiveness of fiber glass and cellulose building insulation. For this Study, two test buildings were constructed in a parking lot of the University of Colorado campus in Denver. The walls in Building A were insulated with 5½ inches of wet spray cellulose. The ceiling of Building A was insulated with R-30 loose-fill cellulose. The walls in Building B were insulated with unfaced R-19 fiber glass batts. The ceiling of Building B was insulated Kraft-faced R-30 fiber glass batts. Over a two-month period, a number of tests and measurements were performed. At the end of the two months, the researchers concluded that cellulose insulation tightened the building 36 to 38 percent more than fiber glass; the cellulose-insulated building was seven degrees warmer than the fiber glass building; and, after three weeks of monitoring, the cellulose building had used 26.4 percent less energy to heat the building than the fiber glass building.

Importantly, independent reviewers have found the Colorado Study to be flawed.¹ As discussed in greater detail below, the Colorado Study has never been published, has never been peer-reviewed, and, moreover, the Study apparently cannot be found today. While a summary of the Study is available, that summary does not contain any of the essential details needed to assess the reliability of the Study. What is known of the Study demonstrates significant deficiencies: 1) no legitimate side-by-side comparison is presented; 2) the facts do not support the conclusion that cellulose insulation limited the air leakage in the building; 3) the thermal resistance comparison cannot be collaborated because the R-value of the cellulose insulation installed in the walls is never disclosed; and 4) there are varied other deficiencies in the Study that undermine the credibility of its conclusions.

COLORADO STUDY DOES NOT PROVIDE ADEQUATE SUBSTANTIATION

The Federal Trade Commission’s (“FTC”) Home Insulation Rule, 16 C.F.R. Part 460, mandates that claims about insulation performance should have a “reasonable basis.” 16 C.F.R.

¹ NAHB Research Center, *Effect of Insulation Type on Air Infiltration in North American Homes: Summary of Existing Research*, November 2006, p. 5. NAHB questioned the validity of the study because of flawed test data and unpublished and unreviewed nature of the study.

§ 460.19(a)(c)(e). That “reasonable basis” is substantiation.² The substantiation requirement exists because every time an advertiser makes an objective claim, the advertiser implies that there is a reasonable basis behind the claim.³ The substantiation requirement dictates that a claim be based on scientifically valid, well-controlled studies that support the claim. The Colorado Study is a single study and is not only uncollaborated by any other study, but is further weakened because other studies contradict it or call its conclusions into question.

In a 1998 report to the U.S. Environmental Protection Agency (“EPA”),⁴ the National Association of Home Builders (“NAHB”) Research Center studied 26 production homes in the Baltimore area constructed by four companies. Each company constructed five homes with non-standard insulation products – cellulose, blown-in-blankets, and low-density polyurethane spray foam. Air leakage and energy use of the alternatives were compared to the builders’ standard practices (typically fiber glass batt insulation in walls and blown cellulose or fiber glass in ceilings). Although air sealing measures were routinely installed with all of the alternative insulation products, sealing measures were not necessarily part of the builders’ standard practice homes (which were constructed prior to the study). Therefore, no causal relationship could be found between insulation type and air infiltration. The study came to the simple yet significant conclusion, “Air sealing seems to have a higher impact [on air infiltration] than choice of insulation.”

In their development of a procedure for identifying air infiltration through various construction elements, Yuill and Yuill [1988]⁵ investigated the resistance to airflow of several wall systems. By testing various wall systems in the same home (rather than comparing one home to another), the researchers found that a well-sealed wall cavity with fiber glass batt insulation and drywall resisted airflow as well as the best-performing system in the test, which consisted of housewrap over untaped XPS sheathing. Untaped foam sheathing by itself had very little resistance to airflow – about 1/15 the amount of the housewrap over untaped XPS sheathing.

The NAHB Research Center also conducted a side-by-side field test⁶ of three homes – two constructed of Insulating Concrete Forms (“ICFs”) and one of conventional 2x4 wood-frame construction with fiber glass batt insulation and housewrap. Using two methods (tracer gas and blower door testing), the researchers found virtually no difference between airtightness of the three homes.

Otto [1998],⁷ in a side-by-side case study, used an infrared camera and blower door test equipment to identify the thermal performance of two insulating systems under depressurization. The two systems were spray-applied polyurethane foam with foam sheathing and fiber glass batt insulation with foam sheathing, housewrap, and air sealing measures. When subjected to -50 Pa

² <http://www.ftc.gov/speeches/starek/nima96d4.shtm>.

³ *Ibid.*

⁴ *Field Demonstration of Alternative Wall Insulation Products*, 1998, NAHB Research Center Report to the U.S. Environmental Protection Agency.

⁵ Yuill, G.K., and D.P. Yuill, 1998, *Development of a Field Procedure to Measure the Airtightness of Wall Construction Elements of Houses*, in Proceedings: Thermal Performance of Exterior Envelopes of Buildings VII.

⁶ *Insulation Concrete Forms: Comparative Thermal Performance*, 1999, Report to HUD.

⁷ Otto, D., *Installed Performance of Two Insulation Systems During Simulated Wind Conditions*, 1998, in Proceedings: Thermal Performance of Exterior Envelopes of Buildings VII.

pressure differential, both systems performed well. Wind-washing was discovered in one area of the fiber glass batt wall system, but the air barrier in that area was subsequently found to be compromised.

These studies demonstrate that air infiltration is not connected with insulation but by wall, wall sheathing, proper sealing, and so forth.

Moreover, the Colorado Study, as discussed in greater detail below, has serious design flaws. Equally relevant, the conclusions drawn from the Colorado Study by various cellulose manufacturers are broader than the limited evidence of that Study. These factors identified by the FTC establish the basic traits of valid substantiation. The Colorado Study does not fit the basic criteria for substantiation.

NAHB noted that the Colorado Study was never published.⁸ The actual Study is not available and only a summary of the Study exists today.⁹ Unpublished or unavailable research presents serious problems because it cannot be checked for validity, clarity, sound scientific approach, or other critical elements of a study. What little is known of the Study demonstrates that the Colorado Study suffered from significant design flaws.

Because the Colorado Study was never published, it was not subjected to peer review. The Colorado Study could have benefited from peer review. Peer review detects different types of defects in a study. Peer reviewers are the best available tool for finding defects in design specifications, test documentation, and whether conclusions are supported by the study.

THE COLORADO STUDY LACKS A LEGITIMATE SIDE-BY-SIDE COMPARISON

The FTC's Home Insulation Rule and its Statement of Policy Regarding Comparative Advertising require clarity in comparative advertisements. Specifically, the study "must give the R-values at a specific thickness for each insulation." 16 C.F.R. § 460.18(d). The Colorado Study is all about an insulation comparison, yet R-values at a specific thickness are not given.

Indeed, comparative studies must characterize the structures used and the materials used in order to eliminate the possibility that these differences will alter the thermal performance of the test samples. In other words, the test must be a genuine side-by-side comparison.

The Colorado Study failed to create a legitimate side-by-side comparison. Consider the following inequities:

- The two test buildings were located at different locations in the campus parking lot. University buildings acted as a block from the primary wind direction for the test building insulated with cellulose.
- The Study summary fails to identify the thermal performance of the door assemblies and windows installed in the two test buildings. Since both windows and doors are

⁸ NAHB Research Center, *Effect of Insulation Type on Air Infiltration in North American Homes: Summary of Existing Research*, November 2006, p. 5.

⁹ *Ibid.*

significant sources of air infiltration, it would be important to establish that identical windows and doors were installed in both test buildings.

- The Study summary is silent regarding sealing or caulking. Lack of proper sealing could account for significant air infiltration and also undermines any attempt to test duplicate structures.
- The Study summary fails to address whether both test buildings had floor insulation or insulated end joists. The heat loss from an uninsulated floor would be sizable. Certainly the uninsulated floors and end joists would account for air infiltration.
- The most significant difference between the two tests buildings is the simple fact that the installed R-value of the cellulose insulation was dramatically different from that of the fiber glass. This discrepancy is discussed more fully below.

FACTS DO NOT SUPPORT THAT CELLULOSE INSULATION LIMITED AIR INFILTRATION

The key conclusion derived from the Colorado Study by cellulose insulation manufacturers is that cellulose insulation limited the air infiltration to a greater degree than fiber glass insulation. The facts do not support the conclusion that cellulose insulation limited the air leakage in a building.

- Careful reading of the report reveals that blower door tests were conducted with no wallboard on the walls. Properly installed wallboard would have had an enormous impact on air infiltration.
- NAHB criticized the study because there was no blower door test data provided post-drywall and final air sealing.¹⁰
- As discussed more fully below, the R-value of the cellulose insulation was significantly higher than that of the fiber glass insulation. This could have impacted the air infiltration results, too.

EQUAL R-VALUES WERE NOT INSTALLED

The Study summary indicates that Building A was insulated with 5½ inches of R-19 sprayed wet cellulose in the walls and R-30 loose-fill cellulose in the ceiling. Building B was insulated with R-19 unfaced fiber glass batts in the walls and R-30 Kraft-faced fiber glass batts in the ceiling.¹¹ These are the nominal R-values. The Study omits any type of validation of the actual installed R-value. Moreover, designating the cellulose wall insulation by inches and then projecting an R-19 is unscientific and not sufficient for a serious thermal study.

The Study summary casually mentions that the cellulose “insulation was installed with approximately 80% moisture which is more than recommended.”¹² Plainly, cellulose insulation sprayed using 80 percent moisture will create a far higher density than typical wet-sprayed

¹⁰ NAHB Research Center, *Effect of Insulation Type on Air Infiltration in North American Houses: Summary of Existing Research*, November 2006, p. 5.

¹¹ Soontorn Boonyartikaran, Arch D. and Scott R. Spiegle, “Research, University of Colorado School of Architecture and Planning, Fiberglass Vs. Cellulose Installed Performance,” May 1990, p. 1.

¹² *Ibid.* at p. 4.

cellulose. This fact becomes more troublesome when viewed in the context of absolutely no attempt to measure installed R-values during the research. Given the extremely high moisture content, it is likely the cellulose R-values were greater than the fiber glass R-values and greater than would be achieved in typical cellulose insulation installations.

OTHER ISSUES

In addition to the deficiencies in the Study noted above, a close examination of the Colorado Study summary raises other issues that call into question its credibility.

For example, the calculations of heat loss and energy use show mathematical errors. Subtracting the initial meter readings from the final readings gives: $697.5 - 614.75 = 82.75$ kWh for the cellulose building and $711.1 - 606.5 = 104.6$ kWh for the fiber glass building in the 16-day test. $104.6 - 82.75 = 21.85$ (approximately 22) kWh difference. The authors then calculated that the cellulose building used “26.4% less heat” by dividing 21.85 by 82.75 which equals 0.264. Actually, the difference of 21.85 should be divided by 104.6, which gives 0.209; the cellulose structure actually lost 20.9% less heat.

As noted above, the cellulose insulation was installed with excessive moisture. This results in an uncontrolled difference in moisture content in these tests, which is important because the moisture content of the wood framing in the cellulose unit was 17 percent and only 9 percent in the unit with fiber glass. This moisture content in the cellulose structure could cause swelling of the framing and close the seams in the framing interfaces and between the bottom plate and subfloor, which is a common source of air infiltration. The Study summary fails to address the potential impact of moisture on test results.

The Study summary also reports that the fiber glass batts were covered with 4 mil poly vapor barrier and no barrier was placed on the cellulose material. If this air barrier was installed correctly, the air infiltration did not come through the insulation path.

CONCLUSION

This unpublished and unavailable Study was never subjected to any peer-review. Essential details of the Study are missing from the Study summary which makes a full and complete analysis/critique of the Study impossible. Yet what details are available demonstrate that the Study was not a genuine side-by-side study because of significant differences in the two test buildings. Moreover, there is no justification for concluding that the difference in air leakage between the two test buildings can be attributed to insulation. Other uncontrolled factors discussed above are more likely to explain the results. There is no data in the Study summary to even suggest that these contributing factors to air infiltration were weighed or considered in reaching a conclusion.

Given these significant deficiencies in the Study summary and the simple fact that the Study was never peer-reviewed, published, or even available for review, the cellulose insulation industry should NOT rely upon the Colorado Study for substantiation. The Colorado Study does not

provide legal substantiation that cellulose insulation outperforms fiber glass insulation in preventing air infiltration.