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INDUSTRY NEWS

Teaching Architects Building Science

When energy experts gather at conferences, they have been known to grumble that the majority of architects have an imperfect understanding of building science principles. According to this view, deficiencies in architectural education partly explain the current crop of lawsuits over ice-dams, window leaks, rot from hidden condensation, and unbalanced HVAC systems in new buildings.

Among those complaining that US architecture schools fail to provide an adequate education in building science principles are many architects, including Richard Keleher of Concord, Massachusetts. On May 15, 2003, Keleher drafted a "Paper of Concern" to the organization responsible for accrediting architectural schools, the National Architectural Accrediting Board (NAAB). Under the heading "Architects Not Technically Knowledgeable," Keleher wrote, "The [architecture] schools are not providing sufficient education in the areas of the building envelope/enclosure and the relevant building science. Practitioners in the Boston area find that their staff often doesn't understand the principles governing the design of building envelopes and the control of heat, air, and, especially, moisture (both liquid and water vapor) within buildings and across and within the building envelope. The schools of architecture should be educating architects as to the principles (technology) of building envelopes and the relevant building science."

According to Keleher, he has received "no reply, not even an e-mail" from the NAAB in response to his memo. Reached by phone, Robert Odermatt, an architect and president of the NAAB board, told ***EDU*** that he has no recollection of reading the Keleher memo. Odermatt asserted, however, that NAAB was adequately addressing Keleher's concerns. "We are quite aware of these issues," said Odermatt. "Periodically, every three years, we have a validation conference to look at the things in the NAAB criteria that should be adjusted. Obviously, those kinds of concerns were addressed at the last conference. But there is pressure that comes from the limited amount of schooling that students have. They need to study historic preservation, accessibility, codes, sustainability, as well as all of the design issues. The question is not, 'Does a subject need to be addressed?' but 'When does it need to be addressed?' We have been trying to separate what happens in school in terms of education from what happens in training, during the internship. What you have to understand is there are only so many semesters in a student's education. There is also a pressure to make the profession accessible —

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more accessible to young people — so that it does not require years and years and years of education."

Surveying the Experts

In an effort to gain perspective on the issue, ***EDU*** recently interviewed several architects and engineers involved with building science issues. In addition to Keleher and Odermatt, ***EDU*** spoke with Edward Allen, an architect and author from South Natick, Massachusetts; James Axley, professor of architecture at the Yale University School of Architecture; Mark Bomberg, an engineering research professor at Syracuse University; Eric Burnett, the director of research at Penn State's Housing Research Center; André Desjarlais, an engineer and program manager for building envelope research at the Oak Ridge National Laboratory; Barry Hardman, an engineer at National Building Science Corporation in Temecula, California; Betsy Pettit, an architect and principal at Building Science Corporation in Westford, Massachusetts; and Bill Rose, an architect and building researcher at the University of Illinois in Urbana-Champaign.

Although most of those interviewed agreed that US architecture schools should be teaching more building science, several were reluctant to point fingers. According to Betsy Pettit, most US architects are acquainted with the current trend toward sustainable design and are eager to improve their knowledge of building science. Eric Burnett was similarly loathe to cast the first stone. "It's very easy to grossly oversimplify," said Burnett. "For one thing, architectural education is not uniform across the country. It is very flexible, and goes by the will and the whim of the architecture school director. In my own interpretation, when it comes to education, all of us are deficient — anyone who works on built facilities, including both engineers and architects."

Of those who were interviewed, the most optimistic ones — a group that includes Desjarlais, Pettit, and Hardman — are those actively working to help provide architects with building science training through workshops or continuing education courses. What follows are some of the observations, grouped by topic, of those interviewed by ***EDU***.

Do Most Architects Have an Adequate Understanding of Building Science Principles?

Desjarlais: "Among practitioners and consultants, there is a lack of working knowledge of how building envelope systems perform from a hygrothermal perspective."

Axley: "It would be wonderful if every architect were a Renaissance man, but in fact people are limited. That is why we have specialists, and why we disaggregate the design process into a number of players."

Hardman: "You won't find architecture plans that go into depth on air barrier details at all. Architects do not understand the principles, and they don't have the training to understand the joining between elements — for example, between walls and roofs. You won't find a detail of how the roof connects to the wall, except perhaps for a structural detail. The question is, who should be demanding these shop drawings showing details between these areas? Architects are just not trained in these details."

Allen: "I think the average architect doesn't understand the basic principles behind keeping water out of buildings. About 50 percent of lawsuits against architects are for leaks. I just don't understand why we are graduating people who aren't competent to design details that will work."

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Do US Architecture Schools Teach Building Science?

Burnett: "Architects study the appearance of buildings but not the enclosure."

Axley: "European architecture education involves five to seven years of courses related to the profession, while in the US, architecture education requires a broad four-year undergraduate degree program which may have nothing to do with architecture, plus a three-year professional degree program. Consequently an architecture student in northern European will take more courses in building science and building technology than our students will in the US. The European construction industry is just way ahead of us in terms of the sophistication of envelope construction, both in terms of analysis and execution — that is, the quality of the construction. … But I don't think the difference between US practice and European practice is widely appreciated at US architecture schools."

Bomberg: "After World War Two, the study of building science in Europe grew very fast. Now, in central Europe and Scandinavia, I don't know of any civil architectural faculty that doesn't include building science. But we'll never get there in the US, because here there is no legislation requiring it and therefore no responsibility."

Desjarlais: "Part of the problem is that, unlike in Europe and Canada, we don't have university-level programs in building science. We just don't teach it."

Rose: "There is a small group of architects who do have an understanding of building science principles, but they have had to pick up that understanding on their own."

Bomberg: "An architecture school should have a technological studio, where for the first part, level one, you study spatial design. And then you invite a few people who are experts, who are capable of guiding the students to answer questions such as, 'Can I make this with plastic, metal, or concrete? What materials or solutions will work? What are the consequences of doing this or that?' But that is the missing part now. That is the part that architects have a great difficulty in accepting."

Allen: "I don't like the term 'building science' — I prefer 'building technology.' It's not generally taught in our schools. My impression is that very few schools teach anything substantial about the building envelope. Very few schools teach any detailing, which I think is a gross failing, because that is the one technical area where architects are expected to be expert. To me, the NAAB has really fallen short on that issue, and so have the schools. There needs to be a lot more taught on the subject of building envelopes. There are scarcely any books on the topic. I just gave a talk at the Association of Collegiate Schools of Architecture annual meeting, and I noted that, in technical areas, architecture schools teach what architects don't need to know and don't teach what they do need to know. They don't teach them anything about choosing materials in a framing system, laying out the frame of the building, detailing the frame of the building. They don't teach detailing. They don't teach much on façades. It is something that has to change."

Bomberg: "The program at Concordia University in Montreal, where I used to teach, was geared toward nonstructural building engineering. It is the only university in North America which has this profile. All of the other architecture schools focus on design, but have no clue whatsoever about the materials or the physical functions of building enclosures. In North America, architects do not like to see engineers teaching any courses in architecture school. At one point I applied for a part-time teaching position at the Carleton University School of Architecture in Ottawa, but I was refused because I am not an architect. That is part of the problem — architects do not want to open the door for engineers to be part of their teaching. But somebody who is not experienced in a field cannot provide a good overview to students of the most important elements of understanding and knowledge. Now, people who were not experts in this field sometimes give these courses."

Axley: "Architecture schools are constantly, almost obsessively, altering their curricula, to adjust to what is perceived to have become important. … What was happening in the US architecture schools from the 1950s to the current time was a systematic replacement of building technology courses with courses that relate to architecture theory, history, and criticism. In the early to mid '60s, it was typical for architecture students to be required to take three or four structural engineering courses and two courses in environmental control systems. But as these history and theory courses were deemed to be more important, the building technology courses were reduced in number."

Architectural Privilege

Rose: "The main role of architecture education is to inculcate a sense of difference and superiority. That is their principal job, to provide an identity for the group and to create barriers to any comparison to builders and engineers. What sustains the privilege is cult

behavior. Their identity isn't pegged to the failure or not of the building envelope. Because of their privileged status, their identity doesn't hinge on whether things perform well or not, and their privileged status is threatened by any requirement that the buildings achieve technical accomplishments. They don't really *mind* providing buildings that perform — they rather like it if they do — but the minute anyone says, 'You must,' they react the way any cult would react — they will cream you. Most architects don't recognize the cult nature of architecture education. They always begin with a genuflection to design, because design is identity-conferring. But these are the people who drank the Kool-Aid."

Legal Liability

Rose: "In granting the franchise for architects to be responsible for construction, the interest of the state is in the health, safety, and welfare of the occupants. But the state is dropping the ball by granting the responsibility to architects."

Hardman: "I see lawsuits almost everywhere these days. But that is the way we move in this country — that's our process."

Rose: "Legally, architects are held to the 'practice standard.' The concept is fundamental to any architect's defense against claims of damage. According to the practice standard, if the architect has done what other architects in the area are doing — the common practice — that constitutes sufficient defense. Architects' ignorance of building performance is shielded by the lawyers."

Bomberg: "An architect can hire whoever he or she wants, but ultimately if there is any failure in the building, the architect is responsible. In Quebec, that is clearly specified by law. But in the rest of Canada and in the US, as far as I know, that is not the case. If the architect is only responsible for the spatial design, then we have a situation where you can sue anybody. I am afraid that now, everyone is responsible for his or her part of the building. But buildings are complex interacting systems. It may be implied that the architect is in control, but in reality he is far from being in control. We need legislation to clarify the situation. There needs to be a very clear requirement that the architect is responsible for the functioning of the building. Then they would have to have a basic technical education."

Necessary Steps to Improve the Situation

Keleher: "Having an air-barrier requirement in the Massachusetts commercial code has had a remarkable effect. Now, for the first time, I hear architects asking, 'What is an air barrier? What are pascals?'"

Axley: "At most US schools, including the Yale School of Architecture, which is seen as a school that privileges high design, the importance of sustainable design has become more and more central to curriculum development. There has been a response to alter the substance of individual courses to meet the larger expanded problems of sustainable design."

Burnett: "The question is, how do you train the guys who are already practicing? That is an urgent need."

Bomberg: "In the 1970s in Canada, Neil Hutcheon, the former director of NRC, tried to build a program for architects called 'Teaching the Teachers.' The idea was to give summer courses for architects, to bring up the topic of building science or building physics. But he found a great deal of resistance already. He did have a couple of workshops at the NRC, but it did not fly. It was organized once or twice but it failed to draw enough people."

Desjarlais: "What we are trying to do with BETEC [the Building Environment and Thermal Envelope Council] is to establish regional building enclosure councils. Several of these now exist around the country. We want to offer this to groups of architects in other cities, but they aren't knocking down our doors to do that yet."

Hardman: "One of the things we are doing with BETEC is to organize workshops for architects called Building Science Insights. The program consists of four folks, a kind of traveling show, that will connect up with a local AIA [American Institute of Architects] chapter for a full-day conference. This is a program designed specifically for architects, to introduce them to the dynamics and physics of building science as it relates to building construction. Each workshop will try to bring in regional information as much as possible, and help bring into focus for the architects the importance of building science — to introduce scenarios of proper design, how to use different materials together, wall modeling — so that at the end of the day, we've brought forth the information that walls are dynamic and physics means a lot. We hope that the participants come away with a new understanding of how things work, that we've made them think and piqued their curiosity."

Bomberg: "What we are trying to do in BETEC is just scratching the surface and waking up interest rather than actually teaching anybody. We are trying to show

that by understanding interactions you can solve some problems faster. You cannot look at an air barrier as just an element of energy conservation; it is also connected to durability. But in planning these workshops I have had to cut out 90 percent of the critical discussion items because I don't have the time. If I had three days instead of two hours, I could go more slowly and say, 'What is my goal? How do I get there?' In a two-hour workshop, you give them ready solutions, and you give them maybe an explanation of why this solution is given. You do this because they need to get something out of it. But that is not really learning — that is acquired digested knowledge. The unfortunate part is that the workshops will not solve the problem. At best we hope to change people from nonbelievers to enthusiasts."

Desjarlais: "Four times a year we offer seminars on using WUFI [a computer program that models the hygrothermal performance of walls and roof assemblies]. We jump back and forth from boring physics lectures to showing where the button is on the computer to make this happen. About 30 people come to each seminar — usually about one-third architects, one-third consultants, and one-third manufacturers of building materials."

Pettit: "Building Science Corporation is a provider of courses eligible for continuing ed credits for the AIA. In most states, architects are required to obtain 24 to 32 continuing ed credits a year. I just taught a course called Building Science for Architects, and 100 people attended. In general, both builders and architects are clamoring for the information, as long as it is presented in ways that it can be understood."

Axley: "Some schools, including MIT and the University of California at Berkeley, have, within the last 25 years, developed specific building technology programs within the department of architecture. These programs were put in there to support the architectural design program. That has been a big shift. So, in principle, the idea is to bring in better qualified technical construction instruction to the architecture program. But at both schools the curriculum has not been extended, so the number of required building technology courses is still relatively small."

Allen: "I think we need pressure at the national level to tighten educational requirements through the accrediting board. We need better textbooks, and we need people teaching this in the schools."

Hardman: "I think that all the architectural schools need to have mandatory classes in building science — in the dynamics of a building, how a building works. We need to train young architects about the physics of a building."

Taking a Historical Perspective

Bill Rose, who has a habit of placing any discussion of current problems in a historical perspective, knows that the current lack of building science expertise at architecture firms is nothing new. In his recently published book, *Water In Buildings*, Rose quotes Max Abramovitz, the architect of the United Nations headquarters in New York, who lamented in 1949, "Actually, I am very concerned that the science of building is going to disappear. I wonder if you realize how very few men are left today who are expert in building science. They are very rare and they are passed around among the large [architecture] offices. You have to dig them out of their holes and revive them."

NEWS BRIEFS

Lennox Introduces 20.5 SEER Air Conditioner

DALLAS, TX — Lennox Industries recently introduced a new residential air conditioner, the XC21, with a SEER rating described as "up to 20.5." The XC21, which uses R410A refrigerant, includes a two-stage scroll compressor and a high-efficiency outdoor coil. The limited warranty covers most components for 5 years, except for the compressor, which is covered for 10 years. According to the manufacturer, the XC21 is "the most efficient central air conditioner on the market today" and is "thirteen times quieter than a standard air conditioner."

Residential Cogeneration Unit Announced

MEDFIELD, MA — A Medfield company called Climate Energy has announced the development of a residential cogeneration unit fueled by natural gas. Called the Micro-CHP (for Combined Heat and Power), the unit is an engine-powered generator that also provides space heat. Developed with help from American Honda Motor Company, the Micro-CHP is not intended to be used to generate electricity during the summer. When used during cold weather, the unit should provide cost savings. Climate Energy expects that one of the units could produce up to 4,500 kWh of electricity per year while also meeting the space heating needs of a typical home. Although similar units have long been available in Japan, Climate Energy is the first company to develop a residential cogeneration unit for the US market. The Micro-CHP is now undergoing field testing, and should be available for sale to

the public (for about $8,000 each) sometime in 2006. For more information, visit *www.climate-energy.com*.

Cooling Buildings With Seawater

HONOLULU, HI — A $100-million project under development by two Hawaii companies seeks to use seawater to indirectly cool 65 commercial buildings in downtown Honolulu. The two companies, Honolulu Seawater Air Conditioning and Makai Ocean Engineering, claim that the electricity required to pump enough seawater to cool the buildings would be only 25% of the electricity required to cool the buildings with conventional air conditioning systems. The plan calls for pumping 45ºF seawater from a depth of 1,600 feet at a location 3.5 miles offshore to a shore-based heat exchanger, where the cool ocean water would be used to lower the temperature of a reservoir of fresh water. The warmed seawater would be discharged back to the ocean, while the cooled fresh water would be distributed through underground pipes directly to the cooling systems of downtown office buildings. Among the hurdles still ahead for the project: obtaining permission to tear up Honolulu streets and signing up customers.

Hydrogen-Fueled Fireplace

LAKEVILLE, MN — Fireplace manufacturer Hearth & Home Technologies has developed a hydrogen-fueled fireplace with a built-in electrolyzer. The fireplace, called the Heat & Glo Aqueon, produces a 31,000-Btuh open flame but requires no connection to a gas supply. Instead, its hookup requirements resemble those of a washing machine: water supply and electrical power. Since the only byproduct of hydrogen combustion is water vapor, no venting is required. The Aqueon is available in several models ranging in price from $35,000 to $50,000. For more information, contact Hearth & Home Technologies at (888) 427-3973 or (952) 985-6606; Web site: *www.hearthnhome.com*.

Coalition Decries Proposed Cuts in Energy-Efficiency Funding

WASHINGTON, DC — Thirty-two business and environmental groups have issued a letter urging Congress to restore funding to energy-efficiency and renewable-energy programs that President Bush has targeted for cuts (see the "New Briefs" section of ***EDU***, March 2005). The White House has proposed cutting the Energy Efficient Buildings program by $7.5 million, or 11%, with an additional $20.5 million in cuts proposed for other energy-efficiency programs. Cuts totaling $24 million are proposed for several renewable-energy programs, including programs promoting biomass fuels, geothermal power, hydropower, and solar energy. According to the public letter, "at a time when the price of gasoline is exceeding $2 per gallon, a barrel of oil is over $50, and natural gas is more than $6/mmBtu, cutbacks in DOE's core energy efficiency/renewable energy programs are truly penny-wise and pound-foolish." Among the groups that have signed the letter are the Alliance for Affordable Energy, the Alliance to Save Energy, the American Council for an Energy Efficient Economy, the American Solar Energy Society, and the Union of Concerned Scientists.

Maryland Energy-Efficiency Legislation Dies

ANNAPOLIS, MD — A move by the Maryland legislature to establish a public benefit fund to encourage residential energy efficiency has died. Two proposed bills, SB 397 and HB 490, would have established the fund, dubbed the Energy Saving Investment Program (ESIP), to pay for incentives to encourage energy-efficiency features in new homes and to subsidize the purchase of energy-efficient appliances. The two bills died after Maryland Governor Ehrlich, who supported similar legislation last year, withdrew his support for this year's bills. "Why the Ehrlich Administration chose to move backwards on energy efficiency, when energy prices are at record levels, is beyond me," said Bill Prindle, the deputy director of the American Council for an Energy-Efficient Economy. "Twenty states, led by Republican and Democratic governors, run ESIP-like programs, most of them more ambitious, all of them cost-effective and well-received. This reversal is astonishingly short-sighted."

New Clothes Washer Efficiency Standards

WASHINGTON, DC — The US Department of Energy (DOE) has announced a new minimum efficiency standard for clothes washers, as well as a new specification for Energy Star clothes washers. The metric for measuring clothes washer efficiency is the Modified Energy Factor, or MEF. Effective January 1, 2007, the federal minimum standard will increase from 1.04 MEF to 1.26 MEF. On the same date, the minimum standard for Energy Star clothes washers will increase from 1.42 MEF to 1.72 MEF. The new Energy Star specification will also, for the first time, include a water-saving requirement.

DOE Grants Refrigerator Efficiency Petition

WASHINGTON, DC — The US Department of Energy (DOE) has granted a petition requesting consideration of a new energy-efficiency standard for home refrigerators. The petition, which was submitted by a coalition of parties including state governments, utilities, and energy-efficiency organizations, cited a recent DOE analysis estimating that higher refrigerator efficiency standards

could save 5.78 quadrillion Btus of energy between 2010 and 2035. The DOE is required by law to set appliance efficiency standards as high as possible consistent with cost effectiveness. The granting of the petition compels the DOE to begin the rulemaking process to consider raising refrigerator efficiency standards.

Improving European Appliance Efficiency

STRASBOURG, FRANCE — The European Parliament has approved a new agreement with European appliance manufacturers by which manufacturers make a voluntary pledge to improve the energy efficiency of clothes washers, air conditioners, boilers, and light fixtures. The agreement covers appliances sold throughout the 25-nation union beginning in 2007. The European Executive Commission has hinted that it may impose mandatory energy-efficiency standards if manufacturers fail to make sufficient voluntary progress. The agreement was criticized by Dr. Stephan Singer, a spokesperson for the environmental group WWF. According to a report from Reuters News Service, Singer noted that "voluntary agreements and the rejection of an independent verification on their implementation are nothing more than an incentive for producers to avoid making the required innovations."

Home Depot Works to Undermine State Ceiling Fan Efficiency Standards

WASHINGTON, DC — According to an Associated Press (AP) story, Home Depot lobbied a member of Congress, Representative Nathan Deal (R - Ga), to introduce an energy-bill amendment to establish a Federal efficiency standard for home ceiling fans. Deal's amendment was promptly approved by the House Energy and Commerce Committee. The apparent intent of Deal's amendment was not to improve the efficiency of ceiling fans but to preclude states from passing their own ceiling fan standards. The tactic employed by the amendment's authors takes advantage of the Department of Energy's notorious pattern of delays in implementing new standards. Among the Democrats who objected to Deal's amendment was Tom Allen (D - Me), who tried to draw attention to the fact that a Federal standard would preempt ceiling fan standards already approved or under consideration by several states, including Connecticut, Maine, Maryland, Massachusetts, New Jersey, Rhode Island, and Vermont. According to the AP, "Todd Smith, a spokesman for Deal, said the congressman had been contacted by Home Depot and by several ceiling fan manufacturers seeking federal legislation that would preclude the states' actions." Home Depot sells half of all the ceiling fans sold in the US.

Protestors Install PV Array Without Permission

HULL, UK — Eight protestors from the environmental group Greenpeace climbed onto the roof of Deputy Prime Minister John Prescott's home in Hull and installed a photovoltaic (PV) array there without permission. The four women and four men, who spent several hours on the roof, explained that their action was intended to draw attention to Prescott's failure to tackle global climate change. One of the protestors, Laura Yates, used her cell phone to call a reporter from the roof, explaining, "Housing is responsible for a quarter of Britain's CO_2 emissions. It's a major contributor to the climate-change problem and Prescott could do something about this, particularly with the millions of new homes that are going to be built in Britain over the next years. He's overseeing this house building program and he should be ensuring that every one of these new homes is built to zero emissions standards." Before they were arrested, the protestors explained that they would be glad to come back at a future time to finish the PV installation, if Prescott wished. Prescott refused to talk with the protestors, however, calling their action "deplorable and unacceptable."

Utilities and Builders Oppose California Solar Bill

SACRAMENTO, CA — The California Building Industry Association and three California electric utilities have publicly opposed the Million Solar Roofs Initiative, Governor Arnold Schwarzenegger's plan to expand state subsidies for the installation of photovoltaic systems (see the "News Briefs" section of ***EDU***, May 2005). According to the Associated Press, a spokesperson for Pacific Gas and Electric announced, "The vast majority of our customers will not be able to take advantage of these incentives" — an apparent referrence to renters and condominium owners. The spokesperson continued, "The nonparticipating customers are the ones who would pay for the program."

New Voluntary Residential Energy Code in Britain

LONDON, UK — A British task group hopes to complete work on a new residential energy code, the Code for Sustainable Buildings (CSB), by the end of this year. As a first step, the code will be implemented in a new residential housing development in London called the Thames Gateway, where builders plan to develop 8,000 new homes annually for the next several years. Although prime minister Tony Blair and deputy prime minister John Prescott have praised the new energy code, the government has no plans to make the code mandatory. According to a *Guardian Unlimited* news story on the new code, "Britain's building standards are well below the rest of Europe."

Fuel Cell Plus PV in New York

HAUPPAUGE, NY — An electrical generation system consisting of a 15-kW photovoltaic (PV) array and a 5-kW natural gas fuel cell has been installed at an office building on Long Island. The fuel cell provides both electricity and domestic hot water. The cost of the system, located at the headquarters of the International Brotherhood of Electrical Workers, was subsidized with renewable-energy funds from the state of New York and the local utility, the Long Island Power Authority.

Quote Without Comment

"Most Americans … think of New York City as an ecological nightmare, a wasteland of concrete and garbage and diesel fumes and traffic jams, but in comparison with the rest of America it's a model of environmental responsibility. By the most significant measures, New York is the greenest community in the United States, and one of the greenest cities in the world. … The average Manhattanite consumes gasoline at a rate that the country as a whole hasn't matched since the mid-nineteen-twenties, when the most widely owned car in the United States was the Ford Model T. Eight-two percent of Manhattan residents travel to work by public transit, by bicycle, or on foot. That's ten times the rate for Americans in general, and eight times the rate for residents of Los Angeles county. New York City is more populous than all but eleven states; if it were granted statehood, it would rank fifty-first in per-capita energy use." [David Owen, "Green Manhattan," in the October 18, 2004 issue of the *New Yorker*.]

RESEARCH AND IDEAS

Furnace Fan Penalty

A new study has confirmed that using a furnace blower to distribute fresh ventilation air incurs a severe energy penalty. The latest researcher to quantify the cost of blower-fan dependency is Robb Aldrich, an engineer at Steven Winter Associates (SWA) in Norwalk, Connecticut. Aldrich's conclusions confirm those of several earlier researchers, including Judy Roberson (see ***EDU***, June 1999), James Lyons (see ***EDU***, May 2002), Harvey Sachs (see ***EDU***, March 2003), and Scott Pigg (see ***EDU***, September 2003).

A furnace fan needs to move a relatively large volume of air — as much as 1,200 cfm — but typically runs for only a few hours per day. In contrast, ventilation air is best provided continuously, in relatively small amounts — typically only 50 to 100 cfm. Using a furnace fan to distribute ventilation air is like using a chainsaw to cut a birthday cake.

New Homes for South Chicago

The latest data on ventilation-air distribution costs was collected at a 23-unit project called New Homes for South Chicago III (see the "News Briefs" section of ***EDU***, December 2003). The new neighborhood is being built by Claretian Associates, a nonprofit developer of affordable housing; some of the project costs have been funded by the US Department of Energy's Zero Energy Homes program, the Building American program, and HUD's PATH program. In three of the homes, ventilation system performance is being monitored by consultants from SWA, including Aldrich. Aldrich also helped develop the specifications for the homes.

Aldrich reported preliminary monitoring results in a paper, "Green, Healthy, and Affordable Homes on their Way to Zero Energy," co-authored with his SWA colleague Douglas Owens. Aldrich presented the paper at the December 2004 Performance of Exterior Envelopes conference in Clearwater Beach, Florida.

Mandating Oversized Equipment

The three monitored South Chicago houses are relatively tight 2,592-square-foot homes with structural insulated panel walls and roofs (see Table 1, page 10). Each of the project's first 12 homes includes a 1.2-kW roof-mounted photovoltaic (PV) system (see Figure 1).

Figure 1. Twelve of the houses at the New Homes for South Chicago III development are equipped with roof-mounted photovoltaic arrays. In most of these houses, the furnace uses far more electricity than is produced by the PV systems.

Unfortunately, the builder did not adopt two of the recommendations made by SWA consultants. The consultants specified furnaces equipped with efficient electronically commutated motors (ECMs), but the recommendation was rejected. (According to the contractor, the $1,000 upgrade charge for an ECM-equipped furnace was a budget buster.) Air conditioners were not specified for most of the homes, but were offered as an option. Although the cooling load calculation showed that a 1.5-ton unit would be adequate, the local building inspector insisted that any house with air conditioning needed a 3.5-ton unit. Since the builder chose not to battle the building department on the issue, at least one of the houses ended up with a 3.5-ton air conditioner, in spite of the strong recommendation from SWA consultants to avoid equipment oversizing.

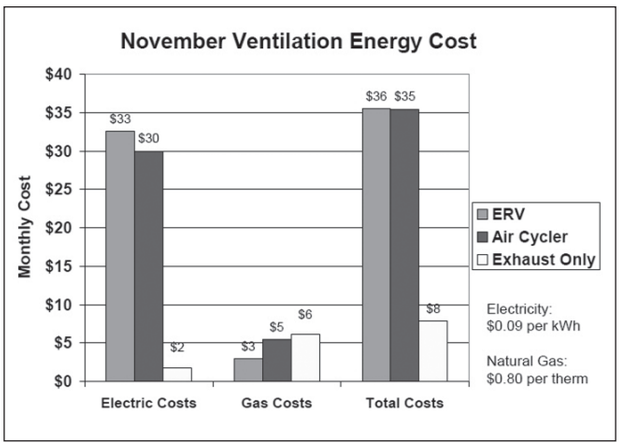

Figure 2. Because the simple exhaust-only ventilation system did not depend on the furnace fan for air distribution, it used significantly less electricity than did either the ERV-based system or the system controlled by the AirCycler.

Three Ways to Ventilate

One of the chief aims of the SWA study was to collect data on ventilation system performance. Three otherwise identical homes received different ventilation systems for monitoring and evaluation:

- House 1 was equipped with an energy-recovery ventilator (ERV) connected to the forced-air heating ductwork.
- House 2 was equipped with a passive duct bringing outside air to the furnace's return-air plenum; the duct was equipped with a motorized damper controlled by an AirCycler (see ***EDU***, January 2000 and January 2001).
- House 3 was equipped with two bathroom exhaust fans controlled by Tamarack Airetrak timers.

At the three houses, the researchers monitored:

- Temperature, humidity, and carbon dioxide (CO_2) concentration outdoors, in two bedrooms, and in the living room.
- Fresh air flow rate, temperature, and humidity.
- Exhaust air flow rate, temperature, and humidity.

The ERV in House 1 was installed in the basement. Although the ERV fan was programmed to run continuously at a rate of 60 cfm — that is, to provide enough fresh air to meet ASHRAE Standard 62.2 — monitoring showed that CO_2 levels in the upper floors were above 1,000 ppm, and sometimes above 2,000 ppm, indicating that ventilation was inadequate. The researchers concluded that most of the fresh air being delivered by the ERV was staying in the basement. To help distribute ventilation air throughout the house, the researchers reprogrammed the ERV to run for 75% of the time, and installed a control to turn on the furnace fan whenever the ERV was operating. According to Aldrich, "While this succeeded in reducing carbon-dioxide concentrations in the home, it drastically increased electricity use."

A Severe Energy Penalty

Electricity use was unexpectedly high at both House 1 and House 2. "The ventilation and whole-house electricity monitoring has provided some eye-opening results," Aldrich said. "We immediately observed that the electricity consumption in the homes was very high. Upon further investigation, it was found that the furnace fans were responsible for a large part of this." In November 2004, the two houses using the furnace fan to distribute ventilation air consumed an average of 347 kWh for ventilation alone — more than three times the average monthly electrical production from the homes' PV systems (see Figure 2).

Each South Chicago furnace draws between 700 and 800 watts in fan-only mode. More efficient furnaces equipped with ECM blowers usually draw 250 watts in fan-only mode, while the maximum power draw of the ERV is only 102 watts. If House 1 had been equipped with dedicated ventilation ductwork, ventilation air could have been distributed with the ERV's energy-efficient fan. In New England, where hydronic heat prevails, such ductwork (typically 6-inch-diameter galvanized ducts) is commonly installed in homes equipped with ERVs. Since the South Chicago homes lack dedicated ventilation ductwork, the only way to distribute the ventilation air is with the power-hungry furnace fan.

Of the three monitored ventilation systems, the most efficient by far consisted of the two bathroom exhaust

fans, which together used only 6% as much electricity for ventilation as the systems that distributed ventilation air with the furnace fan. Although the bathroom exhaust fans had a higher thermal penalty than the ERV, the total energy cost of the simple exhaust-only ventilation system was only 23% of the total energy cost of the other ventilation options.

The indoor air quality in the home with the exhaust-only system did not appear to be any worse than in the other two monitored homes. The median indoor CO_2 concentrations in the house with exhaust-only ventilation were about the same as in the house with the AirCycler, and were lower than in the house with the ERV. According to Aldrich, the CO_2 data do not indicate that the house with an exhaust-only ventilation system has any worrisome problems with ventilation air distribution.

Low Gas Consumption

The overall energy performance of the monitored houses has been mixed. "With regard to gas used for heating, the homes really are performing well," notes Aldrich. "So far, utility bills agree with modeling, showing a reduction of about 50% compared to standard new construction in the area."

The PV systems have been performing as expected, producing about 1,200 kWh of electricity per year. But Aldrich has been disappointed by the home's relatively high levels of electricity consumption. "We had hoped that these homes would be moving towards zero energy, or at least zero electricity, but we see that we're not considerably below the electricity consumption of the average home," says Aldrich. "It is frustrating to me to see people pursue solar when they haven't pursued much more cost-effective efficiency measures. It's worth noting that these homes were on an incredibly tight budget. We approached the builder, South Chicago Workforce, with our findings and *strong* recommendations that more efficient furnaces be used, but the approximately $1,000 incremental cost for ECM furnaces has so far been out of the question. The $12,000 to $14,000 PV systems, on the other hand, are entirely paid for by the state, the city, and, I believe, the utility."

Logical consistency requires any PV-equipped home to use an "expensive electricity" perspective when assessing the cost-effectiveness of any contemplated appliance efficiency upgrade — that is, a perspective favoring investments in very efficient appliances. Otherwise, it makes little sense to spend thousands of dollars installing PV modules on the roof. The designers most likely to have an intuitive grasp of this perspective are those with experience designing off-grid homes, where furnaces with 700-watt blowers are unheard of. But as long as electricity is widely available for 9 cents a kilowatt-hour, builders will probably continue to make the type of appliance-specification errors made in South Chicago.

For more information, contact Robb Aldrich, Steven Winter Associates, 50 Washington Street, Norwalk, CT 06854. E-mail: raldrich@swinter.com.

Table 1 — New Homes For South Chicago III Specifications

Location	Chicago, Illinois
Area	2,592 square feet
Foundation	Walk-out basements; below-grade basement walls are 8-inch-thick poured concrete
Basement wall insulation	Interior 4-inch-thick EPS
Wall construction	6 1/2 -inch-thick SIPs (R-24.7)
Roof construction	10 1/4-inch-thick SIPs (R-42.5)
Windows / glazing	CertainTeed vinyl windows with double-pane low-e glazing (U-factor = 0.30, SHGC = 0.45)
Heating system	Sealed-combustion Armstrong condensing gas furnace (AFUE 92.5%)
Heat distribution	Galvanized steel ducts with R-6 duct insulation; all ducts within conditioned space
PV system	1.2-kW system (16 Spire Solar 75-Watt modules and a Sunny Boy grid-tied inverter)
Air conditioner	3.5-ton Armstrong SEER-10 unit (available option)
Domestic hot water	A.O. Smith Sealed Shot 50-gallon gas-fired sealed-combustion water heater (EF 58%)
Ventilation system	H1 = ERV with distribution by central air handler; H2 = passive fresh air duct to return plenum with distribution by central air handler; H3 = two timer-controlled bathroom exhaust fans.
Blower door test	300 to 350 cfm @ 50 Pa.
Sale price	$155,000

Table 1. The specifications for New Homes for South Chicago III comply with the requirements of the Zero Energy Homes program.

NEW PRODUCTS

Drip Caps With End Dams

Some builders omit aluminum drip caps (also known as head flashing or Z-flashing) above their windows out of the mistaken belief that window fins have made drip caps obsolete. But the purpose of most window fins is merely to provide a way to mechanically attach a window to a house, not to conduct water away from the window opening. On almost all windows, especially windows with traditional exterior casing or brickmold, a drip cap is still essential.

However, as many home inspectors have learned, the typical aluminum drip cap is often problematic. When siding is installed tight to a drip cap, as it often is, the pressure of the siding can pinch the flashing crease, creating a reverse slope in the flashing that conducts rain back toward the house (see Figure 3). The drip cap, now acting as a gutter, directs water to the window's vulnerable upper corners. Drawn by gravity, the water dribbles down the sides of the window. On windy days, the water may be driven inward. If the sides of the window are inadequately flashed, water sometimes follows the trimmer studs down to the rough sill, which eventually begins to rot.

Figure 3. All too often, aluminum drip caps develop a negative slope. The usual consequences include corner dribbling and casing rot. [Photo credit: Jeff May, author of *The Mold Survival Guide* from Johns Hopkins University Press.]

Designing a Better Drip Cap

The ideal drip cap would be sloped, and would be made of a material stiff enough to resist bending. Moreover, it would be equipped with end dams to prevent corner dribbling. Although such a drip cap can be fabricated from soldered copper, custom-made copper drip caps cost too much for most residential jobs.

Recently two manufacturers have started producing plastic drip caps with end dams. A Charlotte, North Carolina manufacturer called Water Out Flashing is selling a sloped polypropylene head flashing equipped with parallel grooves that direct water away from the building. The head flashing is molded with integral end dams, and is manufactured in a single size (6 feet long). It is designed to be used with either straight-topped or arch-topped windows (see Figure 4).

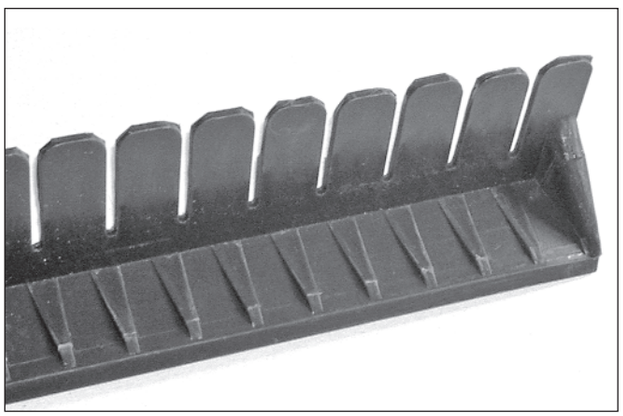

Figure 4. Water Out Flashing sells a polypropylene drip cap for arched windows. The flashing comes with triangular end dams.

When used for any window narrower than 6 feet, Water Out head flashing must be trimmed. If both end dams are retained, the flashing ends up with a center seam. According to the manufacturer, the flashing should not be overlapped; instead, adjacent pieces should be butted against each other and joined with foil tape (for example, Nashua foil tape from Tyco Adhesives).

On an arched window, the seam should be located at the top of the arch. On conventional windows with a horizontal head, such a seam might eventually lead to leaks. Since the manufacturer claims that end dams are not required for straight horizontal runs of flashing, the instructions call for the installation of a single length of head flashing in such locations, cut from the center of a 6-foot piece. According to the manufacturer, water is unlikely to travel to the window corners, because the grooves in the flashing direct the water out.

Because Water Out head flashing's useful end dams must be trimmed off when the flashing is used above straight-topped windows, the product is most suited to use above arched windows. Water Out sells the head flashing for $10 each; discounts are offered for large quantities.

HeadFlash

SureSill, the manufacturer of one of the plastic sill pans reviewed in the July 2004 issue of ***EDU***, recently released a new product called HeadFlash (see Figure 5). Like SureSill pan flashing, HeadFlash is made from rigid PVC and includes an integral slope. The vertical leg of HeadFlash has a rabbet to accommodate overlapping siding.

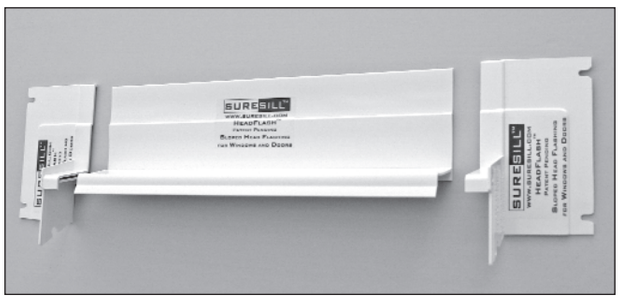

Figure 5. HeadFlash, a window drip cap made from rigid PVC, comes in three sections. The center section is first trimmed to length, and then the end caps are attached with PVC cement to form watertight joints.

HeadFlash is designed to accommodate windows of any size up to 13 feet wide. Each HeadFlash kit includes three pieces: a center section which is easily trimmed, and two end caps. To make a watertight joint, the end caps are joined to the center section with PVC cement.

Each HeadFlash end cap includes an end dam (see Figure 6). These end dams assure that any water hitting the flashing is shed not at the corners, but at the drip edge that extends beyond the window's head casing.

HeadFlash can be used for either windows or doors. Because of its rigidity, SureSill HeadFlash, unlike Water Out's head flashing, cannot be used for arched windows. The straight center sections are available in two lengths (80 inches or 157 inches). At this time, HeadFlash is available in one depth (1 3/8 inch deep), although a shallower (7/8 inch deep) version will be available soon.

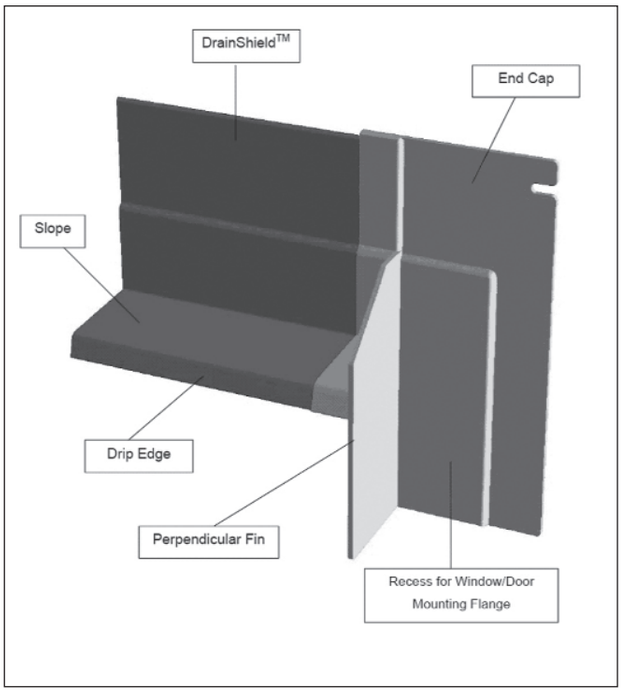

Figure 6. HeadFlash end caps include perpendicular fins to create end dams, which prevent corner dribbling.

For a window or door with a horizontal head, SureSill HeadFlash looks to be a better choice than the product from Water Out Flashing: it is less expensive, more rigid, and it includes end dams. Prices vary with the quantity ordered; HeadFlash components for a 40-inch wide window should cost about $4.

For more information, contact:

SureSill, 6410 Yaupon Drive, Austin, TX 78759. Tel: (512) 231-9469; Fax: (512) 502-0007; E-mail: info@suresill.com; Web site: www.suresill.com.

Water Out Flashing, 8206-1200 Providence Road, Charlotte, NC 28277. Tel: (866) 568-0050 or (704) 771-9330; Fax: (704) 846-7805; E-mail: rallen@wateroutflashing.com; Web site: www.wateroutflashing.com.

INFORMATION RESOURCES

Field Guide to Residential Construction

For information on energy-efficient building details, New England builders of Energy Star homes have turned, for several years, to a useful spiral-bound manual called the *Field Guide to Residential New Construction*. The original *Field Guide* was not intended for national distribution, but was written specifically for builders in Massachusetts. Although the guide's limited geographical focus reduced the potential size of its readership, it allowed the guide to reflect state building code requirements and to be climate-specific.

The success of the original *Field Guide* gave rise to requests for new editions customized for other states. Such guides are now available in five states: Connecticut, Maryland, Massachusetts, New Jersey, and Rhode Island. This year, additional versions of the guide will be published for seven more states: Idaho, Montana, New Hampshire, New York, Oregon, Vermont, and Washington. (Idaho and Montana will be covered in a single book.) Each guide does its best to accurately reflect each state's energy code at the time of publication.

The principal author of the *Field Guide* series is energy expert Bruce Harley, who has been assisted in his work by Adam Gifford, a colleague at the Conservation Services Group in Westborough, Massachusetts. The cost of developing the *Field Guide* series has been underwritten by utility energy-efficiency programs and by grants from the Northeast Energy Efficiency Partnership and the US Department of Energy. "We originally conceived of the book as a companion to the *EEBA Cold Climate Builder's Guide*," says Harley. "The design is similar, but the book addresses topics that aren't covered in the *EEBA Builder's Guide* — information on Energy Star and energy codes."

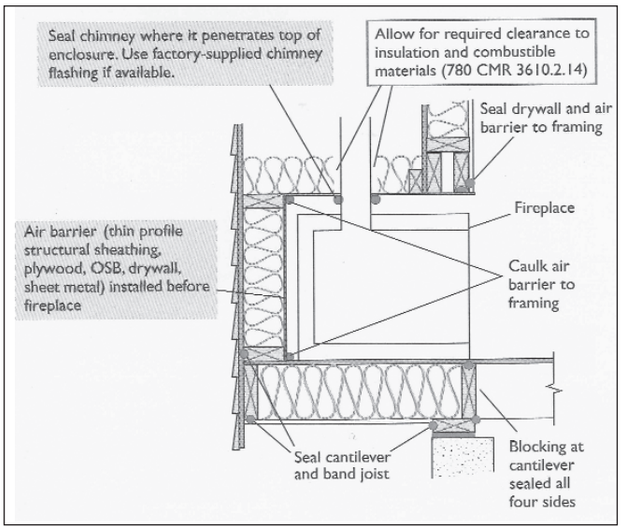

Figure 7. This illustration of suggested air barrier details behind a zero-clearance fireplace comes from the *Field Guide to Residential Construction*.

A Systems Approach

Like the *EEBA Builder's Guide*, the *Field Guide* books are based on a systems approach to building. Each book is between 110 and 122 pages long, and about half of the pages include clear drawings of building details, illus-

Table 2 — *Field Guide* Editions, State By State

State	Availability	Who to Contact for More Information
Connecticut	Last updated in 2001	Norman Barry, Energy Star Homes program; Tel: (860) 832-4753; E-mail: barrynj@nu.com
Idaho and Montana	Available in Summer 2005	Beth Shuck, Portland Energy Conservation Inc.; Tel: (503) 595-4430 or (877) 298-2172; E-mail: bshuck@peci.org
Maryland	Last updated in 2004	Walt Auburn, Maryland Energy Administration; Tel: (410) 260-7204; E-mail: wauburn@energy.state.md.us
Massachusetts	Last updated in 2004	Energy Star Homes; Tel: (800) 628-8413
New Hampshire	Available in Autumn 2005	Energy Star Homes at (800) 628-8413, or Wes Golomb at (603) 271-6306; E-mail: wes.golomb@puc.nh.gov
New Jersey	Last updated in 2002	Ben Adams, MaGrann Associates; Tel: (888) 624-7266 or (856) 813-8741; E-mail: benadams@magrann.com
New York	Available in Autumn 2005	Bill Keating, Conservation Services Group; Tel: (518) 207-4500; E-mail: bill.keating@csgrp.com
Oregon	Available in Summer 2005	Beth Shuck, Portland Energy Conservation Inc.; Tel: (503) 595-4430 or (877) 298-2172; E-mail: bshuck@peci.org
Rhode Island	Last updated in 2004	Energy Star Homes at (800) 628-8413
Vermont	Available in Autumn 2005	Pat Haller, Efficiency Vermont; Tel: (888) 921-5990, ext. 1045; E-mail: phaller@veic.org; or Chris Owen, Vermont Department of Public Service; E-mail: chis.owen@state.vt.us
Washington	Available in Summer 2005	Beth Shuck, Portland Energy Conservation Inc.; Tel: (503) 595-4430 or (877) 298-2172; E-mail: bshuck@peci.org

trating both do's and don'ts. The *Field Guide* does a good job of alerting builders to areas where attention needs to be paid to air barrier continuity (see Figure 7).

Here are some examples of the pithy information provided in the *Field Guide*:

- "Insulate basement slabs, even in unheated basements. One inch of rigid polystyrene foam under the slab will keep it warmer in summer and reduce the chance of condensation which can wet the slab and lead to mold and mildew. … Do not install carpeting on below-grade slab floors unless the slab is insulated under its entire area."
- "Building science has shown that ventilating crawlspaces often does more harm than good, and codes are starting to catch up with the more sensible approach of building a tight crawlspace with good drainage and vapor control."
- "Housewrap, properly installed and sealed with tape, can contribute slightly to the air tightness of a building, but does nothing to slow down air leakage in most large leaks, which are located in basements and attics."
- "There is no way to build a house 'too tight.' Tight is good. You *can* build an underventilated house, but not if you put in a ventilation system."
- "Sealing up air leaks into the attic is the most important factor in reducing ice dams, followed by keeping HVAC out of the attic, and proper insulation."

The *Field Guide* is currently distributed free of charge to interested builders. For more information on availability, see Table 2.

READERS' FORUM

Unfamiliar Terms

Dear Editor,
I could not make heads or tails of several pages of your May newsletter because it assumes intimate familiarity with so many regulations and guidelines — Energy Star, HERS, etc. What about descending to familiar matters such as [energy] cost and BTUs per square foot to heat and cool?

Steve Baer, president
Zomeworks Corporation
Albuquerque, New Mexico

Editor's Reply

Thanks for the feedback. Each month, ***EDU*** strives to achieve a balance between clarity of writing and technical depth; inevitably, some articles negotiate the tightrope better than others.

An Energy Star home is currently defined as a home with a minimum Home Energy Rating System (HERS) score of 86. HERS is a method of evaluating the energy efficiency of a house. A HERS score takes into account energy used for heating, cooling, and domestic hot water, but not for lighting and appliances. HERS uses a scale that ranges from 0 to 100.

A HERS score is calculated by comparing the house being rated to a reference house of the same size and shape. Until recently, the reference house was defined as a house barely meeting the 1993 Model Energy Code. This reference house is assigned a HERS score of 80. Every 5% reduction in energy use increases the rated house's score by 1 point. For more information on the HERS rating system, see ***EDU***, March 2004. A more technical discussion of HERS, "The HERS Rating Method and the Derivation of the Normalized Modified Loads Method," is posted on the Web at *www.fsec.ucf.edu/bldg/pubs/hers_meth/index.htm*.

The BTUH per square foot required to heat and cool a house with any particular HERS score — say, HERS 86 — will vary depending on several factors, including the house's size and geographic location. Although calculating BTUH per square foot is useful when comparing the energy efficiency of large commercial buildings, it is a less useful index to use when comparing small residential buildings. Since energy use in small buildings is envelope-dominated, using BTUH per square foot as an efficiency index tends to penalize small buildings. Most advocates of residential energy efficiency would be loathe to adopt an index that favors larger houses over smaller ones.

Long Overdue

Dear Editor,
I just wanted to say that the ***EDU*** story (April 2005) about reroofing with foam was fantastic, and the piece about the permeability issues with Icynene is long overdue. I have worked on houses that were insulated with Icynene, and we didn't use vapor barriers because the people selling the material said it was not necessary.

David Frane
Alamo, California

In Defense of Minnesota Stucco Contractors

Dear Editor,

My time is better spent on more important issues, but I had to stop for a moment and reply to Mark Bomberg's letter (April 2005) dissing Northern plastering contractors. [Editor's note: In his letter, Dr. Bomberg wrote that "there is a large difference between the good stucco practices in the South and Southwest and those not-so-good practices in the Northeast and North."]

I had the fortune/misfortune to spend approximately a year in North Carolina in 1997 after the big EIFS debacle, and what I know for a fact is that stucco contracting was not widely practiced in North Carolina at that time. This is perhaps why many in that region started using cement board as a substrate for EIFS-type base coats and finishes in lieu of Portland cement plaster (which they often incorrectly refer to as "hardcoat"). Maybe Mark Bomberg is right in his assertion; however, I would wonder whether they could have developed such stucco acumen in just eight years' time.

On the other hand, here in Minnesota, the disciplines of plastering (which includes stucco) have had a rich tradition. Many of the union contractors represented by the Minnesota Lath and Plaster Bureau can lay claim to generations of qualified craftsmen. In fact I know of one contractor which recently celebrated its 100th anniversary in the plastering industry.

I can only surmise that Dr. Bomberg's basis for "drawing our attention to Minnesota" and his opinion on our "not-so-good practices" must come from the co-author of his paper, Paul Ellringer. Certainly if Dr. Bomberg has first-hand knowledge of our practices, we might have been aware of his presence in the area. With that in mind, I would like to issue a challenge to Dr. Bomberg: If he would care to lay down a wager, I would pit any of my contractors against anyone he feels is more qualified. As to "looking for interested parties to join research consortiums with Syracuse University," perhaps Dr. Bomberg and Mr. Ellringer would be better served by reaching out to the plastering industry instead of trying to disembowel it.

Steven Pedracine, executive director
Minnesota Lath and Plaster Bureau
St. Paul, Minnesota

Dr. Bomberg Replies

When I wrote of the "not-so-good stucco practices in the Northeast and North, including almost all of Canada," I meant the whole construction process, from the design of a building assembly through the design of stucco premixes, their field application, and their long-term performance, i.e., durability. The word "practice" did not mean the process of application, and if this was your impression, I sincerely regret the misunderstanding.

What I wanted to say was that I had tested some stucco systems that were not suitable for the Northern climate of Minnesota or Canada. The finishing coat of the latex-modified stucco (Portland cement plaster) that was manufactured by a reputable company and applied by an excellent plasterer showed a water absorption coefficient of 0.0009 $kg/m^2s^{1/2}$ when tested in our laboratory. Since the water absorption coefficient describes not only wetting but also a rate of drying of the very wet stucco, one can infer that the drying rate of such stucco is about 11 times slower than that of cement stucco or 80 times slower than that of lime stucco. Incidentally, the comparison between the water absorption coefficient for cement and lime stucco was first published in 1925.

I have seen this latex-modified stucco two months after its application and can attest to the high quality of its workmanship. First, during its testing at Syracuse University it was found that, unfortunately, this stucco was very slow in drying. This particular stucco was applied on a polymeric water resistive barrier (WRB) that showed, when tested, a "spot water vapor permeance" of about 90 perms at 67% relative humidity. Thus, the rate of moisture transmission through the WRB into the oriented strand board (OSB) was more than four times higher than that of two layers of any building paper or #15 felt.

In effect, the moisture content of the latex-modified stucco has been significantly increased because the drying ability of this stucco is much slower (at least 30 times slower than lime-cement stucco), while the wetting rate of the stucco has not been changed (wetting occurs mainly through cracks and stucco terminations). When the sun shines on the wet stucco, the increased permeability of the WRB facilitates the moisture transfer into the OSB, and eventually causes an increased frequency of OSB failures. (Note that in a Northern climate we have a practice of installing vapor barriers — polyethylene film — that prevent any drying towards the interior of the building.) Table 1 (page 16) shows the increased frequency of OSB failures in Alberta.

Table 1 — Indicators of Problem Walls (from Building Envelope Engineering, 2000)

Ratio Between Number of Examined Walls With Moisture-Related Problems and Total Number of Same Type of Walls

	Stucco	Vinyl	Total
Building paper & OSB	14/24	2/12	16/37
Housewrap & OSB	7/10	0/2	8/13
Building paper & plywood	1/2	0	1/2
Housewrap & plywood	0/1	0/0	0/1

There is nothing wrong with the stucco application, yet we have a durability problem because those designing premixes do not know enough about building physics. For a large number of small but compounded reasons (increased levels of thermal insulation, increased wall airtightness, changes in efficiency of heating systems and air redistribution systems, new materials, etc.), current wood-frame walls are not as moisture-tolerant as they used to be. This is the main reason for which we need to modify the design of stucco premixes: to have them drying as fast as it is possible without compromising their durability.

My invitation to you, Steve, and to your colleagues from the stucco trade remains unchanged. I am confident that after reading our recent papers (at *http://beesl.syr.edu*) you will accept my invitation to join the new research consortium that will start in the Fall. I am sure that with the use of exterior insulation and rapidly drying stucco pre-mixes, we can reduce to a level below 0.1% the fraction of moisture-originated failures in cold climates that is currently estimated at the level of 50% to 60% for stucco with slow-drying finish layers.

Mark Bomberg
Syracuse University
Syracuse, New York

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