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Promoting the Passive House – A Report on the 3rd Annual North American Passive House Conference

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The passive house could play a major role in cutting energy consumption and offers the best way to radically alter our building practices. I have been involved with the organization promoting the concept in America – the Passive House Institute US – for two years. I attended its 2nd annual conference in Urbana, Illinois last year, and this spring I agreed to take part in the founding meeting of the Passive House Alliance, a group of about 20 people building and teaching about passive houses. I was also pleased to be asked to make a presentation at the 3rd annual conference held last month in Duluth, Minnesota.

I have also begun to implement passive house principles in my own buildings and around my hometown. Last year I retrofitted a 1,000 square foot house in Yellow Springs using passive house techniques – it now has a tenant with extremely low heating bills. I also had the pleasure of introducing architect Katrin Klingenberg, the organizer of the annual U.S. Passive House Conferences and co-director of the Passive House Institute US, to an organization in Yellow Springs who is now using her as a consultant for a multi-family building to be constructed next year.

While 2008 saw the third conference in the U.S., this year marked the 12th European Passive House conference, held each year in Germany. Over a 1,000 people attended the 12th European conference in Germany, compared to about 150 who attended the US conference in Duluth. It is only recently that this important movement has been brought to the U.S., largely through the efforts of Katrin and her partner, Mike Kernagis. Together, Katrin and Mike co-direct the Passive House Institute US, as well as ECO-Lab, a non-profit organization that designs energy-efficient buildings for low to middle-income families. I have visited three of these homes and they are delightful, affordable, and environmentally healthy.

To be called a “passive house,” a building must meet the passive house performance standards which are set by the Passive House Institute in Germany. The basic standard is that a building must consume no more than 15 kilowatt-hours per square meter in heating energy per year (equivalent to 4746 BTU per square foot per year). This is achieved by constructing a building envelope, (floors, walls, ceilings, and a roof) that is extremely well insulated and air tight. This means R40 in the walls and R60 in the roof and floor. The building must not leak more air than

0.6 times the house volume per hour at 50 pascals of pressure. The result is a building that uses 90% less heating and air conditioning energy than a typical building according to the Passive House Institute US's website,

“A Passive House is a very well-insulated, virtually air-tight building that is primarily heated by passive solar gain and by internal gains from people, electrical equipment, etc. Energy losses are minimized. Any remaining heat demand is provided by an extremely small source. Avoidance of heat gain through shading and window orientation also helps to limit any cooling load, which is similarly minimized. An energy recovery ventilator provides a constant, balanced fresh air supply. The result is an impressive system that not only saves up to 90% of space heating costs, but also provides a uniquely terrific indoor air quality.”

Last month's conference opened with a presentation by architect Katrin Klingenberg. Born in East Germany, she came to the U.S. several years ago and settled in Urbana, Illinois. Unknown to her at the time, the University of Illinois had been one of the leading institutions focusing on low-energy-consumption building in the 1970s and 1980s, during the first U.S. energy crisis. This happy coincidence placed Katrin's new low energy building movement in a historically hospitable location and the juxtaposition has benefited both the Passive House Institute US and the University. In her talk Katrin gave a history of the passive house, including its remarkable performance characteristics.

Katrin noted that saving energy may no longer be a matter of choice; it may be necessary for survival and world peace. She notes that if we start building only passive new houses today, and we retrofit all homes fully to the passive house standard, then we will be able, with renewable energy sources, to stabilize our climate by 2030.

A big cost advantage of the passive house comes from eliminating the furnace and using the energy recovery ventilation system as a back-up furnace and air exchanger. We not only can get to near zero energy use this way, but to near zero emissions. In addition, Katrin said that we can't think only about the energy used to operate a house; we must also consider the energy embedded in it, and about the emissions its operation causes. The experiences of passive house builders in Germany show that all this can be done, Katrin said. She noted that the passive house is not a purely European conception – in fact, it walked in its baby shoes here in the U.S. with the work of people like William Shurcliff, author of many books in the 70s and 80s on super-insulated houses and solar energy. Katrin envisioned a time when the way we run our building construction industry is going to be completely changed. Finally, she emphasized that the benefits of passive house building go beyond low-energy use and carbon dioxide emissions. It's also about comfort, well-being, and air quality. Katrin likens living in a passive house to living outside.

I followed Katrin with a presentation on Plan C, which is both the focus of our

organization Community Solutions and the title of my recent book, *Plan C: Community Survival Strategies for Peak Oil and Climate Change*. I noted how I had been affected by a presentation at the Affordable Comfort, Inc. Home Performance Conference in April 2007 where Dr. Brendt Steinmueller from Germany gave a plenary speech introducing the German Passive House to the U.S. I also had the opportunity to attend a special meeting set up by Linda Wigington of Affordable Comfort, Inc. titled "Moving Existing Homes Toward Carbon Neutrality," which kicked off an ongoing retrofitting white paper. I showed pictures of our own deep retrofit using the passive house approach and equipment and advocated retrofitting the full stock of 100,000,000 existing American residences to the passive house standard.

The next speaker was Dr. Stephan Tanner who entitled his talk "The Green Bridge." Stephan says that we can either continue increasing our overall energy demand but replace 85 percent of the fossil fuel supply with other energy sources (the active keep burning approach), or we can improve efficiency by 85 percent and thereby reduce our need for fuels (the passive save fuels approach). We need a green bridge, he said, to carry us from the active to the passive approach. Stephan then noted that the technology for reducing energy use by 85 percent is already available at no additional cost, and asked why we aren't choosing this. His own answer is that we view the world incorrectly. In particular, we see only the world's industrial age, and must shift our view if we are to solve the problem of energy efficiency. The mindset we already have won't get us where we need to go, according to Stephan. Holistic optimization is the key, he asserted, if we are to shed the blinding assumptions of the industrial age and lead a new renaissance.

The passive house is a manifestation of a different approach because through it we can see the world differently, and therefore make different choices. Stephan also noted that because of today's collapsing real estate market, many people may be stuck with their existing homes and so see the wisdom of making energy improvements. He observed that many of us have yet to overcome the "buy cheap, sell high" mentality when it comes to buildings. Stephen brought widespread laughter from the audience when he ended his talk by saying, "If clients are serious about greatly reducing their energy consumption, I'm happy to work with them. If they want a plaque, I send them to LEED."

In the afternoon session Mike McCulley, now an associate professor at the University of Illinois School of Architecture, offered a historical perspective. He showed a variety of older houses, including his own, which he had designed and built to use little energy. He described details of his experience building super-insulated houses during the nation's 1970s energy crisis, including his contribution to the design of an important early experiment in low energy building, the so-called "Illinois low-cal house." Mike discussed the evolution of the passive solar house concept during that period, including the discovery that devoting 10 percent of a wall to triple-glazed windows resulted in optimal energy efficiency. Automated thermal shutters added even higher savings. Mike noted that such learning ran

counter to the conventional thought that on the south side of a house using passive solar design, the more glass the better. Mike described almost being lynched at passive solar conferences in the 1970s for refuting this belief. In America, we tend to think that if a little is good, then a lot is better, when actually moderation is best in many cases. A “more is better” approach to passive solar design often results in overheating and the fading of interior furniture, rather than increased energy savings. Mike was careful to point out some of the limits of the super-insulated houses in that earlier period. The need for reliable ventilation strategies was evident in the 1970s, but equipment able to meet the need was not available. Early heat exchangers required a great deal of energy to operate and ductwork located in unheated spaces wasted energy.

Mike summed up his historical perspective by saying that work on super-insulated houses in the 70s had made great strides, which have been built upon and refined in more recent work on the passive house. He noted that different cultures at different times have taken the lead in developing knowledge and improving technology. For example top work was done in Sweden for a time, and today the leadership role is being taken in Germany. Since the passive house is now generating interest worldwide, it is possible that other nations will now contribute major jumps in innovation. American efforts of the 1970s were not in vain and we should be grateful for the work that was done by early pioneers such as Mike.

The next speaker, Manfred Brausem, is a German architect and developer who has been building to the passive house (known as Passivhaus in Germany) standards for well over a decade. He built the first passive house development in 1998. He is currently at work on projects worldwide including a passive house pilot project in Chile. Manfred’s presentation, titled “What’s in the Box?” was more like Santa Claus delivering presents than a technical presentation. The audience of builders and architects felt like kids in a candy shop. Manfred literally reached into a large aluminum box he’d brought along, and pulled out examples of the best and newest technologies that are being used in passive house building. His box contained items both familiar and strange. In many cases he presented us with things we had never seen before.

Especially impressive were the fascinating devices and materials now available to construct the intricate passive house ventilation systems that replace conventional heating and air conditioning systems, such as the bulky ductwork that often runs through unconditioned attics or crawl spaces, wasting much energy in the process. Manfred’s talk was enough to make any student of the passive house approach begin planning to attend future conferences in Germany. That country is several years ahead of the U.S. and moving forward at an astounding rate – in large part because the German government’s commitment to the Kyoto protocol has created a business environment in which firms are rewarded for helping citizens cut their per capita energy use.

Mike LeBeau and Rachel Wagner talked about their experiences and processes in

building high performance homes. Mike's firm, Conservation Technologies, has been specializing in high performance and low energy building solutions for cold and very cold climates. He first heard of passive houses many years ago, and attended one of the early conferences in Europe. Rachel Wagner is the co-owner of Wagner Zaun Architects in Duluth, a firm that specializes in sustainable design. Since 1996 she has specialized in designing energy efficient residences for cold climates. Rachel and Mike's joint presentation about how they design and implement projects was highly impressive, offering us excellent preparation for field trips two days later to visit both a house they completed last year and their project currently under construction. Seeing the theory embodied in practice was very educational. The mechanical systems designed by Mike were eye-opening, and Rachel's architectural design was beautiful as well as functional from an energy standpoint.

Linda Wigington opened the second day of the conference with a talk on "Deep Reductions in Existing Homes – Beyond Business as Usual." Linda is a founder of Affordable Comfort, Inc., an organization promoting building performance, and helps put on its annual conference. She has been a consultant for residential energy programs throughout the country. In 2002 she received the American Council for an Energy Efficient Economy's (ACEEE) "Champion of Energy Efficiency" award. Linda's presentation focused on retrofitting existing homes. I had seen a version of this talk at the July conference of ACEEE where Linda challenged the attendees to go further than the conventional goal of reducing home energy use by 10 to 30 percent. There was a mixed response at her ACEEE presentation, but this was not the case in Duluth. At the Passive House conference she was speaking to the converted –to attendees all committed to very deep energy savings. Linda described her Thousand Home Challenge, an effort to achieve deep retrofits for 1,000 homes around the nation as quickly as possible. Linda's marriage of the relatively new passive house movement with the more established weatherization movement makes her a very key player in the energy reduction effort. Linda has spoken at several Community Solutions conferences and has achieved an impressive low energy life style.

Marc Rosenbaum is a Licensed Professional Engineer in mechanical engineering with bachelor and graduate degrees from MIT, and special expertise in heating, ventilating, and air conditioning (HVAC) He is the principle of Energysmiths, an organization founded in 1979, to show that sustainable communities can only be based on renewable resources. Marc has focused on integrating renewable energy systems, day-lighting, high performance envelope design, health-sustaining mechanical systems, food production and storage, ecological waste systems, efficient electrical and water systems, and benign, resource-efficient materials selection into his projects. He described an impressive recent super-insulation project on an existing house. He shared his view that, "It's not what's sustainable that matters, but what's survivable." He hopes that he is wrong about the seriousness of the problems facing us and that a Plan B approach based on renewable energy will work, but he highly doubts it. Marc envisions people living in

smaller spaces, and farming in the suburbs. Marc showed a delightful series of cartoons describing the future of our current housing stock: some will be bulldozed, some will be shared, some will be used only in the summer, and in others people will combine households. And a certain number, he trusts, will have deep energy retrofits that provide comfort while using as little energy as possible.

Father-and-son team Ty and Ben Newell's presentation was entitled "Design and Operation of a Conditioning Energy Recovery Ventilator (CERV) for Passive Houses." Ben is the President of Newell Instruments and Ty is a retired faculty member in mechanical engineering at the University of Illinois. They are currently attempting to design an integrated unit that will provide whole-house heating, cooling and humidity control for passive houses. Their prototype system is about the size of a window air conditioner. The engineering details of the project were described. They emphasized that integrating the different air treatment machines (heat, cooling, moisture control) allows small units to perform all three functions because a passive house itself is so efficient that conventional units are oversized, expensive and wasteful. This kind of breakthrough is critical. I could not help but think of the legions of engineers working at GE and other giant corporations laboring away to wring out another few percent of energy savings from devices built for big energy wasteful homes.

Mark Hoberecht and Ed Shank presented "Challenges and Benefits of Using Straw Bale Construction to Meet Passive House Standards." Mark has degrees in Engineering, Science and Sustainable Systems and has made a career in natural building techniques. Ed is a mechanical engineer with extensive experience in designing mechanical systems for LEED buildings. They provided an analysis of straw bale buildings and how they compare to other passive structures. There are several straw bale buildings in my town and I am familiar with the details of their construction. This presentation carried what I know a step further, demonstrating new and innovative ways to use straw rather than simply stacking the bales with a post and beam structure. It is interesting to me to see how straw bale technology, at least in my area, has shown developments parallel to those of the passive house approach to super-insulation.

Ludwig Rongen was the second speaker who had travelled from Germany. His talk was on "Quality in Passive House Planning and Construction – Assuring Home Owner Comfort." He emphasized that the passive house is not a high-tech house but rather a low-tech house. He noted that construction managers must pay special attention to the workmanship of a continuous airtight cover and make sure there are no thermal bridges. Less is more when it comes to penetrations in the passive house. He noted the importance of qualified components, like double-sided scotch tape. Ludwig described the Caritas House Network, which is the first passive house senior housing project in Europe and slated for completion in April 2009. Ludwig says that the increased cost to build a passive house in Germany is about five to seven more percent for a single family house that is 100 square meters (about 1076 square feet) but that there is no additional cost for a larger home or a multi-

family building. He asserted that the passive house is now really the cheapest type of house to build when life-cycle considerations are included as well as building costs. As Europeans tend to understand better than Americans, life cycle costs include the lifetime cost of energy to heat and cool the house. From a financial perspective, Ludwig concluded, it makes no sense not to build a passive house.

Chris Benedict and Henry Gifford have been busy retrofitting large multi-family buildings in New York City. They are focused on how to build a passive house type of building without increasing the cost, a key factor for persuading consumers, bankers, and others to consider the approach. Chris noted that in the public and political realm, people are now thinking about renewable energy sources. She wondered what the best word would be to describe people building low energy buildings – “Reducibles”? “Reductibles?” She described being upset with seeing buildings called “green” just because their designs included a lot of glass. Chris and Henry said that they are competing with more than 40 non-profits who are doing energy efficiency audits in New York City (or at least say they are), but who don’t really measure anything. I was amazed to learn from them about the challenges of dealing with energy use and ways to reduce it in large apartment buildings and delighted to hear about their innovative solutions. Henry, on his web site Henrygifford.com, has an article arguing that many LEED-certified buildings are actually using more energy than conventional buildings. I am sympathetic with his critique. There is a great deal of pure hype about green building these days, and the small improvements being touted by some of the leading organizations are not really making a dent in our energy/CO2 problem.

A great deal of technical information and a variety of theoretical perspectives on energy efficient building were presented at the 3rd annual Passive House – US Conference. Some were complex, focusing on mechanical systems and new products (such as those presented by Manfred and by Marc). It was heartening to get a deeper sense of the integrity and promise of this organization and the insights that inspired it. In general I continue to be solidly impressed with the passive house models and encouraged by getting to know more of the practiced builders and architects who appreciate its merits. It seemed that in the U.S. hardly anyone has quite achieved the full standard yet, but the approach has been successfully adopted by many builders and designers who understand that practice makes perfect.

At the end of the conference I talked with Linda Wigington about the relationship of the passive house model to her Thousand Home Challenge. She is less concerned with meeting the exact passive house specifications than with encouraging creativity and inspiring more experiments. The biggest problem with the passive house criteria today, she said, is that it doesn’t account for different locations or house sizes. (Larger houses should really use less energy per square foot, not the same or more.) Fortunately, Ludwig reports that the Passive House Institute in Germany had received a grant to develop specifications for five climate zones, which will probably cover the various zones found here in the U.S. New

specifications may also include the Passive House standards recommendations to build smaller homes.

This was an exciting conference both because of the talented and experienced presenters and because of the committed and growing audience. Everyone here was focused on implementing solutions – not just on measuring the problem. It was a far cry from conferences where presenters do nothing more than talk about billion dollar government and corporate investments in fanciful solutions. The passive house movement is composed of people who are doers, and they should be commended for their work.