



building standards

International Conference of Building Officials

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Frank Lloyd Wright

Defining Architecture

Alternative Futures for Building Regulations

Lunar and Terrestrial Building Technology

Cob Construction and Building Codes



Reduce Through Use— Recycled, Renewable and Reused Building Materials for the New Millennium

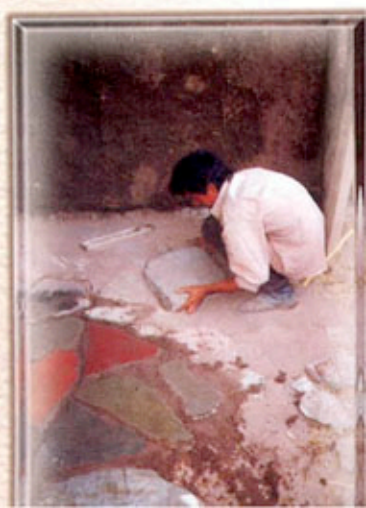
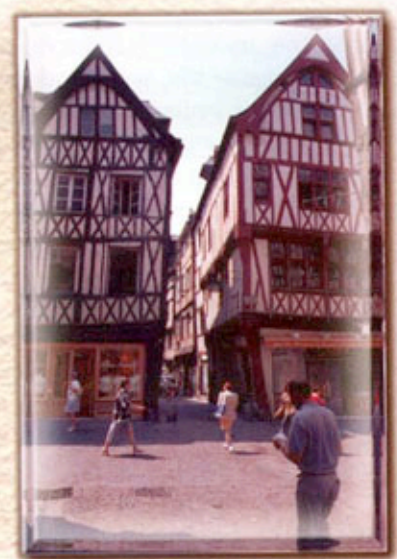
Designing for a sustainable environment and economy represents a change in attitude and mindset for individuals in today's construction industry. This issue of *Building Standards*[™] deals with alternative materials and methods of construction, giving both its authors and the Publications staff of *Building Standards* an exciting opportunity to share information with readers about some of the more popular and environmentally friendly alternative building systems, including cob, bamboo, cast-earth and earthship construction. With the diminishment in quality and quantity of many building materials supplies in the United States and the increasing concern for preserving the ecological balance of the environment, there is much to be said for the unique solutions that building with alternative materials offers the construction industry. It may seem ironic, but due to environmental and economic concerns, wealthy, highly industrialized nations are now taking lessons from the successful building techniques of developing countries and past generations.

The impending millennium presents us with the opportunity to not only step back and reflect on how building construction has changed to ensure safe and affordable housing for our citizens but also to speculate on how it is likely to change in the 21st Century. Sustainable materials and methods of construction offer practical options to conventional methods of building, and *Building Standards* has attempted to present them in such a way that they will be seen by the general public as rational, perhaps even inevitable, alternatives.

A revival in interest and growing public consciousness regarding the use of natural resources paves the path for sustainable living in the new millennium. By meeting the needs of people today without destroying resources that will be needed by future generations, we are ensuring the longevity of our built environment through long-range planning and recognition of the finite character of natural resources.

Dan R. Nickle
Chairman

An Alternative



tive Future for Building Regulation

by David Eisenberg and
Bob Fowler, FAIA, P.E., C.B.O.

Building Standards™ recently asked Bob Fowler, chief building official for the City of Pasadena, California, and David Eisenberg, co-director of the Development Center for Appropriate Technology (DCAT), to share some thoughts about their recent work together, and how it relates to the theme of alternative building materials.

buildingstandards: How did the two of you—one a self-described “recovering contractor” now running a non-profit organization working to facilitate the shift toward sustainable building and development, and the other, one of the most highly regarded building officials in the U.S.—come to be working together in an effort to educate the building regulatory community about the importance of sustainability?

Bob Fowler: Several years ago, David and I were both invited to be instructors at the educational institute that the Colorado Chapter of the International Conference of Building Officials (ICBO) holds in Denver each year. Because we were both talking about subjects that didn’t quite fit into the normal building code categories—David was talking about alternative materials and the need for

us to create buildings that did much less harm to the environment, and I was talking about the importance of developing a single national set of building codes, the *International Codes* and the performance code—they threw us in together in a day-long set of classes called “Building Potpourri.” David’s presentation forced me to rethink many of my assumptions about what we’re doing in this industry, particularly how it impacts what we’ll leave for our children and grandchildren. It had a profound effect on me and, as I’ve learned more, I’ve become much more focused on helping bring about the changes that I see as being essential for our future.

David Eisenberg: When I first got involved with building codes on a deeper level than trying to figure out how to get permits for unusual buildings, I had the good fortune of meeting some building officials who helped me gain essential insights into the codes and the code development process. The first was Bill Schlecht who, as many readers will know, is a former Chairman of ICBO and the Council of American Building Officials, and was the building official of Pasadena, California, and Chairman of the World Organization of Building Officials when I first encountered him.

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The views expressed here are those of the authors and do not necessarily reflect the opinion or agreement of the International Conference of Building Officials.

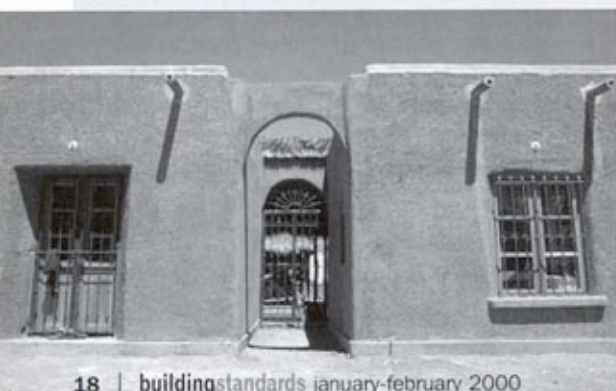


Straw-clay blocks resemble adobes, but unlike adobe they are mostly straw with just a small amount of earth. In the area of Ciudad Obregon, Sonora, Mexico, there are hundreds of thousands of acres of cereal grains planted each year and after the seed-heads are harvested, most of the remaining straw is burned. This straw can be used to make blocks that are similar to adobes, but are lighter, less brittle, have better insulating qualities and use less soil. The latter is of concern because good adobe soil is typically also good agricultural soil, and should be preserved as much as possible.



A house in Ciudad Obregon, Sonora, Mexico, built from straw-clay blocks. The roof framing is made from shipping pallets. Bill and Athena Steen, of the Canelo Project in southern Arizona, have been working in Mexico for several years to develop very low cost solutions to housing needs in cooperation with local families. These houses use locally available, free or inexpensive materials such as straw, earth, shipping pallets, small roundwood timber and used concrete.

The Save the Children office building in Ciudad Obregon, Sonora, Mexico; a 5,000 square foot (464.5 m²) structure built from straw bales, straw-clay blocks, earth plasters, and limited amounts of concrete, steel and other conventional building materials.



I was amazed to find that someone of his reputation and position was truly interested in environmental issues and actively exploring a variety of alternative building technologies. I soon discovered that Bill had designed and was planning to build a straw bale house for himself and his wife in Washington state. Bill's sudden death a few years ago was a tremendous loss to so many people, including me, as I lost both a friend and my first mentor in the building codes community. I remember thinking that I would never find anyone else with Bill's level of credibility who was sensitive to these issues.

A short time later I met Bob. Bob and Bill had much in common—both were not just smart, but wise also, and incredibly hard-working, dedicated, friendly, open and curious about the world around them, and, most importantly, able to recognize that details and context are equally critical to responsible decision-making and leadership. By getting to know Bill and Bob, and many other building officials since then, I've learned a bit about building codes. Better still, these contacts have helped me realize something about the community of building officials that has changed the nature of the work we do. I've begun to see building officials as a "community of care." That's a controversial thing to say in some circles, but I believe it and talk about it, even to disbelievers. I point out that building officials take their responsibility for protecting the public welfare, by maintaining the safety of people in and around buildings, very seriously. That means that they care, which is clearly a good thing. But that also means that what they care about is critically important.

This led me to start thinking of building codes as describing a sphere of concern—those things we've all come to agree are important and need to be dealt with in the protection of people in and around buildings. However, as a result of what is required to satisfy this sphere of concern, there is a much larger sphere of consequence—what happens as the direct and indirect results of those requirements. Most of that sphere of consequence represents unintended impacts; things that happen that are not what we had in mind, such as the environmental impacts of buildings. If we think about those consequences, we will see that there is also a sphere of responsibility the size of the sphere of consequence. This is because we are responsible for what happens as a result of what we require people to do, whether we anticipate it or not. Ignorance is not an excuse in the eyes of the law, and I don't think that it is in terms of this responsibility either. Our task is to expand our awareness, responsibility and concern to include as much as we can of the actual consequences of what we require people to do.

I realized that our goal of trying to introduce a sustainable context to the building codes entailed what the codes were trying to achieve and more, not less. We want safe buildings, but we also want them to be designed and built in ways that assure a safe and healthy environment for all their present and future occupants. Thus, I began to see that we shared the goal of preserving the public welfare by serving public

interests first, and accommodating private or special interests only after that is considered and ensured. That changed how we saw our work at DCAT and the larger vision for the program we've been developing, called "Building Sustainability into the Codes."

buildingstandards: How does this all relate to the subject of alternative building materials?

Fowler: First, it's important to realize that many of the building materials and methods that we call "alternative" in the U.S. are actually mainstream in much of the rest of the world. We are offering our codes and standards to the world, and should acknowledge that it wasn't accidental that the word "International" was picked for ICBO, or the International Code Council® (ICC®) or the set of new national codes that has been in development over the past few years. Even if we weren't intending to have people in other countries use these codes, our influence is greater than that of any other country in the world and what we do carries tremendous weight, especially in developing countries.

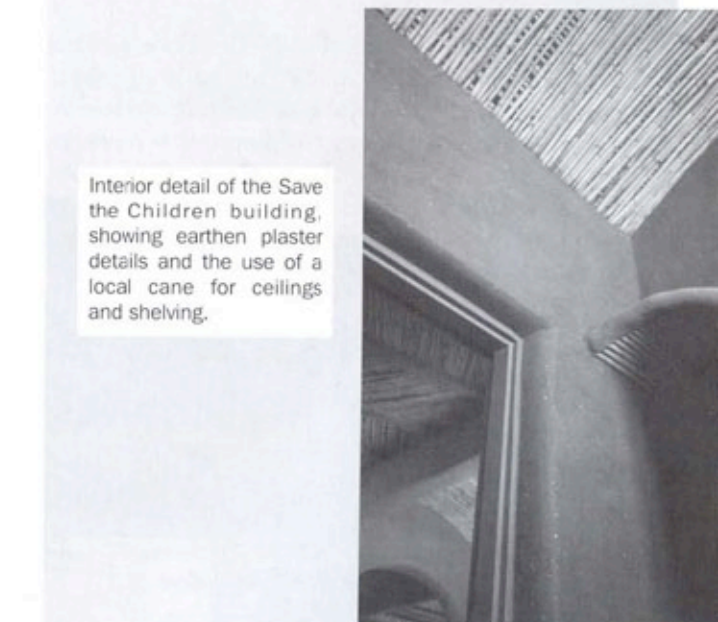
Most Americans are ignorant of the real situation in the world today. My friend David likes to point out that of the six billion of us who are now living on the earth, only about one-third are living in the kinds of buildings that our building codes deal with. Two billion others are living in earthen structures like adobe, rammed earth, or cob and such. The remaining two billion or so people are living in buildings made of other nonindustrial materials, or buildings made from scavenged materials like tar paper, corrugated metal, cardboard, and shipping pallets; whatever they can find. It is estimated that a couple of hundred million people are homeless—that live in no building at all. How do our codes and what we do affect those people? What do our codes reflect of this more common reality? Do we have the resources and environmental capacity for the other four billion people to have houses like ours?

When we think about our codes and alternative materials, we should be thinking on a different scale and in different terms. We've gotten used to just asking for the certification number or evaluation report, expecting that only manufactured and standardized materials can do the job or be acceptable, almost regardless of what the application is. We don't think too much about what they will be used for, how long they need to last, where they will be, who will use them and, most importantly, what the impacts will be from demanding such high levels of standardization in all of our buildings and materials. Safety is very important, but we need to think about the responsibilities for our collective safety; especially the welfare of future generations who, it's worth noting, are unable to represent their interests.

This is where we need balance and why I think David's work is so important. What I've learned through DCAT's efforts to open our eyes to the real consequences of our decisions is that we are ignoring these bigger risks. I've come to



Exterior view of the Save the Children building, showing earthen plaster and the use of gallon jars for windows.



Interior detail of the Save the Children building, showing earthen plaster details and the use of a local cane for ceilings and shelving.

Exterior view of the Save the Children building while under construction, showing straw bale and straw-clay block walls and the construction of the porches using a traditional Mexican palm-thatching technique for the porch roofs.





There are hundreds of thousands of houses all over Europe, like these in Rouen, France, that are timber-frame structures with wattle and daub infill finished with lime plaster. These buildings are over 200 years old.

share his concern about the unintentional damage we do because we can't see it happening and aren't aware of it. Just because it doesn't have a negative impact until the future or happens away from the building site doesn't relieve us of responsibility. The fact that we have to deal with matters in the here-and-now, where we're faced with day-to-day decisions about whether to issue a permit or approve a material, leads us to think only about details without seeing the larger picture. I think this is at least as dangerous as ignoring the details.

That's a big part of why I am so excited about performance building codes. They will open the door to innovative solutions, some of which were "innovated" thousands of years ago. They will also change the way we think about buildings and their components, shifting from concern for what they are to considering what they do. This will allow much more flexibility for designers, builders and building owners, and will also require much more flexibility on the part of building officials. Eventually, we'll have standards and codes for the environmental performance of buildings, just as we require them to demonstrate a certain level of energy efficiency today. Although it presents many challenges, I believe that this is one of the healthiest things that can happen to the building industry and to those of us responsible for regulating it.



A house built in England in 1759: its original stone-shingled roof is still intact.

I see unlimited opportunities for people who can see past the problems to begin developing solutions, and who understand that we need buildings that give back more than they take; that generate their own power, treat their own wastes, and don't pollute and destroy when they're being built, used or disposed of. There are now too many people and too few resources. The natural systems supporting us are too fragile for us

to ignore this reality any longer. We have to get used to the idea that if we are going to leave anything worthwhile for our grandchildren, we need to fundamentally change the way we do things, starting now. One of the first things we can do is take some of these older, less destructive building materials more seriously and be much more open to allowing people to try new or old things in their buildings.

Eisenberg: Today, people struggle to get permission to use natural, nonindustrial materials or integrated designs—approaches that use far less energy and resources, and produce far fewer destructive consequences. They are, admittedly, more difficult for the building official to deal with because they aren't what officials are used to seeing or evaluating. Bob is continually advising other building officials to keep an open mind and use common sense about these alternatives rather than rejecting them because they are unfamiliar. It is much easier to get permission to use materials, methods or designs that are destructive to the environment, or are unhealthy for those who manufacture or install them, or for the occupants of the buildings in which they are used. We seem to save our greatest scrutiny and criticism for efforts aimed at doing less harm, while virtually encouraging those causing greater harm.



The recycling of used concrete into the floor of a house in Mexico.

I am often asked: "If the older materials and methods are so great, why aren't they more widely used today?" The assumption is that they are inherently inferior to the industrial materials and advanced engineering techniques that have replaced them. In reality, they've often been abandoned because they're labor intensive, and labor is expensive in the developed countries. The industrial revolution was about increasing human productivity by reducing labor through the use of resources and technology. In developed countries, resources and technology are relatively abundant and inexpensive, while labor is expensive and skilled labor, being scarce, is even more expensive. In the developing world, the exact opposite is true. Yet, we are trying to convince developing countries to switch to our resource- and technology-intensive, labor-efficient ways of doing things, though they may be inappropriate or worse. At a time when we have more and more people and fewer resources to go around, how wise is it to continue accelerating down this unexamined path?

buildingstandards: What are your ideas about how to bring about the changes that you both think need to occur?

Eisenberg: For our systems to change, we need to get better at understanding the complexity of our relation-

ship with and impacts on nature. We will then see that we need to redesign them to function the way systems in nature function—to run on solar energy, to only use what they need, to eliminate waste and toxicity, to recycle everything, to reward diversity and cooperation, to use local knowledge, and to be beautiful. Recognition of this is what fuels the interest in these alternative and natural building materials and methods of construction. Typically, they are closer to this model than the mainstream industrial materials. They do have some problems, related mostly to the lack of formal research and testing that has been done on these materials and methods. This is primarily due either to their nonproprietary nature and resulting lack of industry-based financial incentives to fund testing, or to the usual difficulties with securing financial resources for any new venture, even a proprietary one.

Fowler: In order to drastically reduce the negative impacts of buildings, it has to be not only theoretically possible but easier in practice to build using these innovations. Today, even when building owners are willing to assume the potentially greater risk associated with alternative approaches, and when they engage qualified design professionals to design their buildings, there is still often strong resistance to approving these alternatives.

continued

Build Smarter with Alternative Materials

by Leon A. Frechette

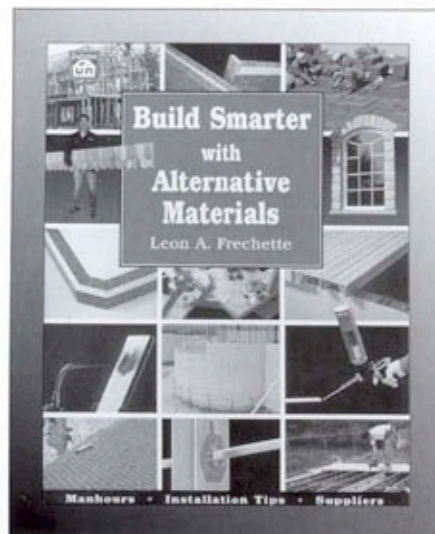
This Craftsman publication provides construction professionals with a clear understanding of how to use new and exciting alternative materials to enhance commercial and residential projects. All materials discussed have been well-researched by the author and can be used in each phase of a project: foundations, walls, roof systems, framing, roofing, siding, insulation, radiant heat, doors and windows, trim, interiors, bathrooms, kitchens, decking, and outdoors. The book also includes phone numbers and addresses of the manufacturers discussed.

Item No. ALTS02 List price: \$34.00 ICBO Member Price: \$30.60

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It is possible for buildings and building materials to return to nature without causing harm to the environment.

The use of natural materials for buildings has a long and ongoing history in Europe. This building is being remodeled in the Netherlands using straw bales, reed mats, and earthen and lime plasters for its reconstruction.



The Lab anti-mall in Costa Mesa, California; an example of the adaptive reuse of a condemned shoe factory.



We have to learn to accommodate this need for change. The performance code will help, but it will require design professionals to be involved in every project of this type. That is not a bad thing, except that for small projects the added cost is often enough to keep people from using alternatives that might otherwise have offered savings. Proving compliance requires performance test results that often don't exist and are very expensive to generate, presenting an even greater obstacle for these projects. David has proposed that we seek support for getting such testing and research done perhaps as part of a pro-bono testing program funded by the established testing laboratories, each doing a certain amount of testing of nonproprietary or non-industrial materials and methods each year. Such testing could also be done through a program established in the national labs and funded in a way similar to the Forest Products Laboratory.

Things that are very exciting to me are starting to move forward. David and I and some key people at ICBO will be meeting soon to discuss how we can work together to create a process to explore and then address these issues. We are also hoping to work with DCAT to develop funding to underwrite the costs of doing all this. ICBO, which has provided leadership in so many ways over the years, is now in a position to do so again, in terms of sustainability. There are some countries that have gone much farther than we have in beginning to look at and address these issues in their codes. We need to look at what is being done elsewhere and focus our attention and resources on this to create the needed changes. This isn't something that is going to just go away, and the sooner we recognize this and deal with it, the easier the transition is going to be. Even from an international competitiveness standpoint, the fact that the building industries of these other countries are addressing these issues now, and we are not, gives them an advantage in the international marketplace in an area of concern that will only increase in the future.

Eisenberg: One necessary and very useful step that we have initiated is planning a comprehensive survey of those building practitioners who have been trying to design, engineer, build and develop more sustainable buildings, building products and development projects. The survey will be designed to identify the general regulatory and specific technical barriers to sustainable building and development. In principle, ICBO has agreed to join the organizations—which include DCAT, the U.S. Green Building Council, the American Institute of Architects Committee on the Environment, the National Conference of States on Building Codes and Standards, the Center for Sustainable Systems at the University of Michigan, and the Rocky Mountain Institute—that are currently discussing this research project. Building officials could also provide highly useful information and insights into the challenges facing this field of development since they understand, from the other side of the counter, what problems they face in

approving such projects. This survey effort could go a long way toward defining the issues and guiding substantive efforts to begin addressing them.

There is also an effort beginning within the American Society for Testing and Materials (ASTM), to develop standards for some of these building materials. As vice-chair of the new ASTM E-06.71 Subcommittee on Sustainability, I can report that we are beginning to address the need for standards that will enable people to use these materials anywhere they are appropriate.

Fowler: At some point, we will have to develop criteria for the environmental performance of buildings, similar to energy efficiency requirements. Alternative materials and methods will become much more than just allowable options once that happens. You can tell that I've come a long way personally from the building official I was when I got up and spoke against the first proposed code change to require insulation in buildings. I thought that was the dumbest idea I'd ever heard and that it had no place in the codes. Looking back, I see that the energy efficiency requirements set a very important precedent for our learning to take responsibility for the full range of the consequences of our buildings. We now need to continue that learning process and open our eyes and our minds to the work of creating sustainable buildings. Our great-grandchildren will thank us. ■

David Eisenberg is co-director of the Development Center for Appropriate Technology in Tucson, Arizona. He is a professional member of ICBO, with more than 20 years of construction experience ranging from building a two-million dollar structural concrete house, to troubleshooting the construction of the steel and glass cover of Biosphere 2, to building with structural steel, masonry, wood, adobe, rammed earth and straw bale. Eisenberg is co-author of The Straw Bale House and helped write the first load-bearing straw-bale construction building code for Tucson and Pima County, Arizona.

Bob Fowler is the chief building official for the City of Pasadena, California. He has also served as a building official for the City of Newport Beach and the City of Abilene, Texas. Fowler graduated from Texas Tech University with a degree in architectural engineering, and is a licensed architect, a licensed engineer and a certified building official. He was in private practice as an architect and engineer for eight years, has served on numerous state and national boards and commissions, and is past chairman of the board of both ICBO and ICC.

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Recommended Reading/Web Sites for a Larger Overview

- Biomimicry: Innovation Inspired by Nature*, by Janine Benyus
Earth in Mind, by David Orr
The Ecology of Commerce, by Paul Hawken
The Logic of Failure, by Dietrich Doerner
Mid-Course Correction, by Ray Anderson
Natural Capitalism: The Coming Efficiency Revolution, by Paul Hawken with Amory and Hunter Lovins
The Natural Step for Business: Wealth, Ecology and the Evolutionary Corporation, www.naturalstep.org
The Natural Step Video, www.videoproject.org/
Our Ecological Footprint, by Mathis Wackernagel and William Rees, www.new-society.com
Worldwatch Institute State of the World 1999, www.worldwatch.org
Worldwatch Paper #124, www.worldwatch.org

Recommended Sources for Earthen Architecture

- Adobe Builder Journal*, Southwest Solaradobe School, Post Office Box 153, Bosque, NM 87006, www.adobebuilder.com
Buildings of Earth and Straw, by Bruce King, P.E.
A Cob Reader, Cob Cottage Company, Post Office Box 123, Cottage Grove, OR, 97424
The Cob Builder's Handbook: You Can Hand-sculpt Your Own Home, by Becky Bee
The Cobber's Companion: How to Build Your Own Earthen Home, by Michael Smith
The Earth Builder's Encyclopedia, by Joseph Tibbets
Earthen Construction—A Comprehensive Guide, by Hugo Houben and Hubert Guillard
The Rammed Earth House, by David Easton and Cynthia Wright

Recommended Sources for Straw Bale

- Build it with Bales*, by S. O. MacDonald and Matts Myhrman
The Straw Bale House, by Athena and Bill Steen, and David Bainbridge and David Eisenberg
Buildings of Earth and Straw, by Bruce King P.E.

Recommended Sources for Bamboo

- The Book of Bamboo*, by David Farrelly
Building with Bamboo, by Jules J.A. Janssen
The Mechanical Properties of Bamboo, by J.A. Janssen

Upcoming Events

- February 6-8, 2000** – *Greenprints 2000 Conference*, Atlanta, GA
March 15-18, 2000 – *Building Energy 2000*, Yale University, www.nesae.org
April 3-8, 2000 – *Affordable Comfort Conference*, Columbus, OH, Linda Wigington, Program Coordinator, (724) 852-3085
October 22-25, 2000 – *2000 International Sustainable Building Conference*, Maastricht, The Netherlands. www.novem.nl/SB2000sb2000@novem.nl