Building a Sustainable Future

An Overview of Alternative Materials and Methods of Construction

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Mr. Eisenberg is currently leading a broad-based collaborative effort called "Building Sustainability into the Codes," with the intention of creating a sustainable context for building code development, modification and enforcement. He is coauthor of The Straw Bale House, *and helped write the first load-bearing straw-bale construction building code for the City of Tucson and County of Pima, Arizona.*

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

This issue of *Building Standards*™ is concerned mainly with alternative materials and methods of construction. The articles that follow present the viewpoints of both proponents of these methods and of building officials who have experience with them. When Rick Okawa, ICBO Vice-President of Technical Services, asked if I would help pull these articles together, I was excited about the opportunity to share information with readers about some of the more popular alternative building systems. I also considered the response that these same readers might have when contemplating materials or methods that are unfamiliar to them, or seem too risky or unlikely ever to be introduced in their own jurisdictions. Since these alternatives represent a small percentage of the buildings being built in the United States today, I asked myself, "What can I say that will be compelling enough to convince these readers to invest the time to learn more about them?" Then I came across some startling statistics.

According to the U.S. Department of Energy (USDOE), in 1996 there were approximately 76.5 million residential buildings in the United States and about 5 million commercial buildings. The Department of Energy projects that by 2010 an additional 38 million buildings will be built in the U.S. Put another way, in less than 15 years we will again build half as many new buildings as were in existence in 1996 (Michael Myers, "Sustainable Communities: Green Buildings," USDOE, January 1997).

Another projection I read recently was that it is likely that 75 percent of the buildings worldwide that will be in existence in 2030 have not yet been built (Worldwatch Paper No. 124). This seems like a reasonable estimate given that only about 2 billion of the 5.8 billion people on earth today live and work in modern buildings; development and construction are increasing at a faster rate in the developing world than in the United States; and that world population is not expected to level off until about 2050, at roughly 10 to 12 billion.

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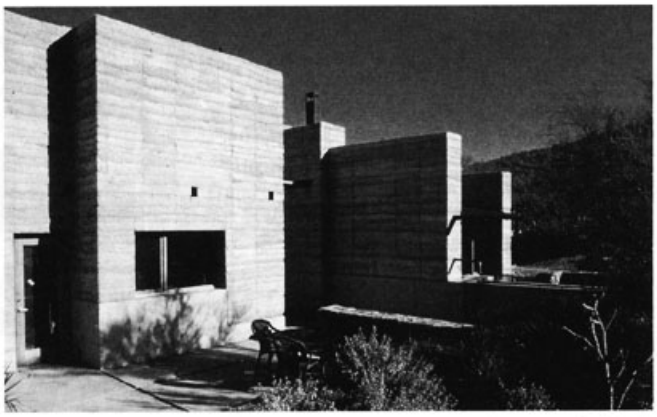
However, what is unreasonable is to expect that we can house the other two thirds of the current world's population in the resource- and waste-intensive ways that dominate mainstream building practice in the United States today, let alone when the population doubles. When looking at buildings through the microscope of building codes, it is difficult to see that these mainstream practices represent only a small percentage of how buildings are constructed around the world. At the same time, many of the materials and methods of construction that have been and remain mainstream in the rest of the world have been relegated to a narrow and marginalized section of our codes, known as "alternative materials and methods."

We have lost sight of some very important things. John Acton, an adobe builder in Southern Arizona, noted that we have somehow gotten to the place where we think of materials like Styrofoam, steel studs, oriented-strand board, concrete blocks and 2 by 4's as traditional building materials, and materials like earth, straw and stone as the alternatives. Joe Lstiburek, a leading authority on building failures, has pointed out that if wood were being introduced as a new material today, it could not possibly get into the codes, as it has nearly every problem a material can have: There are hundreds of species; the strength and durability are dependent on the species, as well as on some of the conditions that existed while it was growing, and how it was dried; the strength is dependent on the orientation of the grain and the size, frequency and location of knots; it rots; it burns; insects like to eat it; it is dimensionally unstable; it splits; and it supports bacterial and fungal growth. Yet despite rising costs and environmental issues associated with its use, more than 90 percent of residential construction in this country today is wood-frame construction. At the same time, if a new (or old) material with only one or two of these problems is introduced today, it is nearly impossible to get it certified and into the codes.



Exposed cement-stabilized rammed earth form the 24-inch-thick (610 mm) walls of this house in Tucson, Arizona.

We should recognize that in spite of all we know about the mainstream materials and methods of construction, building failures continue to happen. The occurrence of those failures typically declines over time as a direct result of widespread use. This has essentially been a "trial and error" period that provided the opportunity for most types of failure to occur and for corrective action to be taken. The regulatory system today makes it virtually impossible for new or reintroduced older methods and materials to have the same opportunity for that process.

We are at a point in time that demands we begin to consider the larger consequences of what we are doing. Building codes should accommodate the full spectrum of materials and methods of construction, not only those that have an industry with money to invest in research, testing and professional lobbying for code changes. We must also begin to account for the full range of real impacts materials and systems have in areas such as resource use and depletion, toxicity of the processes that produce them, and their potential for reuse and recyclability, to name a few.

The alternatives described in the articles that follow represent only some of the many ancient and modern alternatives that are emerging as important components of the solution to building a sustainable future. Among the others not mentioned are methods related to adobe and rammed earth, such as cob and puddled adobe, which use a wet mix of straw, clay and sand to hand-build walls. There are tens of thousands of cob cottages still in use today that are hundreds of years old in the United Kingdom and elsewhere. Another method is *leichtlehm*, or light-clay construction, where straw is coated with a clay slip and compacted into forms as an infill material within structural framing. This technique has a successful history in places like Germany, also dating back hundreds of years. There are many variations on these materials and techniques, such as wattle and daub, which are widely recognized in Europe as traditional ways of building. Other materials, such as thatch for roofs, reed mats as lath for plaster, bamboo as a structural material, and earth for plasters and floors, are all gaining in popularity and have legitimate and important roles to play in building for the future.

This small house in Kingston, New Mexico, is a timber-frame structure with light-clay infill, a traditional European technique in which straw is coated with a clay slip and then compacted into forms to make the walls. The building is shown ready to be plastered.

Last September, at the ICBO Annual Business Meeting in Phoenix, Arizona, I was honored to be on a panel that Bob Fowler, deputy director of planning and permitting, Pasadena, California, put together to speak about the International Codes. I asked the audience a question at the end of my talk that I would like to repeat here: "What is it that goes through your mind when someone comes into your jurisdiction seeking to do something crazy, like build a house out of straw bales or earth, or wants to harvest water off the roof or put in a greywater system? Or perhaps they want to be off the grid entirely and use composting toilets and photovoltaic power. My guess is that your first thought is, 'These people need to be protected from themselves.' And your next thought is, 'Not in my jurisdiction!'

"But," I said, "I want you to think about what is really happening in the majority of these instances. Most of the people who come in wanting to do these things have realized something that is extremely important, and they are taking an action that is very rare and valuable in this culture today. They have realized that their lifestyle choices have consequences, many, if not most, of which are negative—not for themselves, but for their children and grandchildren and great grandchildren, mine and yours. They have also decided to try to take responsibility for at least some of the consequences of these choices. Is that a bad thing? Is it an impulse that we should want to destroy? I don't think so. So, is your job as a building official to keep them from pursuing their goal of taking responsibility by preventing them from building the way they want to build? Or is your job actually to help them find the way to do it well and safely?"

The interior of this straw-bale house in Santa Fe, New Mexico, features earthen floors with hydronic radiant heating and earthen plaster finishes on all the interior walls. This 3,800 square foot house (353 m^2) recently resold for nearly three quarters of a million dollars.

We all recognize the need to address the potential for harm from building failures, both in the near term and those that might happen long after the builder or original owner is gone from the scene. This is certainly a legitimate concern. Yet if we believe we have a responsibility for the welfare of both current and future residents of the buildings we are dealing with today, we also must face the task of balancing their future welfare in both the specific project and in the larger context. This is made more difficult by the fact that most of the available information for our decision-making process is at the project-specific or material-specific level, and the farther we go into considering the larger implications, the less clear things become. Nevertheless, the complexity and difficulty of evaluating these issues does not reduce their importance or relieve us of the need to be accountable for our actions.

This is not an issue of abandoning concern for safety, attention to detail or the overall intent of the codes, but instead is one of recognizing the most obvious: Initial consequences are not the only ones worth examining. Historical precedents, local and distant impacts, and concern for both the immediate and long-term consequences of building all deserve serious consideration as we carry out our work. ■