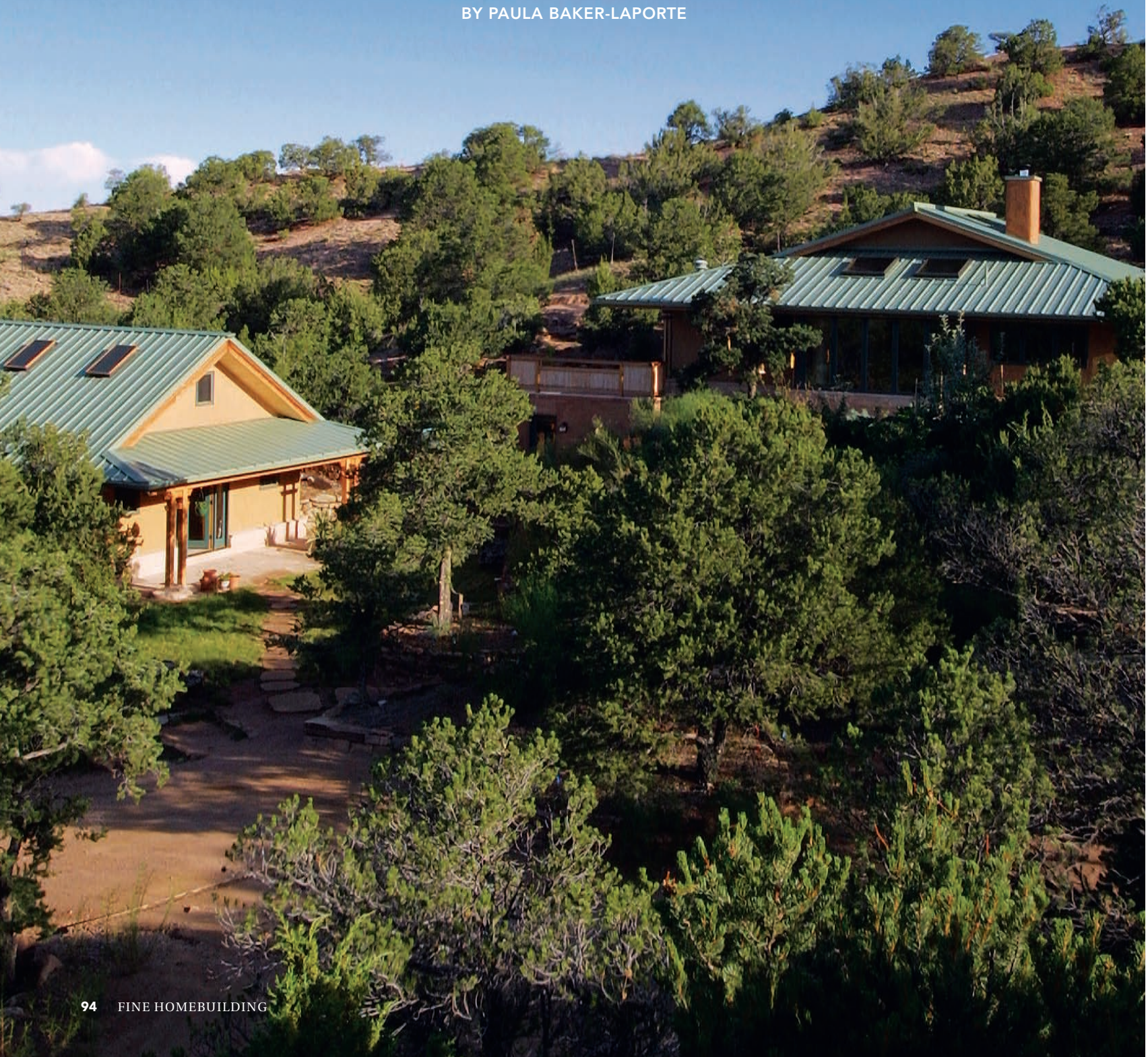


Building Healthful Homes

A centuries-old building technique combines timber and clay to create durable homes in New Mexico

BY PAULA BAKER-LAPORTE



In 1993, after 20 years of architectural work, my career took a dramatic turn. A seemingly unrelated barrage of symptoms, including muscle pain, brain fog and extreme fatigue, was increasingly disabling me. After a frustrating series of misdiagnoses, I finally discovered that my symptoms were caused by multiple chemical sensitivities (MCS; see sidebar pp. 98-99). I was like a pro golfer who realized she was allergic to grass. Because of the rampant use of petrochemical toxins in construction materials, my own building sites were making me sick.

It was my friend and physician Erica Elliott who finally diagnosed my medical condition, but only after she developed the same problems thanks to poor indoor-air quality at a clinic where she worked. I originally had become ill from living in a brand-new mobile home. The Department of Housing and Urban Development now regulates formaldehyde levels in new mobile homes, but at that time, the levels were unregulated. The initial overexposure to formaldehyde and other petrochemical toxins had left me with chemical hypersensitivity.

Once the cause of my own illness became clear to me, I realized that I was not an isolated case; rather, I was one more contribution to a growing body of evidence that standard building practices and materials can be harmful to human health. Seeking out better solutions in my work became a matter of professional ethics. So I set new goals for my architecture practice. The buildings my firm designed in the future would promote good health for those who live in them; use construction materials and techniques with low environmental impact; and work in harmony with nature by making use of sun, wind, vegetation and water to reduce energy consumption and pollution.

What's wrong with how we build most houses?

It is possible to build a healthful, ecologically sound house using conventional stick-frame construction; however, many practices must be reconsidered. For example, standard sill plates are commonly pressure-treated with arsenate-based compounds that prevent rot and insect infestation but are a poor choice because the arsenate compounds are toxic.

Most fiberglass insulations not only contain formaldehyde binders, but the fibers themselves also are now labeled as probable human

carcinogens. Vapor barriers meant to stop the travel of moisture through a wall often trap moisture, resulting in mold and rot. Standard drywall joint compounds contain formaldehyde, and standard paints can contain several toxic chemicals, including toluene and formaldehyde. In my experience, formaldehyde, mold and carbon-monoxide exposure are the most common causes of MCS. Of these, formaldehyde is the one most commonly found in building materials. The good news is that healthful substitutes for all these

the ecological standards I had come to believe in, and I felt as if I had found a focus for my work. Now, seven years later, we are a husband/wife design-build team in Santa Fe.

Santa Fe is a special place. The climate is dry and relatively mild. The sun shines at least 330 days a year. We don't even have mosquitoes. But most important for our work, there is an tradition of natural building here and generations of skilled craftspeople to carry the tradition forward. Consequently, building inspectors are used to dealing with mud.



Long views, small house. Inside, the open floor plan helps this 1400-sq. ft. house to feel larger, while the timber-frame structure defines the spaces. Outside (facing page), the house sits on a southern slope overlooking the author's architecture studio.

problematic materials are becoming more readily available (sidebar p. 99).

In New Mexico, building inspectors are used to mud

In my search for building methods that were ecologically sound and could avoid the use of petrochemical toxins, I read an article about Robert Laporte, who taught workshops about building homes with timbers, straw and clay. Attending Robert's workshop was inspiring. I learned about a building system that met all

Our homes consist of a timber-frame structure, straw/clay walls, earthen plasters and natural nontoxic finish materials. And each home we produce is an opportunity to teach others about ecological building through hands-on workshops (sidebar pp. 96-97).

A timber-frame skeleton enhances an open floor plan

Wood is a renewable resource, but only if we use it wisely. Our timber frames are made of sustainably harvested white fir from a local



forester who runs a sawmill. Even more important, these structures are built to last hundreds of years. The surrounding straw/clay walls protect the frame from the elements, and in turn, a large roof overhang protects the walls.

As an architectural element, the timber frame is a beautiful way to create spatial definition as well as a sense of openness. This approach allows a small footprint to feel and act like a larger one. For example, our own home is less than 1400 sq. ft. but feels much more spacious. Because the timber-frame structure takes all the roof load and because no load-bearing walls are required, the rooms are open to one another (photo p. 95) while the timbers, different ceiling heights and ceiling materials give each room a sense of place.

Straw/clay walls have been used for centuries in Europe

A straw/clay wall is a marriage between straw-bale and adobe construction, with the insulation properties of straw and the mass storage capacity of earth. The 12-in. thick walls weigh approximately 50 lb. per cu. ft. and have an insulation value of approximately R-23. Working with straw/clay, we avoid many indoor air-quality problems associated with conventional construction. This material also has the advantage of being local, abundant, nontoxic and renewable. But its utility isn't limited to the Southwest. The balance of mass and insulation is an appropriate climate response throughout the temperate

zone. In fact, Robert has built straw/clay buildings in 17 states as well as in Denmark, Norway and Sweden.

Straw/clay evolved in Germany from heavier clay construction known as wattle and daub, which was commonly used as infill between timbers throughout Europe. Examples of wattle-and-daub construction dating back 800 years remain in use today. In the 1930s, the Germans first began lightening the clay infill by adding more straw, thus increasing the insulation value.

Robert's own contribution to the evolution of straw/clay construction came when he used the material to wrap around the outside of the structure, rather than simply fill between timbers, thus creating a much more energy-efficient envelope. Traditional infill systems have a tendency to shrink away from the structure, leaving gaps.

Choosing finishes for health

The first rule for finishing any house is obvious: Avoid using toxic substances. If you read product labels or study material-safety data sheets, you quickly discover that many things going into our homes are labeled as human carcinogens or that they can cause myriad medical conditions. Until I became ill, I assumed that the Environmental Protection Agency (EPA) protected us from really harmful things. In fact, the EPA can barely keep up with labeling things. It's up to us to read the labels and be informed consumers.



Although natural materials still can contain caustic or irritating substances, they are generally far more benign than their petrochemical-based counterparts. Here in Santa Fe, we have a large variety of natural materials from which to choose. Natural mud flooring and earthen plasters, for example, are a living tradition here.

Although the concept of a mud floor conjures images of dust and dirt for those who have never experienced one, a good mud floor properly finished is in fact a durable solution. Mud floors have a sensual quality

FOCUS ATTENTION ON ECOLOGICAL BUILDING TECHNIQUES



Paula Baker-Laporte and her husband, Robert Laporte, see every new home they build as an opportunity to teach others, so they conduct periodic workshops on timber-framing and on straw/clay walls. The days are filled with hands-on building, and the evenings provide time for lectures and discussion on green building. For more information, contact Paula at www.econests.com.

Tumbler combines straw, clay and water. Built from a length of culvert pipe and mounted on its own trailer, the mixer receives the straw and clay on one end, tumbles them together and delivers the blended mixture out the other end.

The walls are filled by hand. The straw/clay mixture is placed into the formwork in 4-in. lifts and tamped into place with sticks and feet. Strips of plywood, screwed to the inside and the outside of the frame, serve as temporary forms.



Mud plaster is troweled on. New straw/clay walls contain so much moisture that they sprout grass. When the grass dies, it's a sign that the walls have dried enough for plastering to begin.

comparable to walking barefoot on leather. Traditionally, mud floors were created using ox blood (a good coagulant) to give them hardness. We prefer to make use of a vegetarian version containing clay, sand, chopped straw and wallpaper paste. The carefully troweled floor, once dry, is saturated with several layers of natural oils and then is finished with beeswax.

Our walls are covered inside and out with brown, clay-based plaster. The outside stays brown (photo top left, p. 98), but inside, a finish coat of white silica sand, white kaolin clay,





A different house, but the same ecological consciousness. Unlike the author's own home, which is strongly influenced by Japanese architecture, this house has a more traditional Southwestern look (as well as a second-floor master bedroom). Unplastered adobe bricks have been laid up to form interior walls, eliminating the need for drywall, joint compounds and paint.



mica and natural pigments can create a large palette of color and texture.

Wherever possible, we use adobe bricks for interior partitions, sometimes plastered, sometimes unplastered (photo right). These natural materials not only create beautiful earthy finishes, they also make for quiet rooms and add mass to the interior of the homes. Mass is an important strategy for low-tech climate control.

Heating and cooling strategies for health and energy efficiency

Central heating and cooling with instant comfort at the touch of a dial, once an unimaginable luxury, is now standard residential equipment. Yet most methods are neither healthful nor energy wise. Forced-air systems create dry air and circulate dust. Ductwork can harbor and distribute mold. Various indoor air-quality problems also are associated with radiators, including dry air

and pollution from burned dust particles. Electric-baseboard heaters create high electromagnetic fields. And most systems are inefficient in their consumption of fossil fuels.

Americans use a lot more energy than Europeans, due mostly to the limited temperature range we tolerate. Studies have shown that it is more healthful for people to be exposed to a broad range of seasonal temperatures, yet the concept of central heating and cooling promotes constant comfort at the expense of health and energy efficiency.

Our designs employ several natural climate-control strategies, reducing the need for mechanical heating and cooling. First, we orient our homes for solar gain. And we include solar-collecting greenhouses on the south side of our houses whenever possible. Roof overhangs prevent overheating in the summer.

For heating our own home, we invested in a wood-fired masonry heater (Tulikivi; 800-843-3473; www.tulikivi.com), which is made

of 5000 lb. of soapstone. Although we installed gas-fired hot-water radiant-floor heating throughout our home, only the bathroom zones are regularly activated.

Summers in the high-desert climate of Santa Fe can become hot and dry with daytime temperatures soaring into the high 90s and low 100s. Large roof overhangs, good cross ventilation and extra interior mass keep our homes comfortable throughout the summer.

What does it mean to suffer from multiple chemical sensitivities?

by Erica Elliott, M. D.

Multiple chemical sensitivities (MCS), often referred to as environmental illness, is an immune and nervous-system disorder that involves severe reactions to many everyday chemicals and products. For some people, MCS occurs with dramatic onset, precipitated by a major chemical exposure or industrial acci-

dent. For most people, however, the condition develops gradually as a result of the cumulative exposures of daily life.

The symptoms of MCS are diverse and unique to each person and can involve any organ of the body. Symptoms range from mild to disabling, and sometimes, they can be life-threatening. These symptoms include headaches, fatigue, sleep disturbances, depression, panic attacks, emotional outbursts, difficul-



Healthful building materials

Listed below are some of the author's favorites. For additional sources, see her book *Prescriptions for a Healthy House* (cowritten with Erica Elliott and John Banta, New Society Publishers, 2001) or John Bower's *The Healthy House* (The Healthy House Institute, 2001).

The Allergy Relief Shop
(800) 626-2810
www.allergyreliefshop.com

Building for Health Materials Center
(800) 292-4838
www.buildingforhealth.com

Eco Products Inc.
(303) 449-1876
www.ecoproducts.com

Environmental Home Center
(800) 281-9785
www.built-e.com

BioShield Paint Co.
(800) 621-2591
www.bioshieldpaint.com

Planetary Solutions
(303) 442-6228
www.planetearth.com

Temperatures inside our own home peak below 80°F in the heat of the summer.

The cost of a healthful home

The degree of craftsmanship and intensity of labor required to create a good natural home make it a more expensive proposition than a standard stick-frame home of the same size. However, the timber frame and straw/clay walls constitute less than 20% of the overall

cost of construction, and clients wanting one of our homes are encouraged to build a slightly smaller, more efficient home with fewer bells and whistles to meet the same budget they had allocated for standard construction.

It's also important to consider hidden costs, such as health and well being. In my case, I calculated that the 900-sq. ft. formaldehyde-filled new home from which my illness resulted cost me no less than \$30 per sq. ft. in

lost work and doctor's bills alone over a five-year period. Unfortunately, my experience is not an isolated case. According to recent statistics, 15% of the population suffers from chemical sensitivities mainly due to poor indoor environmental quality. □

Paula Baker-Laporte, A. I. A., is an architect in Santa Fe, NM. Photos by Kevin Ireton, except where noted.

ty in concentration, short-term memory loss, dizziness, heart palpitations, diarrhea, constipation, shortness of breath, asthma, rashes, flulike symptoms and seizures. Symptoms often are triggered by low levels of exposure, including levels lower than permissible as established by the government.

Although MCS is a rapidly growing problem, health-care workers know little about the subject. And unlike diabetes or hyper-

tension, no simple medical test can be used to make a diagnosis. One of the most important aspects of treatment is to avoid toxic-chemical exposures as much as possible. People with MCS need a sanctuary of peace and well being amid a world saturated with toxic chemicals.

—Erica Elliott, M. D., practices family and environmental medicine in Santa Fe, NM.