BUILDING HEALTHY HOUSES

Alternative materials can help protect your client from indoor air pollutants

The author installs steel framing members to avoid using wood or wood products, which can make some people sick due to outgassing.

by John Bower

I am a contractor specializing in nontoxic homes. I got started in this specialty when my wife and I renovated an 1850 Federal-style house. As we worked and lived there, my wife developed a number of troubling symptoms, including inflamed sinuses, stomach and kidney problems, breathing difficulties, and muscle soreness. We soon learned that she was being poisoned—not by anything she was eating, but by the outgassing of fumes from underlayment, carpet, vinyl, insulation, paint, and other synthetic materials we were installing in the house. Eventually we had to move out and build a new house with nontoxic, hypoallergenic materials. Even so, because of her sensitization she can no longer tolerate such things as synthetic clothing or fragrances, combustion gases, most plastics, and printer's ink.

Unfortunately, my wife is only one of thousands of people around the country who have developed sensitivities to commonly used building materials. These materials emit over 500 different volatile chemicals. Some of these are toxic, some cause cancer, and some are merely irritating. In most cases, concentration of the toxins decreases as the materials age. However, cumulatively they can destroy a person's health. In fact, the air in most houses today is worse than the air outside, even in large, smoggy cities. According to the EPA, indoor air pollutants, most of which come from building materials, now outrank outdoor pollutants as a cause of cancer.

As builders, we should know these materials and their alternatives for our sake and for that of our clients. We risk our own health because we work with these materials soon after manufacture, when their outgassing is highest. We also risk being sued should a house we build make an occupant sick.

So, what can be done? To build a house my wife could tolerate, I had to make quite a few changes in construction techniques and in my choice of materials. But with what I've learned, I can now offer buyers a "healthy house," one that serves as a clean living space rather than a trap full of pollutants and irritants.

Alternative Materials

Framing. One of my biggest deviations from standard residential construction is using steel framing instead of wood. This avoids the need for toxic termite treatments that are needed where I live in Indiana. Along with the steel drywall studs most builders are familiar with, I also use heavier steel studs for load-bearing walls. These cost about two-and-a-

Figure 1. *Steel framing members cost more than twice as much as wood, but you can save by framing 24 inches on-center and eliminating termite protection.*

half times as much as wood studs do (see Figure 1). However, when you consider that they can be placed on 24-inch centers and that you eliminate the cost of termite protection, the total cost is comparable. I have a house under construction right now that uses steel wall studs and wood roof framing. (The subterranean termites can't get up into a roof very easily.) The framing cost for this 1,200 square-foot house is about $400 more than it would have been had I framed entirely with wood. That difference roughly equals the cost of treating for termites.

Particleboard. Another big adjustment I've made is that I no longer use man-made wood products, which emit high levels of formaldehyde gas. The adhesives used to bind particleboard, plywood, and medium-density fiberboard emit high levels of formaldehyde for years. Medium-density fiberboard is the worst because it uses the most volatile glue. Hardboard, on the other hand, releases very little formaldehyde, but even it affects chemically sensitive people.

Formaldehyde levels are dropping in some of these products as the wood products industry tries to correct the problem. However, they are still high enough to affect many people. As many as one in five of us reacts to even low levels of this gas, which the EPA recently labeled a suspected carcinogen. To avoid these fumes, I use solid wood for cabinets and stainless or porcelanized steel for counters and bathroom splash areas. Instead of using plywood sheathing, I wrap the house with a perforated-foil wind barrier.

Carpets. A more obvious source of fumes is synthetic carpet. New synthetic carpet contains up to 100 volatile chemicals. Their fumes can permanently sensitize a susceptible person to even low levels of exposure. In addition, as the carpet ages, it creates synthetic dust. The dust can enter the heating system, where its combustion produces other gases. Even natural-fiber carpets, such as wool or cotton, usually come loaded with insecticides, preservatives, or other chemicals. And carpet of any sort can have microscopic molds and dust mites, both of which can cause allergic reactions. For clients who want something on their floors, I recommend area rugs, which can be washed regularly.

For our own floors we chose ceramic tile, because it is so inert. Hardwood would have been our second choice, but ceramic tile on a concrete slab was less costly, and we are very happy with the way it looks (see Figure 2). To hold down costs, we didn't chose an expensive tile. In fact, we bought seconds. The minor imperfections aren't noticeable, and at $1 a square foot, the material was cheaper than carpet.

Figure 2. *For floors, ceramic tile was used because it is inert. Though the tile adhesive outgasses, the tile and grout block the gas from entering the living area.*

Mold-Free Slabs

One thing to keep in mind about a concrete slab-on-grade is that it must be kept warm and dry to prevent mold growth on the floor. To accomplish this, I put polyethylene sheets under the entire slab. I also put extruded polystyrene vertically around the perimeter of the slab and horizontally under the slab in 6 feet from the edges. The 4-inch-thick slab keeps these materials from outgassing into the

HEALTHY PRODUCT DIRECTORY

You may want to build the safest home possible. But where do you find non-toxic products?

Following is a selected list of hard-to-find products for healthy home construction along with descriptions and price ranges. The list was compiled with assistance from John Bower, author of The Healthy House (Lyle Stuart Books; Secaucus, N.J.), and Paul Bierman-Lytle, master builder and author of Home Safe Home (Nichols Publishing; New York, N.Y.). Another resource is Healthy House Catalog, a national directory of indoor pollution resources, available from the Environmental Health Watch and Housing Resource Center, (Cleveland, Ohio; 216/961-7179).

Bierman-Lytle notes that building and decorating materials affect every individual differently. Very sensitive people must test all samples of products to be used to determine their acceptability.

Floor Covering

Bangor Cork Company (Penn Argyl, Pa.), distributes natural linoleum made in the Netherlands. The resilient sheet flooring, available in nine to eleven colors, is made of wood floor, linseed oil, and resin binders applied to a natural jute backing. Noted for its sturdiness, the material was widely used for countertops before formica. Not all installers are familiar with the product. Suggested retail price: $21 a square yard. For information: 215/863-9041.

Carousel Company (Ukiah, Calif.), manufactures carpeting and custom area rugs of cotton, wool, jute, and linen and will use nylon or synthetic materials only on request. Carpeting and area rugs are unbacked unless requested: Wall-to-wall has latex backing. The company can customize almost any design, including hand-hooked rugs. Carpets average $135 per yard. Call 707/485-0333.

Grout

C-Cure Products Company (Houston, Texas), manufactures grout from inorganic chemicals, silica, calcium rock, and iron oxide pigments. The product comes in 36 standard colors. $6.94 to $10.58 per 10-pound box; $11.54 to $18.78 per 25-pound bag. For information, call 713/697-2024.

Paint

AFM (Riverside, Calif.), makes paint from synthetic resins and water-based plastic polymers, but it's considered non-toxic and widely accepted by allergenic clients. The paint comes in bone and white, but can be tinted to a pastel using the universal system. $19 to $22 per gallon. Call 714/781-6860.

Sinan Co. (Susun City, Calif.), distributes AURO paint from Germany. Paint is linseed or milk-based, $28 to $32 per gallon. Plant pigments for tinting milk-based paint is $9.90 to $30 per gallon. Mineral pigments for tinting linseed-based paint are $6.50 to $11.20 per gallon. Call 707/427-2325.

LIVOS (Santa Fe, N.M.), distributes nonpetrochemical-based paint and wood finishes from Germany. $34 per 1.5 gallon container of natural resin wall paint. Eleven different earth and mineral-based concentrates available for tints. For information: 800/621-2591.

Roofing

Metal Sales Manufacturing Corp. (Louisville, Ky.), roll forms of galvanized painted steel into 17 different roof profiles, from a Spanish tile facsimile to a basic post frame. From $.98 a linear foot for agricultural panels to $2.25 a linear foot for architectural panels. Call 502/426-5215.

Eternit Inc. (Reading, Pa.), manufactures Eternit slate, a rigid fiber-reinforced cement and roof slate that contains no asbestos. $350 per 100 square feet of surface area. The company also makes Eterspan, a non-asbestos, fiber-reinforced cement applied as the external substrate to prefab or field-installed steel or wood-stud assemblies. $1 to $1.25 per square foot. For information call 800/233-3155.

Windows, Doors

Tischler Und Sohn (Greenwich, Conn.), makes windows, entry doors, and rolling glass doors in any size and shape. Wood is solid sipo or swietenia mahogany. Prices vary. Call 800/282-9911.

Wood Products

Greenheart Durawood, Inc. (South Amboy, N.J.), distributes Pau Lope, a pressure-treated lumber alternative. Containing no formaldehyde, the hardwood panels can be used for outdoor decking, panelling, and flooring. $1.90 per board foot. Call 800/627-DECK.

Nappanne Wood Products Inc. (Nappanne, Ind.), crafts kitchen, bathroom, and other home cabinets and entertainment units from solid oak, hickory, birch, wormy maple, walnut, and cherry. All orders are custom made. Kitchen cabinets average $12,000. For information: 219/773-4156.

ScandiaHouse (Riverhead, N.Y.), distributes solid wood homes manufactured in Finland. Exterior and interior interlocking, tongue and groove boards are of solid arctic spruce or red pine. ScandiaHouse offers on-site observation. Call 516/727-9107.

Heat Recovery Ventilators

Mountain Energy and Resources, Inc. (Golden, Colo.), produces the MER 150 heat exchanger. The dual fan system, with a stainless steel housing, can bring about 8,000 cubic feet of air from 0°F to 70°F per hour. Recovers 70 percent of heat from exhausted air. Runs off a 115-volt power supply. The system costs $475. For information: 303/279-4971.

VanEE Equipment (Saskatoon, Saskatchewan), features a polypropylene core and a metal case, VanEE's ventilator cycles 230 cubic feet of air per minute. Three levels of filters are available: regular, medium efficiency, and high efficiency for very sensitive people. $200 to $1,200. For information call, 800/667-3717.

Vent-Aire (Colorado Springs, Colo.), manufactures the Model 22 aluminum counterflow heat exchanger. It contains a standard humidistat, recirculating defroster, and variable speed motors, which circulate 200 cubic feet of air per minute. Vent-Aire says its products contain only water-based paint and adhesives and no arsenic-based sealants. List price is $973. Call 719/599-9080.

Insulation

Air-Krete (Weedsport, N.Y.), distributes a lightweight foam insulation product. Contains no mildewcides, fiberglass, fungicides or chemicals. The product's main ingredient is magnesium oxide extracted from seawater. It costs $.25 to $.30 per square foot. Call 315/834-6609.

house. I don't like the way polystyrene manufacturing harms the ozone layer, but the only other insulation commonly used that can come in contact with ground moisture is cellular glass, which costs two or three times as much and has a lower R-value.

Figure 3. *For roof and siding, the author chose inert materials like metal siding and metal roofing because their baked-on finishes have minimal outgassing.*

Combustion Gases Eliminated

Combustion gases from appliances—mainly gas ranges and heating units—are another pollutant I try to minimize. Gas ranges present several problems. To begin with they produce toxic fumes, so a range hood is required. But when the range hood is turned on, it creates a vacuum in the house that can pull combustion gases down the furnace flue and into the living area. To avoid this no-win situation, I install electric ranges when possible. If a client insists on a gas range, I use a high-quality, two-speed, externally vented hood. I also advise opening a nearby window when the range and vent are used.

Woodwork and Finishes

In addition to these major adjustments in materials and systems, I found I also had to pay attention to less obvious sources of pollutants. For instance, in my own house we made all interior woodwork and doors out of tulip poplar, a native hardwood. We chose this over pine because highly sensitive people often react badly to the natural aroma of softwoods.

In addition, I used specially made finishes and paints that are hypoallergenic; that is, they do not cause allergic reactions (see "Healthy Product Directory"). I also choose caulks, adhesives, and similar products with extreme care and use them sparingly. Even with these precautions, we had to wait two months for the outgassing from these materials to drop before my wife could move into the house.

Siding, Roofing, Insulation

Exterior materials require less caution than those on the interior, since roofing and siding don't outgas into the living space (unless a window is open). In our case, we chose inert materials wherever possible anyway. We used metal siding and roofing because their baked-on finishes have minimal outgassing (see Figure 3 & 4). We installed triple-glazed, aluminum-framed windows with thermal breaks. Our exterior doors are insulated steel models.

Figure 4. *Custom-built homes in Indiana sell for about $55 a square foot, excluding land. Nontoxic "healthy houses" can be built profitably for about $60 a square foot.*

To avoid any risk of combustion gases backdrafting into the home, I prefer modern, high-efficiency furnaces with sealed combustion chambers. If the house is especially tight or if I know the client is especially sensitive, I use electric baseboard units. I installed these in my own house. By insulating heavily, I avoided the need for a more expensive heat pump. Our heating bill is around $200 per year, and I know of heat-pump installations that cost that much in annual maintenance alone.

As for insulation, I haven't found a material that is totally nontoxic. However, a well-sealed house will prevent insulation from contaminating the inside air. I use fiberglass because of its availability and cost. (Cellulose is no less noxious than fiberglass.) Fiberglass tends to be a bigger problem for the installers than for the homeowners. I wear a quality mask and long sleeves when I work with it. The protection is worth the trouble.

In new construction, I use superinsulated walls 101/2-inches thick, and I lay 12 inches of insulation over the ceiling. Foil-backed drywall keeps particles and gasses from the fiberglass from entering the living space. I carefully seal all electric boxes, windows, doors, and other openings. Using nontoxic, non-irritating materials allows me to build an airtight structure without compromising indoor air quality. We use a heat-recovery ventilator (air-to-air heat exchange), designed to change the air inside every hour, and running it about 6 hours a day keeps the inside air fresh.

The hybrid phenolic foam is similar to Koppers' rigid insulation, except that it has a component (urea) which, according to several scientists we spoke with, makes it possible for the formaldehyde to outgas, even after the foam has cured.

Who Will Pay the Extra Cost?

I'll be the first to admit that the houses I build are extreme, and few people require as pristine an indoor atmosphere as my wife does. On the other hand, clients don't deserve to breathe the poor-quality air found in most houses. If only some of the techniques and materials I have described are incorporated into conventional house design and construction, indoor air quality will improve dramatically. Otherwise, as builders we will continue to needlessly expose ourselves and our clients to noxious substances.

But will homebuyers pay the extra cost for an alternative? conventional custom-built homes in my area sell for between $50 and $55 a square foot, excluding land. I build my "healthy houses" profitably for about $60 a square foot. My superior insulation alone nearly justifies the difference, and apparently my clients agree. They also get a healthier indoor environment. It seems they would rather send a little extra to the bank each month than to the doctor. ■

John Bower designs and builds ecologically safe houses near Bloomington, Indiana. His book The Healthy House *(Lyle Stuart Books, Inc., 120 Enterprise Ave., Secaucus, NJ 07094; $17.95) deals with non-toxic construction materials and techniques.*