CHAPTER 4

healthy interiors

Figure 4.1 A client with multiple chemical sensitivities resides in this healthy home. All exterior and interior assemblies, including building materials, finishes, and furnishings, were fully vetted to ensure a healthy indoor environment.

Photo courtesy of Rowland + Broughton. Designed by Rowland + Broughton and Wendy Silverman with product vetting by Annette Stelmack.

Can we agree that if toxic chemicals from a building material are showing up in babies, then that is not a green building material?

—Bill Walsh, Healthy Building Network

Our health is inextricably connected to the home environment we create; what we design, specify, and provide for our clients matters. Unfortunately, studies indicate that there has been a steady increase in respiratory conditions, from asthma to allergies to a variety of illnesses, that link health concerns directly to the indoor environmental quality of a home.

The interior finishes, furnishings, materials, and products used to build homes are polluting their indoor air. Global organizations recognize that human health is being compromised by the homes we build, and important bodies of research point to the negative health effects of exposure to indoor chemicals. According to the World Health Organization (WHO), "There are many potentially hazardous compounds released indoors due to combustion, emissions from building materials, household equipment, and consumer products."[1]

Sustainable, green materials and products are a step in the right direction, but we must also consider the potential health consequences of using these materials and products in the spaces where we live, work, and play. Focus on the indoor emissions: toxic off-gassing that is odorless and harmful to health, and toxic particulates that may be released into the indoor air we breathe. We should not assume a material or product represented or sold as healthy, eco-friendly, or green actually is unless it has been vetted through rigorous testing protocols: Most products that are used in a residential environment have *not* been tested and deemed safe. Making informed choices when researching and specifying materials, finishes, and products is essential to minimizing our clients' chemical exposure.

Green Building Framework

Over the past few decades, green building has been adopted by governments at the federal, state, and municipal levels as well as by developers as green building rating systems, product certifications, and standards have proliferated. Some practices, like working with local and renewable materials or passive solar design, date back centuries. The Mesa Verde cliff dwellings in southern Colorado are exquisite examples; they were built in the twelfth century by the Anasazi and remain standing beneath the overhanging cliffs. While some were one-room buildings, others had more than 150 rooms. Villages in the Southwest built by the Anasazi were designed to capture passive solar heat during the winter, which warmed the spaces.

Today's green building efforts were born of a desire for energy efficiency and eco-friendly building practices. In the 1970s, oil prices increased at alarming

[1] http://www.euro.who.int/__data/assets/pdf_file/0007/78613/AIQIAQ_mtgrep_Bonn_Oct06.pdf

rates, prompting research on energy efficiency and the use of renewable energy. Experiments with green building techniques emerged from the environmental movement of the 1960s and 1970s. "Earthships" were some of the first radically sustainable buildings embodying sustainable design and construction strategies. Earthships aimed for balance among the different strategies for homebuilding—generating their own water and power, conserving and reusing water, using local, recycled materials and passive heating and cooling, and growing food on site. By the late 1990s, these design and construction methods were delivering a radically different home—built with recycled materials and providing shelter, utilities, and food—for much the same cost as a conventional home.

In the 1990s, the industry reached several significant milestones: the American Institute of Architects (AIA) formed the Committee on the Environment (1989); the U.S. Environmental Protection Agency (EPA) and the Department of Energy (DOE) launched the Energy Star program (1992); the city of Austin, Texas, introduced the country's first local green building program (1992); the U.S. Green Building Council (USGBC) was founded (1993); the Clinton Administration announced the "Greening of the White House" (1993); and the USGBC established its Leadership in Energy and Environmental Design (LEED) program (1998).

Congress and federal agencies also got into the act: The Energy Policy Act of 2005 included sustainable performance standards for all federal buildings, the Federal Green Construction Guide for Specifiers was made available in the Whole Building Design Guide (WBDG), and the Office of Management and Budget (OMB) unveiled an "environmental scorecard" for federal agencies focused on sustainable building (2006).

These programs, publications, and legislation led the building industry, especially the commercial sector of the building industry, to begin adopting and implementing green building practices. By 2013, LEED registered and certified projects numbered 44,000 in the United States alone and totaled nearly 52,500 globally. Sustainability is here to stay. It is considered best practice by many and has become the norm in numerous places.

While the adverse environmental impact of building decreased, buildings still account for a lot of the total resources use in the United States. According to the USGBC, building, operating, and maintaining buildings accounts for 73 percent of all electricity consumption and 41 percent of overall energy use; consumes 14 percent of all potable water—15 trillion gallons per year; is responsible for 38 percent of all CO_2 emissions; and use 40 percent of raw materials globally.

The energy crisis of the 1970s in part inspired the ingenuity and passion that moved green building from exploration and development to actuality; architects, designers, and builders had found a way to make a difference. The initial focus was decreasing our dependence on fossil fuels through high-performing buildings and the use of renewable energy, then embraced water efficiency, sustainable site strategies, resource effectiveness for materials specified, and the comfort and health of the indoor environment.

Green commercial buildings consume less energy when compared with their counterparts. LEED Gold buildings in the General Services Administration's portfolio generally consume 25 percent less energy and 11 percent less water, cost 19 percent less to maintain, score 27 percent higher in occupant satisfaction, and emit 34 percent less greenhouse gases.

The building industry has begun to ameliorate the negative environmental impacts and to address the health and comfort of occupants. What other steps can we take to design and build healthy, high-performing, and intelligent homes that support the health, safety, and well-being of our clients? Addressing the indoor environment as well is key, not just because people spend 85 to 90 percent of their time indoors but because it is the right thing to do.

Let's enumerate what actions will have a net-positive effect on the health of our clients and that of future generations and the planet. We need to demand products and materials that support and improve health. Why aren't we asking for zero-hazard materials instead of settling for products that merely contain *fewer* toxins and contaminants? Why do we continue to spec systems that reduce energy and water consumption by just a small percentage? Wouldn't we rather have more stringent industry standards?

In the last fifty years, over eighty thousand industrial chemicals have been registered in the United States, yet only one thousand have been tested to determine if they are carcinogenic. And only five types of chemicals have been banned by the EPA under the Toxic Substances Control Act (TSCA): polychlorinated biphenyls (PCB), fully halogenated chlorofluoroalkanes, dioxin, asbestos, and hexavalent chromium. The use of four new chemicals used in metalworking fluids has also been forbidden. Worse, when two new chemicals mix in the environment they can create a new, potentially toxic chemical and add to the already increased level of burden on our bodies.

Volatile organic compounds (VOCs) are cancer-causing agents that off-gas from finishes, furnishings, and building materials; they include arsenic in pressure-treated wood, asbestos in old insulation, formaldehyde in composite wood products, and benzene in cigarette smoke.

Reproductive and developmental toxins affect fertility and fetal development and can cause birth defects and health problems later in life. These toxins, also found in finishes, furnishings, and building materials include phthalates in vinyl sheet flooring, acrylamide in adhesives, 1- and 2- bromopropane in coatings, and ethylene glycol in cleaning products.

Endocrine disruptors mimic the body's hormonal system, and even at low levels of exposure can affect the body adversely. These toxins include phthalates in vinyl sheet flooring, bisphenol A (BPA) in epoxies, PCBs in caulk and old light fixtures, halogenated flame retardants in foam furniture and mattresses, and dioxins and various pesticides.

Carcinogenic and endocrine-disrupting pesticides have been detected in more than 50 percent of those tested; fire-retardant chemicals (polybrominated diphenyl ethers, or PBDEs) were found in nearly all everyone. BPA was found in 90 percent of urine samples; women had higher levels than men or children.

Greenguard, a third-party certifier of products relating to indoor air quality, sampled and tested more than twenty-five untinted paints over a two-week period using dynamic environmental testing chambers. The products' stated content of VOC levels ranged between 0 grams per liter (g/l) up to 150 g/l. They also found that seven of the samples off-gassed formaldehyde above California's limit on dry product emissions and that two samples contained ethylene glycol emissions 50 percent above that limit. (This sample testing demonstrates that VOC content cannot be correlated to VOC emissions; more on that later in this chapter.)

The American Society of Interior Designers' Position on Sustainable Design

The American Society of Interior Designers, or ASID, endorses the following principles of environmental stewardship:

Advocacy for safe products and services: Interior designers should advocate with their clients and employers the development of buildings, spaces, and products that are environmentally benign, produced in a socially just manner, and are safe for all living things.

Protection of the biosphere: Interior designers should eliminate the use of any product or process that is known to pollute air, water, or earth.

Sustainable use of natural resources: Interior designers should make use of renewable natural resources and protect vegetation, wildlife habitats, open spaces, and wilderness.

Waste reduction: Interior designers should minimize waste through the reduction, reuse, or recycling of products and encourage the development and use of reclaimed, salvaged, and recycled products.

Wise use of energy: Interior designers should reduce energy use, adopt energy-conserving strategies, and choose renewable energy sources.

Reduction of risk: Interior designers should eliminate the environmental risk to the health of the end users of their designs.

ASID believes that interior designers should endeavor to practice sustainable design whenever feasible. Interior designers should meet present-day needs without compromising the ability to meet the needs of future generations.

Source: American Society of Interior Designers, http://www.asid.org/content/asid-position-sustainable-design

The primary issues of health, safety, and welfare for our clients should be non-negotiable. William McDonough said it best: "Don't poison people; tell the truth and let them know. Don't tell me it's impossible to make a safe, healthy interior. Instead tell me you weren't able to do it because you aren't able to find materials and products to create a healthy space."

Our homes and the homes of our clients are sanctuaries, the places we go to regenerate and that shelter us from storms, literally and figuratively, providing a shield from adverse external conditions. Shouldn't they also support the health of the occupants and construction tradespeople?

Let's examine why health matters and look at the issues of indoor air quality (IAQ), safety, and well-being. Then we'll discuss mitigation strategies and recap the benefits of alternative principles and practices that will hopefully become industry standards.

Why Health Matters

Our clients' welfare is contingent on their physical, mental, and emotional well-being; the aesthetic qualities of the texture, colors, and patterns that surround them; as well as their access to daylight and views. How can professional interior designers create healthy interior environments? Healthy home objectives involve material science and composition, ergonomics, daylighting and artificial lighting, indoor environmental and air quality, and acoustics, and embrace a connection to nature. To ensure safety, we must consider function and layout as well as circulation and egress patterns; source control of chemicals and pollutants; and the products and building systems necessary to minimize physical risks and accidents.

We must therefore research interior finishes and furnishings and then specify healthy ones. This section examines the shortcomings of some chemicals whose use is widespread in the building industry and explores chemical sensitivities and the electro-pollution surrounding us.

We spend 85 to 90 percent of our time indoors, and the level of indoor air pollutants can be two to five times higher than pollutants measured outdoors, even outside large and industrial cities. Greenguard noted in their "Children's Health Statistics" report that we are exposed to the highest levels of VOCs at home. Indoor air pollution has been linked to cancer, respiratory and heart disease, and headaches, lethargy, and dizziness.[2]

But what causes indoor air pollution? Household cleaners, adhesives, carpets, paints, perfumes, air fresheners, synthetics, resins, ducts, formaldehyde, adhesives, heavy metals, upholstery, cabinetry, sealers, particulates, VOCs, substrates, candles, finishes, allergens, ventilation systems, equipment—the list goes on and on.

[2] http://www.greenguard.org/Libraries/GG_Documents/GG_1008_IS_16_ChildrensHealthStats_SHORT_ONLINE.sflb.ashx

So, what can we do about it?

Many organizations are researching the answer. Renowned architecture firm Perkins+Will compiled a comprehensive study for the National Institutes of Health's Division of Environmental Protection as part of a larger effort to promote health in the built environment. The government, regulatory agencies, and academic sources have identified 374 substances linked to asthma; 75 of them are found in paints and adhesives which are used in nearly every home constructed. This data will allow us to minimize their use in building materials and furnishings.

The study from Perkins+Will also reports that 23 million Americans suffer from asthma, 7.1 million of whom are children, and the numbers are growing exponentially. And according to the Global Initiative for Asthma, more than 10 percent of the U.S. population have been diagnosed with asthma.[3] In fact, asthma is one

Each appears on at least six reference lists

(2-Aminoethyl) ethanolamine
1,1'-Methylenebis (4isocyanatobenzene) MDI
4-Methylmorpholine
Azoicarbonamide (1-1' - Azobisformamide)
Chloroamine T
Chromium
Chromium Compounds
Chromium, Hexavalent
Cobalt
Colophony (Rosin)
Crab
Diazonium salt
Egg Protein
Ethanolamine (2-Aminoethanol)
Ethylenediamine (1,2-Diaminoethane)
Formaldehyde
Gluaraldehyde (aka Cidex)
Hard Metal
Hexamethylene diisocyanate (HDI)
Hydralazine
Isocyanates
Isophorone diisocyanate (IPDI)
Latex
Maleic anhydride
Methyl Methacrylate
Methyl tetrahydrophtalic anhydride
Mites
N,N-Dimethylethanolamine
Napthalene Diisocyanate
Nickel
Papain
Penicillins (Ampicillin)
Piperazine dihydrochloride
Polymethylene Polyphenyl isocyanate (PPI)
Polyvinyl Chloride
Psyllium
Spiramycin
Styrene
Toluene diisocyanate (TDI)
Triethylene Tetramine
Tungsten carbide
Wood dust

Figure 4.2 This insert from the study prepared by Perkins+Will and the National Institutes of Health enumerates substances linked to asthma and the frequency with which they appear on research reference lists.

Source: Perkins+Will (http://transparency.perkinswill.com/Media); National Institutes of Health (http://www.nems.nih.gov/Sustainability/Documents/NIH%20Asthma%20Report.pdf)

[3]www.ginasthma.org/local/uploads/files/GINABurdenSummary.pdf.

of the most common chronic diseases worldwide, affecting an estimated 300 million people. And it doesn't stop there. The rate of asthma increases as developing countries westernize. By 2025, it is estimated that more than half of the world's population will live in urban areas, and there is therefore likely to be a marked increase in the number of asthmatics worldwide over the next two decades: an additional 100 million individuals. Already, the number of children under 17 affected by asthma has doubled in 20 years to nearly 10 percent as of 2011.[4]

The World Health Organization (WHO) has partnered with the United Nations Environment Programme (UNEP) to identify health issues related to building materials (see sidebar). Their in-depth study points to commonly specified building materials as major sources of endocrine-disrupting chemicals (EDCs). According to the report, "Over the past decade it has become clear that humans, in particular small children, are. . .exposed to EDCs via dust and particles in indoor environments like homes, schools, childcare centres, and offices."[5] The report also notes that a large number of chemicals are used as additives in indoor materials as well as other products found in our homes. These chemicals can leak into dust particulates or food. They have called for full disclosure of chemical contents in materials and products, pushing the industry toward transparency in ingredients. And the Healthy Building Network has reported that health issues impacted by EDCs are on the rise. The table below indicates the primary areas of concern:

Clearly, our indoor environments of the buildings where we live, work, learn, and play are adversely affecting our health and well-being; the rise of asthma,

Rising Incidences of Health Impacts Associated with Endocrine Disrupting Chemicals	
Autism	**1:110 in 2007** Increased from under 5:10,000 in 1970, globally
Childhood Asthma	**Doubled in 20 years, to 9.4% in 2010** U.S. children, 0-17 years of age
Testicular Cancer	Up to **400% rise** Since 1967 in Baltic countries
Preterm Births	**30% increase** Since 1981 in US, UK & Scandinavia
Low Birth Weight	**19% increase** From 1990 to 2010 in US
Pediatric Brain Cancer	**7% increase** From 1995 to 2007 in US
Healthy Building Network	
Source: *State of the Science of Endocrine Disrupting Chemicals – 2012, WHO/UNEP, 2013*	

Figure 4.3 This table from the Healthy Building Network shows the rising incidences of health issues impacted by endocrine-disrupting chemicals.

Source: Healthy Building News.

[4]www.childstats.gov/americaschildren/tables.asp.
[5]http://www.healthybuilding.net/news/130225-who-edcs.html

reproductive difficulties, respiratory diseases, developmental conditions, cancer, and chemical sensitivities are just a few examples of how. We can no longer question whether indoor environments affect our health.

Chemical Concerns

Our endocrine system regulates the release of certain hormones essential for metabolism, growth and development, sleep, and mood. Substances known as endocrine-disrupting chemicals, or EDCs, can alter the function(s) of this hormonal system, thus increasing the risk of adverse health effects. Some EDCs occur naturally, while synthetic varieties can be found in pesticides, electronics, personal care products, and cosmetics. They can also be found as additives or contaminants in food. These chemicals contribute to the development of nondescended testes in young males, breast cancer in women, prostate cancer in men, developmental effects on the nervous system in children, attention deficit hyperactivity disorder (ADHD) in children, and thyroid cancer.

EDCs can enter the environment through industrial and urban discharges, agricultural run-off, and the burning and release of waste. We can be exposed to them via food and water, inhaling gases and particles in the air, and skin contact.

In 2013, the World Health Organization and the United Nations Environment Programme released *The State of the Science of Endocrine Disrupting Chemicals* 2012, a joint report that found that many synthetic chemicals that have never been tested for their disruption of the hormone system might have significant health implications and presents the current scientific knowledge on exposure to and the effects of EDCs.

Dr. Maria Neira, WHO's director for public health and environment, says, "We urgently need more research to obtain a fuller picture of the health and environment impacts of endocrine disruptors."

The report calls for more research on the associations between EDCs and specific diseases and disorders, noting that more comprehensive assessments and better testing methods could reduce disease risks, saving both lives and money that would be spent on treatment.

Everywhere we go we are surrounded by chemically laden products. It's time that we demand transparency in product content.

Source: World Health Organization http://www.who.int/mediacentre/news/releases/2013/hormone_disrupting_20130219/en/