HOMES FOR PEOPLE WITH MULTIPLE CHEMICAL SENSITIVITIES

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1. Introduction

One small but telling specialty of environmentally progressive design is the creation of hygienic, nontoxic environments for people with Multiple Chemical Sensitivities (MCS), asthma, and other environmentally related health problems. These dwellings offer compelling case studies of the steps necessary to avoid both natural and man-made threats in the indoor environment. This concern for health, in turn, plays a significant role in the general program of ‘green’ or environmentally responsible design.

This article specifically examines the design insights offered by the architecture of the MCS community, presenting uncompromising examples of design prioritizing indoor air quality.

We begin with a brief discussion of MCS from a medical point of view and a brief history of the larger problems of indoor air contaminants in contemporary residential construction. The bulk of the article catalogues design issues specific to MCS environments, from the site selection to construction supervision. Finally, this narrow field of practice is situated within the larger ‘healthy house’ and ‘green building’ movements, and current trends and future tasks are discussed.

In the design of dwellings focused on the idea of health, indoor air quality is the most important but by no means the only topic from both medical and design perspectives. While this article limits its scope to indoor air quality, other issues that are often grouped together with air quality are domestic water quality, electromagnetic field safety, and thermal, visual and acoustic comfort. Each of these topics introduces environmental stresses that can potentially interact with and amplify those described here.

2. Defining Multiple Chemical Sensitivity (MCS)

Multiple Chemical Sensitivity (MCS, also known as 'Environmental Hypersensitivity', '20th Century Disease,' and 'Environmental Illness or EI') is a controversial medical condition involving a heightened sensitivity to chemicals now commonly found in the built environment, as well as to naturally occurring toxins and allergens such as pine turpines, pollens and molds.

Symptoms such as headaches, nausea, disorientation, and lack of muscle control are similar to those of Sick Building Syndrome (SBS), which has been widely studied in the context of typical office environments. Unlike the effects of SBS, however, MCS symptoms tend to be persistent and not specific to any single immune response.

Though MCS is experienced as a range of ailments, there is no clearly established cause and effect relationship to explain the body's reactions to what are commonly considered harmless doses of environmental toxins. Similarly, no treatment has been reliably proven to restore an MCS victim's health. This dilemma leaves isolation from potential irritants as the best available therapy for a person with such hypersensitivities, and given proper refuge, many people with chemical sensitivities do eventually regain some measure of health.

Though the National Academy of Sciences has estimated that 15% of the population may experience some sort of increased allergic sensitivity to chemicals, the wide range of potential causes and expressions of these sensitivities has made the diagnosis of MCS itself exceedingly controversial.

The mainstream medical establishment in the United States does not recognize MCS, though in recent years debate has subsided and shifted towards seeking consensus on approaches to what is now widely recognized as necessary research.

Figure 1: Ecology House, San Rafael, California. Kodama Associates, Architects.
Photograph by the author.

The medical communities of Canada, Great Britain and several European countries do recognize MCS as having a potentially physiological basis, and, with or without medical consensus, MCS is gaining legal standing in the United States. "Ecology House" in San Rafael, California, for example, stands as the first United States Housing and Urban Development Authority (HUD) funded housing project built specifically for MCS victims, where MCS has been recognized by HUD as a disability.

3. A History of Indoor Air Quality Problems

As a medical condition, MCS is circumstantially linked to the post-war chemical revolution and to the widespread construction of tightly sealed environments following the 1973 energy crisis.

The post war period brought several ‘revolutions’ that effected the production of the domestic environment. Innovations in chemistry and industrial processes generated by the war effort were translated into housing production on a number of fronts. Plywood, developed for airplane manufacture, revolutionized construction by reducing the skill and materials required, while improving structural performance. Other new synthetic materials had a similar effect. Labor saving and mass production strategies were introduced throughout the industry, replacing the highly skilled, labor-intensive methods of traditional construction.

Examples of chemicals introduced through this industrialization process that are now medically recognized as potential indoor air quality threats include many now ubiquitous substances. Formaldehyde, for example, is a basic component of the glues found in many engineered wood products. Similarly, volatile organic compounds (VOC’s) are emitted from paints, solvents, caulks, sealants and adhesives, ‘volatilizing’ or evaporating as the material cures. Phthalate esters, the most commonly used plasticizers in polyvinyl chloride resins, produce the characteristically flexible plastics used in many construction materials and consumer goods.

At the same time, synthetic pesticides have been introduced into the environment in a great variety of ways, in agricultural fields, domestic landscapes and building interiors. Pesticides integrated into the manufacture of industrialized building materials themselves have offered technological substitutes for naturally water or pest-resistant materials and for traditional methods of construction designed to manage these natural threats. Modern household cleaning and maintenance products have introduced complex mixes of synthetic chemicals into the typical dwelling.

This trend towards an increasingly synthetic, chemically laced domestic environment collided in the 1970's and 1980's with a new concern for energy efficiency, following on the energy crisis of 1973. In order to make houses more energy efficient, structures were insulated and weather sealed. These actions tended to make houses reasonably tight containers, with profound unintended consequences.

In the case of urethane foam spray insulation, for example, the new insulation technology itself introduced high levels of indoor air pollutants into the home. Commonly, tightly sealed environments have acted to trap pollutants emitted from other new building materials or household items. Most dramatically, these insulated building assemblies have, on occasion, trapped moisture in ways that have created both life-threatening indoor air quality problems and severe structural damage. Equally destructive problems have been created in benign climates with early applications of synthetic stucco cladding systems, which promised simple and inexpensive barriers against the forces of nature and have proven vulnerable to moisture trapping failure with similar results in terms of indoor air quality and structural damage. All of these physical changes in the domestic environment are compounded by the fact the majority of the population spends more time indoors than ever before.

4. Indoor Air Pollutants

The medical literature on indoor air quality recognizes a bewildering array of potential pollutants that chemically sensitive individuals typically seek to avoid. These roughly divide into chemical exposures and biological exposures, with various fibers and soil gasses as additional narrow topics.

Chemical sources include pesticides, volatile and semi-volatile organic compounds such as formaldehyde, phthalates and other chemicals used in the manufacture of plastics, alkyl phenols used in detergents, pesticides, latex paints and other consumer goods, and products of combustion such as carbon monoxide. Many of these chemicals are known to be toxic in significant quantities. Other health effects are poorly understood. Phthalates and alkyl phenols, for example, are not considered highly toxic by traditional toxicological analysis but are both known endocrine disruptors, and so present potential risks to processes of biological reproduction and development.

Biological sources include fungi, proteins associated with arthropods, rodents, and domestic animals, and pollen. Fungi, or more commonly molds and mildews, can act as agents of infection in situations where a person's immune system is already suppressed. They can produce allergens that are linked to conditions such as hay fever and asthma. They can produce a variety of poorly understood but potentially deadly toxic substances, or mycotoxins. And they can produce VOC's, which account for the distinctive odor of certain molds.

Fibers include asbestos, synthetic vitreous fibers such as fiberglass, mineral wool, and slag wool, and cellulose. Asbestos is a known carcinogen that is no longer allowed in construction and only of issue in renovation work. Synthetic vitreous fibers are irritants and their greater potential for damage is a matter of debate. Cellulose is categorized as a nuisance dust, but as an ideal food source for biological activity it presents special problems.

From an architectural designer's perspective, this list of health threats is commonly organized in terms of their immediate sources. On one hand, there are threats in the external environment to be deflected. On the other, there are threats from within to be eliminated, isolated, or flushed out with adequate ventilation. As with the medical literature, in most design literature these threats are also categorized as either biological or chemical in nature. Biological problems are generally related to the presence of water, while chemical exposures are generally related to the materials and products of the built environment.

Figure 2: Mold growth at a window jamb, caused by water leakage from the exterior. *Photograph courtesy of Mark Meiling, Foresight Home Performance, Wauwatosa, Wisconsin.*

For the designer, radon is functionally grouped with water as an environmental force controlled by venting to the atmosphere, while fibers are typically grouped with chemicals as man-made irritants to be isolated or eliminated in favor of less problematic alternatives.

Potential threats in the general environment include both pests and pesticides, water both above and below grade, soil gasses such as radon, and polluted or allergen laden air. Threats originating within the structure similarly include pests and pesticides, uncontrolled quantities of water and various air quality contaminants. Combustion byproducts introduce both toxic chemicals and excess water vapor. Moisture introduced within the dwelling by cooking, bathing, burning natural gas and even breathing can create significant mold problems. High relative humidity levels also promote potentially asthma inducing dust mite activity. Off-gassing from construction materials, furniture, household cleaning and maintenance products, and many types of personal belongings, introduce potential odors, irritants and health threats.

With both external and internal threats, the specifics of the situation vary widely depending on the climate in which the dwelling is located, the technology of construction and the specifics of an individual's health problems.

5. The Design of Dwellings for people with MCS

5.1 Introduction

Given this long list of potential health threats, the process of creating refuge environments for people with MCS involves every aspect of programming, design and construction. The documented dwellings of the MCS community naturally represent a broad spectrum of responses, from the universal to the idiosyncratic. Especially in cases of designing for severe disabilities, individual dwellings respond to different specific sensitivities and differing priorities. As a whole, however, these dwellings offer clear and broadly applicable solutions to the challenge of eliminating possible chemical contaminants, controlling for biological contaminants, and accommodating lifestyles altered by an individual's sensitivities.

5.2 Programming: Determining Individual Standards

The common first step in designing an appropriate refuge environment is to establish a palate of building materials that are tolerable to the effected individual. This task is made difficult by the lack of medical tests available to isolate and rank individual sensitivities. For a person with extreme sensitivities, coming to a personal understanding of what exactly they should avoid may be in itself a long and involved process of trial and error, paying attention to subtle clues in their own physical and emotional swings as they find themselves in different settings. Keeping a journal of such observations is a frequently recommended beginning point. Beyond this, the most common self-administered tests involve sniff testing sample materials, as many MCS symptoms are associated with detectable odors. Some individuals describe more involved regimes, such as keeping samples by the bedside to extend the exposure time. Paints and other finishes are occasionally applied in stages so that their presence can be evaluated before fully committing to their use.

As with any physical disability, the social aspects of being chemically sensitive also often come to the fore in the design process. One question with a social dimension is to what extent the dwelling should take its own form in response to the specific requirements of its inhabitants, and to what extent it should conform to convention. This is a significant question for many chemically sensitive people because the condition itself is socially isolating and many MCS victims fear being stigmatized as such. This author's research points to the fact that houses for people with extreme sensitivities can be built that are for the most part indistinguishable from their neighbors. The same research identifies individuals that have taken great pride in the distinctiveness of the innovations employed to make the dwellings into personal refuges.

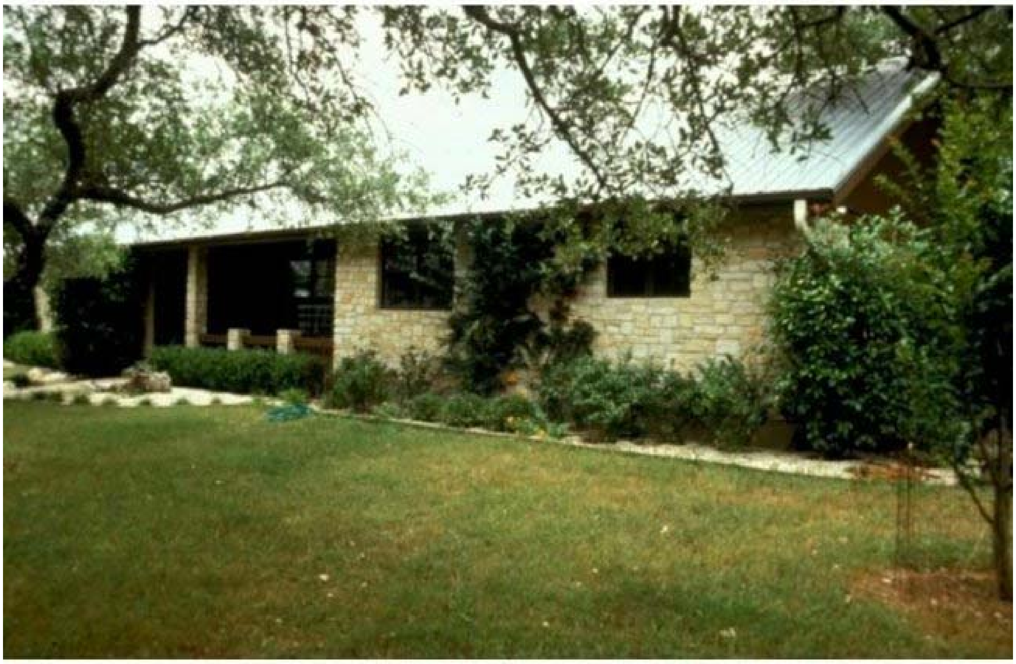

Figure 3: Oetzel House, Wimberley, Texas. The Oetzel house is a conventional tract house in appearance and yet a refuge environment for its owner, a nationally recognized expert on the specification on non-toxic building materials. *Photograph by the author.*

A second social aspect of the problem is the necessity of designing to accommodate other family members or individuals who may not have the same sensitivities. MCS can put great strains on personal relationships, and finding ways to allow for activities that may be in conflict with the needs of the sensitive individual can be very important. This is primarily an issue of separation, as described in the discussions of space planning and ventilation below.

A final social dimension of the design problem is that even for an extremely ill individual, there are compelling reasons to build in such a way that the dwelling anticipates change and even recovery. On a psychological level, this offers the obvious anticipation of pleasures that may be temporarily denied but remain as promises of the future. On a functional level it often implies providing adaptability so that the dwelling can accommodate changing mobility related requirements. Likewise it often implies insuring that the dwelling will be marketable should it need to be sold.

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Biographical Sketch

James Wasley is an Associate Professor of architecture at the University of Wisconsin-Milwaukee, teaching architectural design and environmental technology. His research and professional work concerns the practice of integrative, ecologically informed design, and the interrelations in practice between energy efficiency, resource conservation and human health. He is the co-author with David Rousseau of the general audience book Healthy By Design: Building and Remodeling Solutions for Creating Healthy Homes (1999, Hartley and Marks), a book documenting houses built by and for people with extreme chemical sensitivities. He is currently serving as the president of the Society of Building Science Educators and the Wisconsin Green Building Alliance: an Affiliate of the United States Green Building Council, working to promote broader awareness of these issues.