

Health is Material to Design

BRADLEY GUY

The Catholic University of America

NANCY HULSEY

HKS Architects

TANYA MEJIA

Perkins Eastman

LONA RERICK

ZGF Architects

The manufacture, use, and disposal of building products has profound effects on human and natural ecosystem health and is a realm where the architect can exert significant influence. In the broad intersection of health and design, material selection is a critical issue which can serve a vital role in comprehensive design for well-being. However, the practice of incorporating and institutionalizing the potential human health impacts of building products into architectural design has yet to be fully realized. Further understanding and research is necessary to develop methods to factor emerging human health and environmental concerns around certain building product ingredients and cradle to grave environmental impacts into the design process. Ultimately, quantifiable human health and environmental impacts will likely become a standard part of the many complex factors considered when selecting building products in design and construction.

This paper assesses the state of the industry with regards to safer material selection in architectural design as exemplified through case studies, the results of a stakeholder survey of current design firm practices, and practitioner experience. Through our analysis, we explore methods of successfully institutionalizing the value of health and well-being as an important factor of material selection in design practice.

INTRODUCTION

The majority of owners, clients, and design professionals, including those practicing in educational, housing, landscape, office workplace, and urban design, do care about the health of people and the environment. The recent drive toward material transparency, including many manufacturers sharing full lists of a product's chemical ingredients and sometimes even emerging human health impact

research about those chemical contents, has made the goal of reducing toxicity of building products achievable. However, it is often difficult for either the designer or the client to understand how to incorporate the value of safer material selection into their "bottom line" and tight project timeframes.

The array of potential best practices for choosing materials in design can be overwhelming to even an experienced designer. From pre- to post-occupancy, it is necessary to incorporate a dizzying array of evidence-based measures into the design process and one cannot exclusively rely on an array of generic prescriptive measures. Practitioners and their clients who are having success incorporating these new ways of reviewing building materials typically set at least one clear materials goal on each of their projects. This concept of limiting variables can enable the development of a clear set of criteria for the impacts of material selection on human well-being without the confounding effect of too many parameters. This clear team materials vision can also create a foundation upon which to study and quantitative economic, social, and environmental knowledge around the processes and outcomes of each material being considered.

Research Intention

Our group came together out of the AIA Materials Knowledge Working Group and a shared desire to understand best practices for incorporating evolving information about building products' chemical ingredients in a designer's material selection process. We wanted to know how the current state of scientific understanding about potential human health hazards associated with those ingredients can best be translated into how materials are selected for the construction of our projects. Our hope was to identify concrete steps that could be taken today in our practices and by other design firms to begin incorporating safer materials in our work.

STATE OF THE INDUSTRY

The importance of human and environmental health has emerged as a trending topic in the architectural design industry in recent years, and has been accompanied by an increase in knowledge and policy initiatives surrounding material selection in design. Non-governmental organizations, for-profit organizations, and private firms have sponsored initiatives or undertaken design projects to

explore best practices in material selection. Additionally, an array of third-party standards and certification programs have been established to provide tools to analyze the potential effects of materials on humans and the environment. In the sections that follow, industry case studies, material transparency product disclosure programs, and the results of a stakeholder survey are assessed to inform methods of institutionalizing design practice to successfully incorporate the value of health and well-being.

MATERIALS TRANSPARENCY PRODUCT DISCLOSURES

As concern about the chemical ingredients of building products has increased in recent years, the need to move beyond Materials Safety Data Sheets (MSDS) has become clear. The MSDS documentation identifies the chemical contents of building product at installation and can often be as vague as only documenting chemicals at the 10,000 ppm level or higher. Most certification programs and standards have established that chemicals should be documented to at least the 1,000 ppm level in order to thoroughly capture and document potential risks and hazards. The three most prevalent methods within the industry to recognize the chemical content of building products to at least the 1,000 ppm level are highlighted below.

Health Product Declarations (with GreenScreen hazard assessments)

The Health Product Declaration (HPD) is a standard reporting format for disclosing product ingredients. HPDs use the “GreenScreen for Safer Chemicals,” a chemical hazard assessment method, to give a snapshot evaluation of the known human health hazards within each chemical ingredient. Greenscreen BM-1 (Benchmark 1) chemicals are ones that consensus research has shown to be so hazardous that precaution suggests that they should be avoided. HPD’s with Greenscreen assessments do not necessarily address the risk of exposure from the particular application of the product in question. However, the precautionary principle leads many designers to err on the side of not using products containing BM-1 chemicals; while they might be safe during the use phase of the building, other phases of their life cycle such as manufacturing or disposal may cause harm.

Declare

The Declare product label is a tool developed by the International Living Future Institute (ILFI) to pre-screen products against the Living Building Challenge’s (LBC’s) Red List. The LBC Red List, according to ILFI, is a list of “worst in class” chemicals commonly found in building products. The Declare “nutrition label” is a self-declared list of all of a product’s ingredients which quickly identifies whether products contain any of the banned chemicals from the LBC Red List.

Cradle to Cradle

Cradle to Cradle (C2C) is a third-party verified, multi-attribute product certification program that can be used to verify the sustainable attributes of building materials, as well as other types of consumer products. Fully certified products and their manufacturers are rated (Basic, Bronze, Silver, Gold, or Platinum) in five categories: Materials Health, Material Reutilization, Renewable Energy Use and Carbon Management, Water Stewardship, and Social Fairness.

Cradle to Cradle also offers a standalone Material Health Certificate. This single attribute product certification uses the same Material Health criteria as required for full product certification. It addresses human health hazards, including the avoidance of the C2C Certified Banned List of Chemicals, similar to the LBC Red List. Unlike Declare and HPD, C2C products currently do not publicly disclose their chemical composition. However, at each level of certification, it is clear which additional hazardous chemicals beyond the C2C Certified Banned List of Chemicals are absent from the product. Only C2C staff members have access to the full product information provided by the product manufacturer. However, with increasingly higher levels of certification, consumers can know from the certification protocol what additional chemicals of concern are avoided in the products at each certification level.

CASE STUDIES

AIA Materials Knowledge Working Group

In 2013, the American Institute of Architects (AIA) conducted a survey of architects to establish sustainable design priorities for their constituents. This survey culminated in the Sustainability Leadership Opportunity Scan report and the prioritization of four issues: Resilience, Energy, Health, and Materials. As a result, the AIA released a statement about the importance of sustainable materials selections and established the Materials Knowledge Working Group (MKWG) in 2014 to help architects address materials issues in their work. So far, the AIA MKWG has released a materials transparency risk paper to establish sound practices around emerging product disclosures and created a series of classes for designers called Materials Matters. The group is currently working on a web-based resource to help building professionals navigate the emerging landscape of materials transparency.

The Rose Housing

Currently, there is a general perception within the building industry that, to significantly reduce the toxic chemical content of materials in a project, the budget must be increased to accommodate material research costs and more expensive building materials. The Rose, an affordable housing project in Minneapolis, MN, provides one counter example. Aeon, a non-profit affordable housing developer, Hope Community, and MSR Design led an integrated team to reduce the quantity of Living Building Challenge Red List chemicals in The Rose. The project team achieved significant success with a mere 1% increase in construction costs for the selected building products.

While the team could not find affordable alternatives for every building material they researched, they made strategic product selections to improve the lives of building occupants. For example, by installing bio-based rather than vinyl flooring tile, 250 pounds of toxic chemicals per housing unit were eliminated from the occupants’ daily environment. That amounts to a reduction of over 11 tons of toxic chemicals for the 90-unit housing complex from the flooring product selection alone. Post-construction/pre-occupancy testing of air quality in the housing units detected 20 to 30 micrograms of volatile

organic compounds (VOC's) compared to the standard target measurement of 500 micrograms.

The key to the success of this project was the will of the united team effort. Increased awareness that this level of reduction of toxic chemical content can be achieved without significant increases in building material costs could change health-based outcomes within the industry. Furthermore, resources and information generated by projects like The Rose are becoming more accessible to the industry through initiatives like HomeFree, an initiative of Healthy Building Network, which is building a product database from affordable housing projects.

Healthier Hospitals Initiative's Safer Chemicals Challenge

The Healthier Hospitals Initiative (HHI) was originally founded by twelve of the largest, most influential U.S. health systems, including Kaiser Permanente, along with Practice Greenhealth, Health Care Without Harm and the Center for Health Design. The initiative was founded to create a guide for hospitals to improve sustainable practices in the following six areas: Engaged Leadership, Healthier Food, Leaner Energy, Less Waste, Smarter Purchasing, and Safer Chemicals.

HHI's Safer Chemicals Challenge recognizes that harmful chemicals, linked to cancer, birth defects, asthma and other health problems, are currently widely used in health care products, furniture, and fabrics. This challenge recognizes that hospitals can create healthier environments by using cleaners, medical products, and furniture with safer alternative chemicals. In particular, the Part C - Healthy Interiors guidance of the Safer Chemicals Challenge requires that at least 30 percent of a participating hospital's furnishings and furniture purchases, based on cost, eliminate the use of the following chemical types: formaldehyde, perfluorinated compounds, polyvinyl chloride (PVC), antimicrobials, and all flame retardants (where codes allow). Included furnishings and furniture types are seating (chairs, stools, sofas, benches, etc.), work surfaces (tables, desks, etc.), built-in and modular casework, systems (walled desks with seating), beds (including mattresses), storage units (cabinets, filing cabinets, dressers, drawers, etc.), shelving (bookshelves, built-in shelves, etc.), panels and partitions, cubicle curtains, and window coverings.

STAKEHOLDER SURVEY

METHODOLOGY

Our group worked together to create questions that would help answer the following:

- What is the current state of safer materials selection within design firms?
- What practices are leading design firms currently implementing?
- Do these leaders have best practices/lessons learned that others could adopt in their own design processes?

RESULTS

The survey relied heavily on professional networks of sustainability professionals working at design firms. Since in some cases the anonymous survey was sent to multiple individuals in various roles at a given firm, it is not clear how many firms are included among the 92 respondents. The results do, however, reflect diversity with regards to geographical dispersal across the U.S., firm size, and the number of office locations per firm.

While there were a few outlier firms that are on the front lines of considering human health hazards in their materials selections; the vast majority of those surveyed noted that their firms still have a lot of room for improvement. Within those survey respondents who indicated that their firms had fully institutionalized human health hazards, many simultaneously indicated that their firms were not looking at factors beyond VOC content when looking for safer products, which no longer represents best practices within material selection. The survey respondents who indicated that their firms had institutionalized best practices for materials selection, and also provided evidence of advanced material selection criteria within projects, were taken to represent the leading edge.

82.61% (n=76) of respondents agree or strongly agree that industry certifications standards motivate their firm's considerations for materials with reduced human health impacts. When asked to choose the sources for information related to the issue of material health impacts, the top three selections were experts via webinars and conference sessions (19.04%, n=83), websites for certifications or standards (17.89%, n=78), and non-profits advocating and education on health impacts in materials (14.22%, n=62).

Although firms report that industry certifications and standards motivate their firm's consideration for materials with reduced human health impacts, the majority of firms (61.96%, n=57) have never set a specific materials human health impact reduction goal beyond limiting VOC content for a project. Responses to the statement, "consideration of the health impacts of building materials is institutionalized in my firm's practice," were almost exactly evenly split between agree / strongly agree and disagree / strongly disagree. 30.43% (n=28) neither agreed or disagreed with the statement.

61.96% (n=57) of respondents answered no to the question, "Has your firm ever set a specific materials human health impact reduction goal beyond limiting VOC content for any project(s),". Of the 38.04% (n=35) that answered yes, 73.71% (n=21) agreed or strongly agreed that the set goal was achieved.

When asked what percentage of their clients express concern for materials health in their project beyond VOC content limits, 69.65% of respondents (n=64) responded 0-20%. Combined with the 21-40% category, 90.22% of respondents (n=83) responded that 0-40% of their clients express concern for materials in their project beyond VOC content.

When respondents were asked, “When specific materials health impact reduction goals beyond VOC reduction are not pursued on a particular project, why not (select all that apply), the three most selected responses were client preferred to continue with standard or typical finishes and products (22.04%, n=67), budget did not allow for research or additional materials costs (20.39%, n=62), and issue never came up with client (16.45%, n=50).

Basic Analysis

A wide gap exists between firms reporting that material health information affects their consideration of materials and seeing material health information make an impact beyond VOC content when it comes to practice. Several possibilities could explain this difference. One is that the translation of knowledge into actual practice is difficult. It could also be due to an overly optimistic sense of the institutionalization of materials health information throughout the firm. The most noted sources of information about materials health is reported as being from outside the firm’s internal resources; i.e. via webinars, websites, etc rather than being integral to project teams, such as in the form of preferred material palettes to present to all clients, etc. This suggests that firms need to establish strong internal materials education programs.

Also, the perception of client interest may limit the degree to which design firms present the health impacts of materials to clients. Presenting information to a client who has little interest in a subject that the design firm is only newly becoming familiar with can limit the resolve to introduce new materials considerations.

Even in cases where firms pursued material health goals beyond VOC reductions, those goals were not always met. There are still strong pressures that keep material health goals from being met such as budget considerations, client preference to stick with familiar products, and a need for designer and client education.

INSTITUTIONALIZING DESIGN PRACTICE TO SUCCESSFULLY INCORPORATE THE VALUE OF HEALTH AND WELL-BEING

From the assessment of existing case studies, initiatives, and survey of design practitioners, it is clear that material selection has become a critical consideration when considering the intersection of health and the design of the built environment. However, while the number of successful case studies is steadily increasing, practitioners and firms are struggling with how to incorporate the health impacts of building products into their designs on a consistent and institutionalized basis. It is necessary to assess and develop methods for incorporating the impact of material selection on health and well-being through a design process so that it can become a standard part of architectural practice and ultimately provide a clear, quantifiable value.

What is the Vision?

In order to move towards an institutionalized consideration of material selection, it is first important to establish the importance of the issue and relate it to the values of the client, designer, and occupant.

If the stakeholders and designers do not know or “care” about material selection, it will not become an integral consideration in design. As the survey of practitioners indicated, client and designer education is one of the main issues halting the adoption of meaningful material selection practices.

Design practice can aim to inspire stakeholders and designers by highlighting how material considerations can affect the economic, environmental, and social value of design. The majority of owners, clients, and design professionals in education, housing, landscape, office workplace, and urban design do care about the health of people and the planet, but might be overwhelmed by information which is often presented in terms of negative consequences. A clear presentation of how design choices can instead have a positive effect on occupants can inspire designers and clients to make more educated choices. Instead of relying on regulations or certifications to present the negative implications of material choices, designers can proactively present the positive aspects of implementing better material selection practices to fellow colleagues or clients.

What Are the Metrics?

In the survey of case studies and practitioners, a common thread among successful projects and initiatives is that they have set at least one clear goal for the project from the beginning of the design process. After establishing the positive value of careful material selection among the stakeholders and designers, goals can be set for a project that frame all decisions moving forward. A clear objective can make complex decisions more manageable and allows for metrics to be established in order to measure the success of the implemented strategy.

Goals and associated metrics can be internal to a design firm and also external to a project and client. For example, the Rose housing project set a defined goal to reduce the toxic content of materials (as outlined by the Living Building Challenge Red List) in an affordable housing development as well as to do it in a manner that did not significantly increase the budget. The goals had an impact on the client, the design firm, and the occupants, and the results were able to be measured through air testing and benchmarking against standard industry practices.

By defining a clear goal and measuring the results on every project, knowledge is captured with each project, and contributes towards an established body of case studies for a firm and the broader design practice. Goals can be of varying ambition and present an opportunity for further education of client and designer. For example, the practitioner survey indicated that, for many projects, the extent of material selection consideration was the consideration of VOC reduction. If clients are already familiar with VOC reduction, a next step could be the selection and elimination of one additional chemical of concern or the consideration of a group of chemicals that affect a particular aspect of health, such as asthma. Lessons learned from the education and implementation process could then be carried over into future projects and lead to further advancements.

Project Application & Process

From case studies, surveys, and practice, it is apparent that the intent to apply material health best practices does not always translate into effective firmwide practitioner implementation. While design must be tailored to specific projects and clients, there are approaches that may be applied across projects or institutionalized as organizational practice. A significant preliminary approach is for designers to accept the responsibility of educating clients and colleagues and raise issues of material health within an active discussion. This type of discussion is especially fruitful with repeat clients and ongoing client relationships, and is supported by the work of industry leaders such as the Healthier Hospitals Initiative.

After education and discussion, a clear goal or set of goals can be established for the project, and strategies are then selected in support of the goals. Qualitative and quantitative measurement of chosen strategies is key in order to establish the value and results of a given approach. While quantitative measurement is useful wherever possible, pre- and post-occupancy evaluations can also assist in measuring qualitative data such as occupant satisfaction and comfort, and provides further depth to a performance-based approach. If every project within a firm sets one goal around material health and measures the results, the firm then begins to institutionalize material health goals and establishes a comprehensive body of case studies.

CONCLUSIONS & FUTURE WORK

While knowledge of material selection and the impact on health and well-being is growing in design practice, the incorporation of material health has not yet been institutionalized as an industry standard. A need for education and direction is highlighted in the survey of design practitioners and industry case studies. With further education and implementation of performance-based goals on design projects, a body of evidence can grow that may affect both market demand and highlight gaps in current knowledge. Further research into the institutionalization of human health and environmental impacts of material selection in design practice should analyze the potential to quantify the value of health outcomes and the most valuable methods of client and designer education. In general, designers are looking for the right paths to act on material safety concerns and the metrics to measure success.