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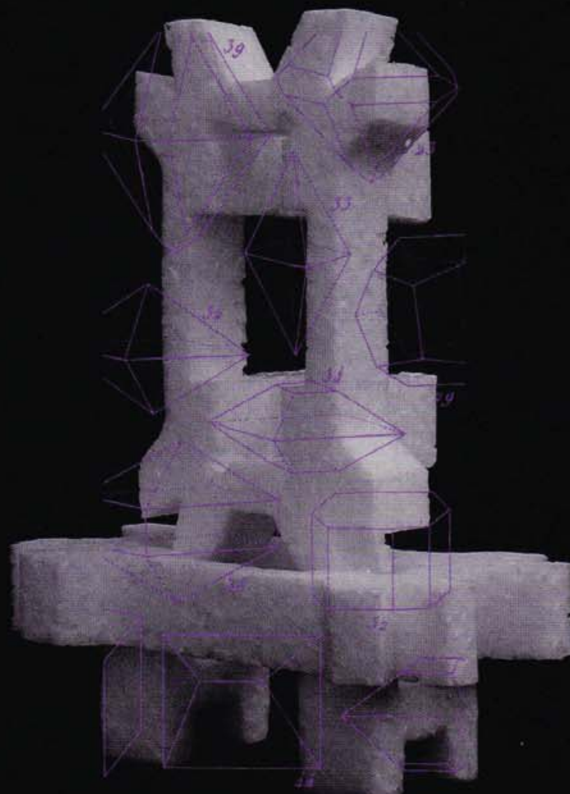

NEW MATERIAL

- Sensuous Surfaces
- Of Transgenic Spider Webs and Bicycle Seats
- What Counts as Green? (and Why?)

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new material

Content

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Comment

"Incompetent, irrelevant, and immaterial," Hamilton Burger used to say, on the old Perry Mason show. "Immaterial," here, meant "of no substantial consequence." Stuff becomes material when it is of substantial consequence, when it is brought to bear, put to use. Materials can become material, but so can other things—ideas, methods, strategies.

Accordingly, the title of this issue of **arcCA,** "New Material," encompasses many things. New materials, of course, but also new ways of thinking about materials, old or new, and new ideas, as represented in the 2002 AIACC Design Awards.

Because the Design Awards—as well as "Under the Radar"—are so intensely focused on buildings, three of our other articles step away from architecture, to seek insight from the discipline of product design. A fourth article steps back from the eager application of green building guidelines, to question the comprehensiveness of those guidelines as they are currently being applied in the U.S. And, for the Coda, we present a "Green Map" that will help residents of the Ballona Creek Watershed find, among other salutary things, a place to dispose properly of *old* materials.

Like every issue of **arcCA,** this one bites off more than it can chew. For those who want to explore architecture's materiality more critically, the bibliography that follows may be of some help. I don't usually recommend my own articles (especially in such company), but one turns out to be material—er, relevant—here, so I've included it.

You should also check out the research work of Kieran Timberlake Associates LLP, of Philadelphia, the first recipients of the Latrobe Fellowship from the College of Fellows of the AIA. The fellowship sponsors a research initiative, in which they are evaluating, "for potential transfer to the building realm, a wide range of technologies (including both process innovations and cutting-edge material applications) used beneficially in other industries including automotive manufacturing, aerospace and shipbuilding." For more information, go to http://mb2010.com.

For a proprietary material information database, Kara Johnson, author of "From the Science of Materials to Design," suggests you check out the Cambridge Engineering Selector at www.grantadesign.com.

In the Bay Area, a timely show is running at CCAC's Wattis Institute through 10 January 2003. Curated by Adi Shamir and Marina McDougall, "In the Making" is an exhibition of artists and designers who experiment with tools and materials, conducting their studios like research laboratories. For more info, see http://www.ccac-art.edu/wattis/exhibitions.

Finally, I should mention that my whining, two issues back, about being unable to find someone to write a profile of citizen architect Michael Stepner, FAIA, has paid off. His profile appears in this issue, better late than never. ◉

Tim Culvahouse, AIA, editor

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Contributors

Tylor Garland is founding principal of boomBang, a creative incubator that develops, patents, and solicits venture capital to build enterprises around innovative products that are informed by new and emerging materials and technologies. He was previously Managing Director of Product Development for frogdesign.

Kara Johnson is the Materials Lead at IDEO, an innovation and design consultancy. Her role is that of supporting designers in the selection of materials and introducing unique methods of integrating materials in the design process.

Hal Levin is a research architect and consultant with his own firm, Building Ecology Research Group, in Santa Cruz, and an Architect-Engineer/Scientist at Lawrence Berkeley National Laboratory. In the 1970s and '80s, Levin taught in the Architecture Department at UC Berkeley and in the Board of Environmental Studies at UC Santa Cruz, and for 8 years he served as a member of the California State Board of Architectural Examiners. He has been elected a Fellow of ASHRAE and ASTM. His "Building Ecology is My Destiny" appeared in *Architecture California,* vol. 17, no. 1 (May 1995).

Elizabeth Martin is creative director of Alloy Design & Technology, a multi-disciplinary design firm focusing on building, new technology, and craftsmanship. In addition to practice, Liz is the director of the new, Los Angeles-based A+D Architecture and Design Museum, located in the historic Bradbury Building.

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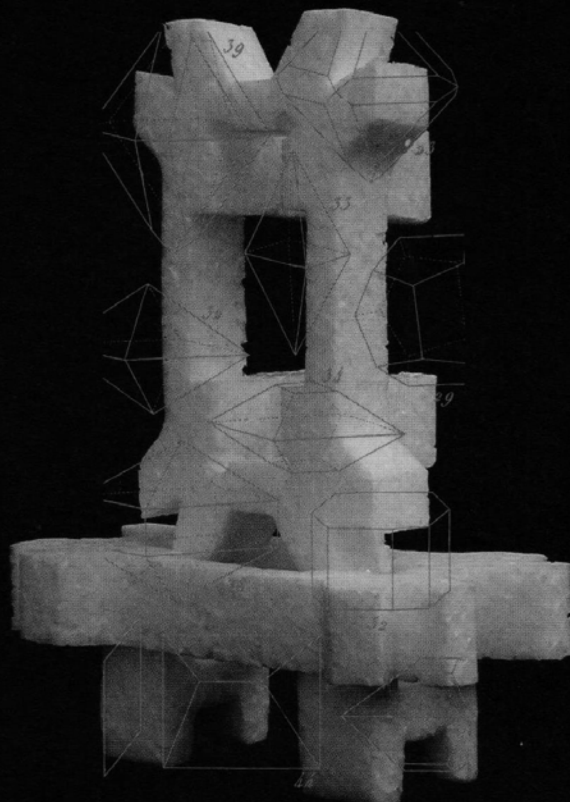

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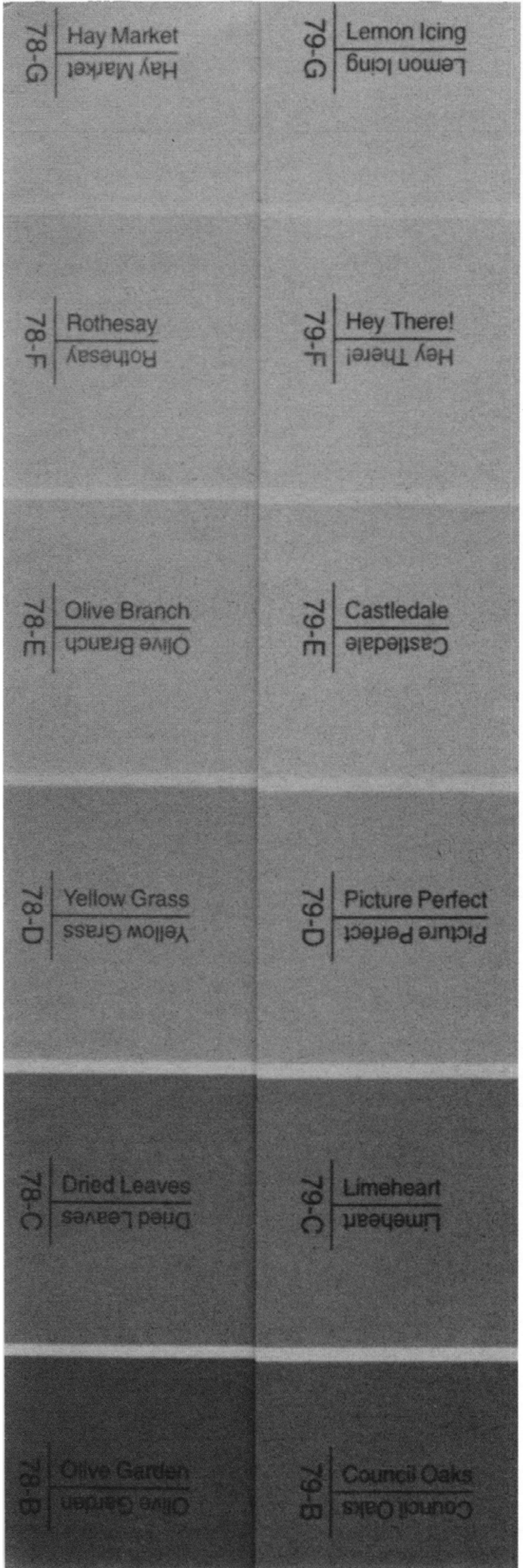

What Counts as Green?

(and Why?)

Hal Levin

"Sustainability" has been variously defined, as was clearly illustrated at the recent United Nations Earth Summit in Johannesburg. When discussed in the context of the impacts of buildings on the environment, its meaning is ambiguous and often distorted. Buildings are not either "sustainable" or not. No buildings being built today are sustainable in the true sense of the word. While many guidelines exist for guiding design to improve building environmental performance, most of the available guidelines do not assess the total impact of a building on the environment. Instead, they tend to rate buildings on the basis of individual features considered "green" or "sustainable" by the designers.

A more rigorous approach to assessing building sustainability is needed in practice. Such an approach evaluates a building by its total effect on the environment, not by the number of discrete "green" maneuvers it makes. Some software tools exist that can support decision-making to design buildings based on rigorous analysis of the environmental impacts.

Finally, the assessment of a building's impacts on the environment must be related to goals for meeting local, national, and global environmental needs. Such goals can be established and used as benchmarks for building performance. These procedures can be used with available design tools to create new buildings and to evaluate existing buildings on the basis of their projected total environmental performance. When such tools are routinely used we will we learn enough to make wise decisions and create buildings that are more sustainable.

DEFINING THE ISSUE

There is widespread and apparently growing interest in protecting the environment, especially in the design of schools and local, state, and federal government buildings. Designers are increasingly pressed to design "green" buildings. But how is one to know what is "green"? Is "green" the same as "sustainable"? Everyone who considers his building design services or product "green" knows what green is. Nearly everyone else is left wondering.

"Green building" is a construct without any inherent meaning as a label for environmentally responsible building. You can't measure one characteristic of a building's environmental performance and then decide whether or not it is "green." In fact, many things have to be measured, and few of us would agree on what those many things are. Beyond that, we might not all agree on how important various characteristics are. Is air pollution more important than water pollution? That probably depends on where and who you are. What about global climate change versus species extinction?

At the heart of any operational definition of "green" building, there needs to be a clear, prioritized, weighted set of environmental goals. And there must be yardsticks available to measure how well a building performs against those goals. When evaluating a building's "greenness," we must assess the impact of the total building on all the environmental problem categories. It is possible to do this today, but not in California, not even in America. CADD-compatible software packages have been developed based on life cycle assessment methodologies, but so far only in Finland, Germany, and Holland. The latter two software programs are in German and Dutch, respectively, and the databases used are from those countries. We need such software in English, using data from sources of products, materials, and energy used in American buildings. Such tools could themselves then be used to develop guidelines based on a representative set of scenarios. They would provide designers with vastly better guidance than is available from existing green building guidelines.

CURRENT GUIDELINES

Formal guidelines do, of course, exist for determining the "greenness" of a building. These have to do with energy conservation, use of recycled materials, reduced emissions of toxic chemicals, and many other specific characteristics. The guidelines generally involve incremental improvements over typical current practice. In general, buildings conforming to these guidelines may be less harmful to the environment than buildings designed without the benefit of such guidelines, but we don't actually know if that is true. And even the best of buildings built today fail to reduce resource consumption and pollution emissions to a sufficient degree compared to the scale of reductions needed to create truly "sustainable" buildings. It is difficult (if not impossible) to find a building being built today that could be regarded as truly sustainable.

Most green building guidelines are based on designers' judgments about immediately available solutions rather than an analysis of the way a particular building design will actually affect the environmental problems of concern. Most of the available guidelines are prescriptive in nature; few are performance based. As such, they almost all suffer from the same fundamental flaw—they fail to involve an assessment of the combined impacts of the various individual measures promoted by the guidelines—that is, the actual or projected impacts of the completed building throughout its whole life cycle on the local, regional, and global environment. The guidelines may reflect good current practice, but few of them even involve best current practice.

The increasingly widespread acceptance and use of many green building guidelines—the US Green Buildings Council's LEED Rating System and scores of others—give the incorrect impression that we know enough about buildings' environmental impacts to provide reliable guidance. The truth is that we simply do not know the net environmental impact of buildings that get higher or lower scores using the available guidelines.

DEFINING LOCAL GOALS

Environmental goals of projects are occasionally explicit but usually implicit. When stated, they often take the form of reducing resource consumption and pollution emissions and, occasionally, disturbance of sensitive habitats. The environmental goals of building projects may differ significantly depending on locale and client.

- Acid deposition is not much of a problem in the Far West, but it is a major issue in the Upper Midwest and the Northeastern United States.
- Urban air pollution is a big problem in the major communities in California's Central Valley and along coastal Southern California but not along California's Central Coast (Santa Barbara, San Luis Obispo, Monterey, and Santa Cruz).
- Hydroelectric power generation in the Pacific Northwest is controversial due to the extensive damming of rivers and the resultant impacts on the fisheries. Pacific Northwest electric energy costs are so low that energy conservation measures do not gain much support through analysis using purely economic criteria.

❄ Water consumption in water self-sufficient regions is not an issue of resource depletion. But what is the impact on air quality and climate—and the indirect impact on the abundance of allergens—when abundant water facilitates extensive landscaping in the otherwise arid climate of Phoenix? People who moved there to avoid exposure to pollen and mold are now victims of the "greening" of the desert.

As these and countless other examples suggest, differences in local or regional conditions will have significant impacts on the desirability of building designs and their operational protocols. In addition, building owners often associate particular aspects of the environment with their needs, products, or image. Thus, priorities have to be established in the context of a particular project location and client. Yet broad guidelines tend to follow a one-size-fits-all format.

SETTING GLOBAL TARGETS

An ideal starting place for creating defensible guidelines is an analysis based on a comprehensive set of environmental concerns and a set of targets based on human impacts on the environment. Such targets have been set for large-scale development projects and regional or national development, and there are whole books written about criteria used and measurements made in such projects. Building projects can and should be similarly evaluated.

A rational approach to establishing guidelines for environmentally responsible buildings should start with a set of problems and measurement of the impacts of alternative design solutions on each of the problem areas. Too often, solutions are aimed at only one or a small number of problems and may end up working at cross-purposes with other solutions for different problems.

Buildings are very large contributors to environmental deterioration. They account for 15% to 45% of the total U.S. environmental burden for each of the eight major Life Cycle Analysis inventory categories shown in Table 1. Determining buildings' contributions allows us to prioritize generic environmental protection goals. The portion of buildings' environmental impacts is generally consistent around the globe.

THE DUTCH EXAMPLE

A set of target values for environmental resource consumption and pollution can easily be derived. While such targets themselves are subject to human judgment, they can reflect the best available science, and, if the methodology is transparent, as it should be, the targets can be revised as new information arrives. The Dutch government commissioned a study to propose just such goals in order to move Dutch technology toward sustainability over a 50-year time frame. The authors assumed that all humans are entitled to utilize the same amount of environmental resources and to contribute an equal share of pollution —that is, each inhabitant is entitled to the same "ecospace." They established some "ecocapacity" limits on basic resource consumption and pollution emissions, then calculated ecospace targets for 50 years in the future. The authors allocated environmental resources among nations and calculated the Dutch share. Then, working backward, they calculated reductions necessary in current consumption and pollution to achieve sustainability. Their informative results are presented in Table 2.

RESOURCE USE	% OF TOTAL
Raw materials	30
Energy use	42
Water use	25
Land (in SMSAs)	12

POLLUTION EMISSION	% OF TOTAL
Atmospheric emissions	40
Water effluents	20
Solid waste	25
Other releases	13

Table 1: Environmental Burdens Of Buildings, U.S.

The Dutch authors point out that there is a 30 to 1 disparity in resource consumption and pollution emissions shares between inhabitants of OECD (developed) nations and developing nations, or between "north" and "south." The authors propose to reduce the ecospace disparity by a factor of three, to a ratio of 10 to 1, during a 50-year planning time frame. They do not propose how such a shift toward universal environmental equity should be accomplished, but they base their analysis and projections on the assumption that such a shift is desirable.

The Dutch project that their carbon dioxide emissions must be reduced by 80% in the next 50 years. Using their method, we calculated reductions in per capita energy consumption in the United States necessary by the year 2050 for us to share equally with all the earth's projected 10 billion inhabitants. Just in terms of carbon dioxide and equivalent other greenhouse gas emissions, Americans must reduce current per capita consumption by more than 95%. Reductions of 80 to 95% are necessary in several other categories. Some consumption, such as copper, for example, will not have to be reduced much,

Dimension/indicator of environmental impact	Sustainable level	Expected level 2040	Desired reduction	Scale
DEPLETION OF FOSSIL FUELS:				
* oil	stock for 50 years	stock exhausted	85%	global
* natural gas	stock for 50 years	stock exhausted	70%	global
* coal	stock for 50 years	stock exhausted	20%	global
DEPLETION OF METALS:				
* aluminum	stock for 50 years	stock for >50 years	none	global
* copper	stock for 50 years	stock exhausted	80%	global
* uranium	stock for 50 years	depends on use of nuclear energy	not quantifiable	global
DEPLETION OF RENEWABLE RESOURCES:				
Biomass	20% terr. animal biomass	50% terr. animal biomass	60%	global
	20% terr. primary production	50% terr. primary production	60%	global
Diversity of species	extinction 5 species/year	365-65,000 species/year	99%	global
POLLUTION:				
Emission of CO2	2.6 Gigatons carbon/year	13.0 Gigatons carbon/year	80%	global
Acid deposition	400 acid eq./hectare/year	2400-3600 acid eq. /ha./year	85%	continental
Deposition nutrients	P: 30 kg. per ha. /year	no quantitative data	not quantifiable	national
	N: 267 kg. Per ha./year	no quantitative data	not quantifiable	national
Deposition of metals:				
* deposition of cadmium	2 ton/year	50 tons/year	95%	national
* deposition of copper	70 ton/year	830 tons/year	90%	national
* deposition of lead	58 ton/year	700 ton/year	90%	national
* deposition of zinc	215 ton/year	5190 ton/year	95%	national
ENCROACHMENT				
Impairment by dehydration	reference year 1950	no quantitative data	not quantifiable	national
Soil loss through erosion	9.3 billion ton/year	45 to 60 billion tons/year	85%	global

Table 2: Sustainable versus expected level of environmental impact for selected indicators.

if a large fraction of the copper in use is recycled, and the proven reserves are therefore not likely to be stressed in the foreseeable future.

SETTING TARGETS FOR PERFORMANCE

The decision-maker must divide up and allocate the global, regional, or local "ecospace" for each problem being addressed depending on the type of problem:

1) on a per capita basis, determine how much of a building's use is allocated to a given number of people, or
2) on the basis of annual units of building use per person (person square meters per year), or
3) on the fraction of the building type accounted for by the particular building (x percent of all school or office or residential etc. space in the local (or regional or global) community)

There are some important issues with each of these three approaches that need to be addressed in the details of their implementation. One of them, for example, is what's called "normalization." This involves trying to create equivalencies so comparisons aren't distorted. There are questions of social justice. For example, if one house is very energy efficient but very large, and another is very energy inefficient but very small, and if both are occupied by the same number of people and use the same total amount of energy, is the small, inefficient house dweller to be penalized for having an inefficient house?

In the end, as is the case with most things, it's a matter of values. For the design process, what is important is that these questions be considered and resolved as part of the basis for making the many trade-offs that inevitably must be made. There may not be one single "correct" way to do this. But it must be done, and the assumptions and methods must be explicit in order for us to be able to evaluate the results.

Such target setting can provide benchmarks that enable us to evaluate a building's total contribution to environmental stress in quantitative terms. Using life cycle assessment tools in conjunction with CADD software, every decision can be evaluated in terms of the total projected impact on the environment throughout the building's life cycle. Using a "Building Ecology" perspective, comprehensive, science-based analysis can inform our designs so that we are able to measure our efforts toward sustainability. All that is lacking is the will to do so. ◉

[Editor's note: for an expanded version of this article, complete with references, visit arcCA's website, www.aiacc.org/communications/archcal.html.]