"Green" Design in the New Age of Ecology…

I had the pleasure of speaking at the March 21st IFDA chapter meeting at ECO SUPPLY CENTER (www.ecosupplycenter.com) in Manchester. Being the first day of Spring - - the season of renewal and re-birth - - it was a timely discussion given the resurgence of the American environmental movement that began in earnest in the early 70's and which is rapidly taking hold of the U.S. mainstream - - and it is indeed a grip that shows no signs of loosening in the foreseeable future!

The premise of my talk originated with the observation that American society is finally beginning to actively question the *industrial* idiom of design, which has been challenging the principles of nature for far too long, to the point where we are literally over-shooting the carrying capacity of Earth's life support systems - - the air, water, soil & biodiversity. Specifically, we simply cannot continue with the current practices of virtually unchecked deforestation, fossil fuel dependencies, industrial fishing and agriculture, degradation of topsoil, habitat destruction and the continued proliferation of dangerous and persistent toxins throughout the biosphere. And of course, as most of the world's preeminent scientists agree, human activities are at least partially responsible for the warming of the planet and the resultant climatic imbalances. The time is long overdue to re-design our relationship with the Earth in such a manner that respects her cycles, patterns and flows rather than perpetuating the linear "take-make-waste" system in a more efficient "less bad" mode. Just over the past few years within the context of a nationwide surge of interest in organic farming, community gardening, "eco-friendly" consumer products from A to Z, we have witnessed a similar shift toward "green" or "sustainable" design and building practices. While the movement has gained a great deal of traction over the past decade - - in particular due to the establishment of the U.S. Green Building Council (USGBC) and it's LEED (Leadership in Energy & Environmental Design) rating system (www.usgbc.org), we still have a distance yet to go down the path of truly mitigating the damage. For a dose of dimension to the crisis, consider the following areas of concern:

Natural Resources: The construction, operation and maintenance of buildings simply gulps down resources - - approximately 40% of all "natural capital" put through industrial processes (+/- 3 billion tons!) annually is directly attributed to the building industry. Furthermore, 136 million tons of construction and demolition waste are generated every year (about 2.8 lbs per capita) - - and most of it is recyclable. 25% of annual virgin wood harvest finds its way into buildings in one form or another; the dimensions of this figure are only magnified when one considers that the average new American home (just over 2,000 square feet) requires approximately 1.5 acres of forest to construct. EACH DAY, worldwide human demand leads to the felling of over 80,000 acres of forest, with another 80,000 acres degraded in the process of extracting these resources. What is 80,000 acres? Think one *Virginia* per year! Of this total area, most of the irreversible destruction is wrought in the tropical regions, the rainforests where almost 50% of the world's oxygen is produced (and the proportionate carbon sequestration occurs) and at least 50% of the living species reside. Aside from being veritable treasure troves of biological and genetic information, rainforests are considered the "lungs of the planet" and play a fundamental role in the basic functioning of the

Earth system by helping maintain the climate by regulating atmospheric gases and stabilizing rainfall, protect against desertification, and provide numerous other ecological functions. And, once they are destroyed, they can't be restored.

Species Loss: Of course, with the loss of habitat, so goes numerous species of flora and fauna - - conservatively estimated at 150 per day, most of which have not been documented by science. One such story is the threat posed by our demand for that material whose name has become almost generic, but is certainly not. *Luaun* to most of the design and construction world is simply a name for a cheap sheet good, the preferred underlayment for various flooring materials or otherwise as a veneer plywood used in the fabrication of doors and other low-cost products. However, to the *Sumatran Orangutan*, this is prime habitat and a tree native only to Southeast Asia. Furthermore, their species is the last of the Great Apes in Asia and, genetically speaking, one that is 96% human (in fact, *orangutan* translates to *"Person of the Forest"* in two Indonesian dialects).

Water: Though the Earth is about 71% water, less than 1% is available for human use. According to the USGBC, 12% of all potable water is used in the residential & commercial sector, mostly for non-potable uses such as flushing toilets, clothes washing, car washing and irrigation. Think about these numbers the next time you flush - - for newer code-compliant toilets, 1.6 gallons of pure drinking water and for older units, anywhere from 5 to 8 gallons! Furthermore, in the U.S. alone 3% of all electricity usage is attributed to the waste water treatment process.

Energy: Within the design of our current industrial and technological systems, nearly all human activity requires a fossil fuel input at some point in its life cycle, the reality of which is rapidly becoming modern civilization's greatest challenge due to the finite nature of conventional energy truly beginning to manifest - - particularly with regard to oil and natural gas - - in everything from the price we pay directly at the pump to the indirect cost reflected in the price of building materials and products. Most of the power used in buildings is delivered via the coal-combustion system which, by the time the chemical energy is converted to electrical for use at the outlet, is operating at 10% efficiency! The noted poet/essayist/farmer Wendell Berry applies the term "hellish symbioses" to such relationships as those between coal-fired power plants and air conditioning - - that is, when a "solution" (air conditioning) and a problem (atmospheric heat) reciprocally magnify one another.

Toxins: There are over 70,000 synthetic industrial chemical compounds in use in the U.S. today; of that, not quite 3,000 of them have been tested for their effects on human health. Considering that we spend an average of 90% of our time indoors and inhale from 2,000 – 3,000 gallons of air every day, it is our responsibility as designers to ensure that the materials going into our projects do not make people sick, especially when the link has been made between how our buildings are made and the fact that up to 5 million American children now suffer from asthma! In fact, every time we specify and/or purchase a material or product, we are engaging in its life cycle - - and our decision to do so is tantamount to placing an order for more of whatever that item manifests, whether it's health and nutrition or more persistent bio-accumulative toxins.

Toward this end, there are two materials that I strongly encourage all designers (especially those of you who are focused on the interiors realm!) to avoid whenever possible. The first is PVC (polyvinyl chloride, a.k.a. vinyl), which is used in a wide range of products such as roofing, siding,

trim, windows, wiring, plumbing, flooring, wall covering, insulation, blinds/shades, furniture, and nearly endless consumer products (packaging, toys, cars, computers, shower curtains, etc.). It's a plastic that I would rate a 12 on a scale of 1 – 10 (1 being the bio-polymers now readily available). Widely known as the "poison plastic", vinyl is the most toxic of all. Among the numerous chemical threats posed by PVC, the most notable is the fact that *dioxin* is created during all phases of production as well as disposal by incineration or accidental fire. Dioxin is one of THE most dangerous substances ever created by humans. It is carcinogenic, persistent and bio-accumulative and is second only to radioactive waste in its danger to life. Human exposure is so widespread that the science community has written off any viable control groups to study - - the average body-burden of dioxin in humans stands at 2X the safe threshold according to the EPA. The softeners used to make PVC pliable (it is otherwise rigid) are known endocrine disruptors (which mimic hormones and wreak havoc on physiological processes) of the highest order and are readily bio-available in that these compounds are not chemically bonded to the polymer chains, which allows them to abrade (fall off). In addition, PVC is also extremely energy intensive to manufacture, with chlorine production accounting for 1% of total global electricity use!!!

Secondly, there's *formaldehyde*. Like PVC, it is almost ubiquitous in the built environment - - it is used as a preservative and/or a binding agent in various building materials such as plywood, fiberboard, particle board, glues, adhesives, paints, insulation and is in consumer products such as nail polish, paper product coatings, shampoo, perm press fabrics, etc. It is one of the best-known VOC's (volatile organic compounds) and is a colorless, flammable, noxious gas (as you may recall from your high school biology lab). It is considered a known human carcinogen by the International Agency for Research on Cancer and a *probable* carcinogen by the EPA.

On the subject of VOC's, I'd also like to clarify this issue as there has been a great deal of misunderstanding propagating through the marketplace. "Low VOC" and "Zero-VOC" are omnipresent in today's "green" lexicon and extend the recognition that it is prudent to avoid or reduce the number of bio-available chemicals in building materials; however, reduced VOC levels in paints and other finishes are mandated by the EPA specifically due to their effect on the ozone layer, NOT for the purpose of protecting indoor air quality as is commonly thought. So, while elimination of VOC's by paint manufactures is a positive, it does not mean that other contaminants aren't part of the recipe. For example; some paints contain ammonia and acetone which are highly dangerous chemicals to human health yet they are not required by law to appear on the label. In addition, fungicides and biocides used to prevent mildew growth and extend the shelf life of the product could still be present in low- or zero-VOC paints and are toxic. Furthermore, some of the toxins in paint are actually bound up in the pigments used to color them. One popular "zero-VOC" paint contains crystalline silica which has been shown to induce cancer in rats and perhaps in humans, yet the paint was awarded a "Green" label. Furthermore, in their quest to reduce the effect of VOC's, some manufacturers will add other chemicals solely to mask the offensive paint smell!!!

As a matter of broad consideration of material and resource issues in the design process, I encourage all designers to apply the following fundamental set of evaluation criteria that we in my firm, Watershed, contemplate in our efforts to fully understand the implications of our decisions relative to the full life cycle of a material or product:

Extraction: Ascertain the process of harvest and acquisition of the raw materials that comprise the recipe. Understand the associated energy use, toxic effects, atmospheric, watershed and habitat impacts as well as resultant waste stream.
Manufacture: Understand the energy and chemical inputs (i.e. catalysts) as well as the associated waste stream.
Transportation: What distance has the product or material traveled and by what means? Specifically, consider the energy and atmospheric effects of this component.
Installation: What materials, chemicals and amount of energy are required to set a certain component into place?
Use: How durable is the material, product or component? During its service period, is it off-gassing noxious fumes, or in some manner is it creating a deleterious effect on the users or other living creatures?
Disposal: At the end of its useful life, can a material/product be recycled, re-purposed, re-used or otherwise flow back into an organic cycle? Or, like PVC (which cannot effectively be recycled), is it simply stopping off for a visit on its way to the landfill?

More specifically, I offer the following "starter" list of *basic* recommendations for enhancing the environmental integrity and performance of your projects:

- For new construction of homes and additions, think *small* and build only what is needed to serve the purpose; also, take advantage of passive energy flows and microclimate of the site (i.e. sun, breezes, protection from existing trees);
- Specify recycled content and/or biodegradable materials (i.e. www.paperstoneproducts.com);
- Where feasible, specify that all demolition or other 'waste' materials be recycled;
- In renovation projects, stockpile salvageable materials for re-use/re-purposing in the same project;
- Design/build on 24" module to minimize or avoid waste (www.pathnet.org);
- Seek locally or regionally harvested wood (www.appsusdev.org/sustainable_woods.html);
- Specify FSC (Forest Stewardship Council) wood to ensure material has come from well-managed forest (www.fsc.org);
- Avoid *Luan* plywood; as an alternative, specify birch veneer plywood, preferably from a regional source;
- Use products made from agricultural waste (i.e. www.agriboard.com);
- Specify low-flow shower heads (2.5 gpm or less), dual-flush waterclosets (www.totousa.com), waterless urinals (www.waterless.com) or if you're really ambitious, try a composting toilet (www.sun-mar.com);
- Install rain barrels to collect water for use in the garden;
- Avoid PVC wherever possible! For information on alternatives go to www.besafenet.com/pvc/safe.htm
- Use paints and other interior coatings that meet the Green Seal standard (www.greenseal.org); otherwise, avoid paints with VOC levels above 50 g/l and that contain ammonia, glycol esters, heavy metals (cobalt, cadmium), phthalates, toluene and formaldehyde;
- Specify lighting that will allow for compact fluorescent lamps which have 10X the life of incandescent bulbs and are 75% more efficient while generating 90% less heat; better yet,

specify LED lamps (www.permlight.com), which are even more efficient and contain no toxins (CFL's contain a small amount of mercury, which poses a significant exposure threat when lamp is broken);

- Specify appliances and other equipment that have an Energy Star Rating (www.energystar.gov);
- Specify carpets and rugs that carry the Carpet and Rug Institute (www.carpet-rug.com) "Green Label" or "Green Label Plus" certification.
- For the most reliable and broadest possible trove of information within the green building industry, I subscribe to Environmental Building News, published by Building Green, Inc. (www.buildinggreen.com) and their BuildingGreen Suite, which is an online database offering comprehensive, practical information on a wide range of topics related to sustainable building--from energy efficiency and recycled-content materials to land-use planning and indoor air quality.

John Muir wrote in his journal back in 1869 that *"whenever we try to pick out anything by itself, we find that it is bound fast - - by a thousand invisible cords that cannot be broken - - to everything in the universe"*. This quote captures the basic maxim of ecology - - that everything is connected to everything else within Earth's closed system such that what we do to her, we do to ourselves and all other species - - and, for me, serves as the foundation for design thinking with respect to true and sustaining environmental and social progress. By this mindset, ecological thought can become the very *basis* of design and thereby lead to vast reductions of the impacts associated with the making of not just buildings, but *everything* - - in fact, the goal of ecological design is to realize outcomes that sustain and even restore the vitality of earth's bounty over the long term. Therefore, *green design* is synonymous with *good design* because it is simply the result of principled decision-making with respect to nature's laws and is ultimately a quest for quality in the truest sense, which is of course the purpose behind environmentalism - - sustaining the quality of life for all Earth's inhabitants.