TEN SHADES OF GREEN

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Introduction

Peter Buchanan, Curator

ARCHITECTURE ALONE CANNOT CREATE A SUSTAINABLE CULTURE.

It can, however, make a major contribution to the pressing quest to devise ways of life that are less taxing on the earth's resources and capacities for regeneration. Buildings account for nearly half the energy consumption of developed countries, and therefore are the major cause of global warming, the most tangibly urgent of environmental problems.

But green design is not only about energy efficiency, and it is not purely a technical matter. Instead it involves a whole nexus of interrelated issues, the social, cultural, psychological and economic dimensions of which are as important as the technical and ecological—thus the 'ten shades' of this exhibition's deliberately ambiguous title. Ten shades refers to ten key issues that need to be considered to create a fully green approach to design: low energy/high performance; replenishable sources; recycling; embodied energy; long life, loose fit; total life cycle costing; embedded in place; access and urban context; health and happiness; and community and connection. It refers as well to the built schemes that are the exhibition's focus, and to their various degrees of 'greenness.'

The buildings on display represent a variety of building types and architectural and engineering approaches. None was chosen because it is the most energy-efficient example of its type, or because it fully meets every criterion of the 'ten shades' (although Hopkins' Jubilee Campus is a remarkably comprehensive and accomplished work of green design on all counts). Rather, these particular buildings were chosen because they are complete works of architecture: buildings in which environmental responsibility is fully integrated with formal ambition and responsiveness to an enlightened vision of community life.

And they were chosen for their contrasts. The jewel-like Götz headquarters uses a sophisticated double-wall system and hundreds of electronic sensors to capture and distribute the energy of the sun, while the Minnaert Building demonstrates the possibility of designing the building fabric to do work typically left to a mechanical system, thereby
retaking more of the budget for architecture. The Mont-Cenis Training Center shows how an enormous building envelope can create a microclimate that shelters new space for public life, reduces construction costs, and harvests enough ambient energy to eliminate the use of fossil fuels and even export energy. The four North American houses exhibited, amalgamated as one of the ten designs in recognition that no single house could represent such a large continent, show the continuation of the tradition of learning from the vernacular to respond appropriately to site, climate and local materials. The Beyeler Foundation Museum demonstrates that energy efficiency can be achieved even under the demands of maintaining closely controlled conditions for displaying art, while the Cotton Tree housing beautifully makes clear the possibility of achieving animated, place-specific, energy-efficient design on the constrained budgets available for public housing.

**AS A GROUP, THE BUILDINGS PRESENTED MAKE SEVERAL CRUCIAL POINTS:**

- There is no such thing as a green architecture or a green aesthetic. Instead there are countless ways design can address and synthesize green issues.

- Green design is not merely a matter of add-ons or product specification. It involves more than insulation, low-emissivity glass, non-polluting paints, and water-conserving toilets. Rather, it influences the form of the whole building and is one of its major generators from the first moments of the design process.

- As a corollary, pursuing a green agenda is no constraint on creativity but instead a major stimulus towards an architecture that is innovative, significant, and relevant.

- Greenness is not incompatible with the highest levels of architectural excellence. Europe’s leading architects are also among its best exponents of green design.

- Green design acknowledges the dynamic interaction of buildings with their immediate natural setting and ambient forces. It is these interac-
tions on which the design process focuses as much as on the resultant form of the building. This way of working draws on and parallels the most up to date insights from science.

* Many green buildings represent the leading edge of engineering design. In particular, the design of buildings such as Commerzbank or the Jubilee Campus is the product of predictive modeling techniques. Their functioning depends on neural network software and a myriad of sensors. Such buildings, which are produced through close collaboration with engineers from the first moments of design, need to be far more precisely engineered than conventional buildings.

The majority of the buildings presented come from Europe. There, individual governments have enacted stringent environmental standards for new buildings. The European Union has fostered green design by sponsoring applied research combining innovative technology and design. Clients, attracted by the economic advantages of green buildings, along with architects and engineers, have risen to the challenge of producing high performance buildings designed for long-term use.

The United States is far behind, and American architects will have to work very hard, very fast to catch up. Among the many challenges this poses, several stand out. Clients and architects will have to learn to think long term, rather than short term. They will have to rethink their measures of the impacts and profitability of a building, and consider its legacy to future generations. Architects and engineers will have to learn to work more collaboratively. They will also need to reopen themselves to understanding of, and respect for, the functioning of the natural world—an understanding that was once an expected part of an architect’s knowledge and is currently the locus of cutting edge discovery and invention in other fields.

The challenges are significant, but the potential rewards are immense: an architecture consonant with, rather than destructive of, the natural world; an architecture that supports community; an architecture that offers much richer sensual experience of the environment and an intensified sense of place; an architecture, in short, that increases the quality of life.
Shades of Green

Low Energy/High Performance

The single most effective way of reducing emissions of ‘greenhouse’
gases is to ensure that buildings consume only a fraction of the fossil
fuel-derived energy they use presently—which constitutes nearly half
the total energy consumption of the developed world. To make the dra-
stic savings required, three strategies need to be applied: the whole form
and organization of buildings should be shaped to be far less dependent
on fossil-fuel energy; any mechanical plant should be as efficient as pos-
sible; and the building and its environmental systems should harvest and
be fueled by constantly replenished ambient energies.

Artificial lighting is a building’s biggest consumer of energy, followed by air-
conditioning. The use of daytime lighting can be reduced enormously, by
abandoning the deep plan in multistory buildings, as well as by installing
sensors that prevent lights being used unnecessarily. To let in lots of light,
windows should be big; they then need to be shaded by overhangs, or by
being recessed, so that high summer sun is excluded but low winter sun is
admitted. Forsaking the deep plan also allows air-conditioning to be dis-
pensed with in favor of natural ventilation, with the added advantage that
this can be under the personal control of each building occupant.

Even naturally ventilated buildings have to be designed to always remain
within the range of comfort, however, and so may need occasional heating
and cooling. In temperate climates the need for this can be greatly reduced,
and sometimes eliminated entirely, by exploiting the thermal inertia of
exposed heavy structures. These absorb large amounts of heat while
warming up slowly, and then dissipate heat while cooling down equally
slowly. Another increasingly common strategy is the double-layered
facade, with a cavity sealed to form an insulating jacket in winter and
opened to use the stack effect to draw cool air up it in summer. Double
facades also allow windows in this inner skin to remain open in rain and at
night when cool air purges heat from the structure. Careful design and
devices of this sort will considerably reduce both the period heating and
cooling are required and the energy they consume, which in any case can
be drawn from ambient energies and replenishable sources.
Replenishable Sources

Much of the destruction wrought on the planet by industrial civilization derives from the use of unreplenishable sources for energy and building materials. To live more gently on the earth we need to use the non-depletable ambient energies of the sun, wind, waves and gravity, and use constantly replenished materials such as woods from sustainably managed sources, or near inexhaustible materials such as mud, clay (for bricks) and sand (for glass).

Much of the energy consumed by buildings might soon be generated from un-depletable sources, with electricity from wind farms, hydroelectric, geothermal or biomass (vegetal waste) burning plants and wave or tide-driven generators. Yet it could be that less of such power is needed, because buildings themselves will harness the ambient energies around them. After all, a building only uses a tiny percentage of the energy that impacts upon it in the form of sunlight and wind. Already with today’s technologies, it is feasible for buildings in much of the world (and most of the United States) to be self-sufficient in energy terms, or even energy exporters.

It would be very difficult for most buildings to be made totally of replenishable materials. Yet a far greater proportion of each building could be made from such materials, as well as those that have been recycled or lend themselves to recycling.
Recycling: Eliminating Waste and Pollution

In nature there is no waste. In the organic cycle, the ‘waste’ from one creature or process is the nutriment for the next. Today, we not only consume or destroy nature’s resources faster than they can be regenerated, but we give nothing back to nature. Instead we further burden it with waste and toxic pollution. We have to stop this or urgently learn how waste and pollution can become resources to be recycled.

Obsolete buildings, their materials and components tend to be treated as waste. Yet many of the materials could be recycled, and new buildings and the components they are made from be designed to be robust and adaptable enough for a long life. These buildings would also be designed so that if they were to be demolished, their materials and components could be readily recycled.

Though the earth is mostly covered with water, less than three percent of this is fresh and much of this is now contaminated. Yet buildings continue to use and pollute vast amounts of water. Green buildings conserve and recycle water in a variety of ways. Rainwater is captured and used for plants and flushing toilets; ‘grey water’ from showers, baths and basins is also used to flush toilets or repurified through reedbeds that are part of the buildings’ landscaping.

Already in some countries a major planning and urban design concern is to locate buildings and industrial plants so that the waste from one is a resource for the next. At its simplest level, the heat from power stations, garbage incinerators or industrial plant is used to heat neighboring buildings.
Embodied Energy

Buildings not only use energy, it also takes energy to make them. This is ‘embodied’ energy, which is all the energy required to extract, manufacture and transport a building’s materials as well as that required to assemble and ‘finish’ it. As buildings become increasingly energy efficient, the energy required to create them becomes proportionately more significant in relation to that required to run them. This is particularly true because some modern materials, such as aluminum, consume vast amounts of energy in their manufacture.

The common building material with least embodied energy is wood, with about 640 kilowatt-hours per ton (most of it consumed by the industrial drying process, and some in the manufacture of and impregnation with preservatives). Hence the greenest building material is wood from sustainably managed forests. Brick is the material with the next lowest amount of embodied energy, 4 times (X) that of wood, then concrete (5X), plastic (6X), glass (14X), steel (24X) and aluminum (126X). A building with a high proportion of aluminum components can hardly be green when considered from the perspective of total life cycle costing, no matter how energy-efficient it might be.

From the perspective of embodied energy, every building, no matter what its condition, has a large amount of energy locked into it. This is yet another factor in favor of conserving and restoring old buildings, and for designing long life, loose fit buildings that easily accommodate change. Also, because the energy used in transporting its materials becomes part of a building’s embodied energy, this is an incentive to use local materials, thus helping the building to be embedded in place.
Long Life, Loose Fit

As well as conserving nature and energy, green design is concerned with conserving old buildings, and with new buildings that lend themselves to being conserved. There are several reasons for this, including not wasting the embodied energy in the building fabric and increasing the financial returns on the initial investment. Designing such buildings forces architects to think long term about the legacy to future generations, and to transcend the utilitarian and the fashionable to consider how to make buildings that will always be valued, that people will identify with and wish to reuse and conserve.

Many historic buildings are proving more adaptable to reuse than buildings from the recent past. This is because the older buildings were not built to minimal space standards and ceiling heights; and they avoided the debilitating extremes of either being tightly tailored to function and the mechanical equipment that serviced them, or of being without character so as to be totally flexible. In today’s parlance, they are long life, loose fit. They were also built with materials that lasted and even improved visually and in tactility with age.

Green buildings should be long life, loose fit: generously accommodating and generic in organization so as to adapt to, yet set a dignifying framework for, change over the generations; hospitable and socially convivial rather than merely utilitarian; pleasant in character and relatively timeless rather than saddled with gratuitous gestures that quickly become passe. And they would be made largely with robust materials that mellow with age and weathering, as generally do those with low embodied energy and from replenishable sources, or those that are virtually inexhaustible.
Total Life Cycle Costing

Green thinking takes the long-term view and looks at the larger impacts of any action on the environment and society. Total life cycle costing is an essential part of such holistic thinking. Even when applied in a narrowly economic manner, life cycle costing demonstrates green design to be a sound investment. It proves that a building’s initial capital cost amounts to only a small fraction of the total cost of running and maintaining it. Over the years, the savings in utility bills achieved by energy efficiency can prove equal to or exceed what the building originally cost.

Also, buildings that require less maintenance, and are easier to clean, can recoup several times over any extra investment necessary to achieve this. If the wages, contentment and performance of the building’s occupants are considered, the cost benefits of green design can prove enormous. During the life of an office building, factory or hospital, the salaries of those who work there amount to several times the building’s original cost. The diminished absenteeism and staff turnover, along with the increased productivity, typically reported of green buildings are compelling economic (as well as social and political) reasons for investing in green buildings.

Increasingly, total life cycle costing is considered in terms that are broader than economic, and longer term than merely that of the building’s life. It is concerned with assessing the total costs—including those to society, local community and individuals, ecology and larger environment, the psyche and sense of the aesthetic—of every aspect of the building, from the extraction, manufacture and transport of its materials, through its erection and useful life to the ultimate recycling of its materials or their degradation back to earth.
Embedded in Place

A green building cannot be designed in the abstract and imposed on a place. Instead of being conceived to produce a self-contained object, the design process must focus on elaborating a dense web of complex symbiotic relationships with all aspects of the building’s setting. This does not imply a single, ideal design approach, but a spectrum of approaches. These range from a process informed by knowledge of the place, its local materials and building traditions, and drawing on the personal experience of the designer, to one based on rigorous surveys of all aspects of the site and then predictive analysis that draws on state of the art computer modeling. Informing this whole spectrum of approaches is the intention to create an architecture that does not homogenize; rather it helps every locale be more richly differentiated, more resonant with its own particularities.

Although the two extremes characterized above are very different—one drawing on tradition, rule of thumb and intuition, the other on leading edge science and engineering—both are equally relevant when applied appropriately. The former approach is best suited to small scale and familiar building types, such as houses, and might consist of interpreting or updating the vernacular. It is best applied by architects who already know their locale intimately and usually consists of adapting and improving traditional devices for tempering the climate and using local materials.

The latter design approach is best suited to large scale or less traditional building types and draws on the latest scientific understandings and survey techniques as well as the computer’s capacity for massive calculation and synthesis. It proceeds by extensively studying the microclimate and ecology, geology and hydrology of the site and surrounding area and then assessing, through predictive modeling and wind tunnel testing of models etc., how to minimize any negative impacts on these. Design almost recapitulates the process of an organism evolving to fit an eco-niche.
Access and Urban Context

Transport, particularly automobile use, is the second biggest consumer of energy, after buildings. Even the most energy-efficient workplace, if sited miles beyond access by public transport, does nothing to ameliorate pollution and global warming—at least until low-energy or non-fossil fuel burning automobiles become a reality. Such a building would be even less useful from a green perspective if it were removed from local shops, restaurants and opportunities to socialize, and housed none of these itself. A building’s location in terms of its accessibility and proximity to a range of other functions is critical in determining how green that building can be.

In the larger quest for sustainability, the design of our cities and other forms of settlement, and the relationship of these to each other and to their regions, are as crucial as is the design of individual buildings. Too many architects extrapolate from the fact that half the world’s population now live in cities the dubious conclusion that the inevitable future is an ever-greater proportion of mankind living in ever-bigger cities. Each such city has a huge ‘ecological footprint’, defined as the area necessary to feed it, supply the materials for its buildings and industry, absorb its wastes and convert its carbon dioxide back into oxygen.

One of the most urgent challenges for architects, planners and politicians is to reduce the ecological footprints of cities and seek a variety of other forms of human settlement, or networks of settlements. These should be less taxing in their impacts on the earth, yet also exploit our increasingly miniaturized and etherealized technologies so that everybody everywhere will enjoy all the benefits of contemporary life. Just as green buildings are conceived of as intimately related to their settings, so such settlements, like the cities of the future, will be considered along with their hinterlands as an indivisible organic whole. What will matter is the long term viability of both settlement and hinterland, and the health and happiness of their human and non-human inhabitants.
Health and Happiness

Too many contemporary buildings, particularly workplaces where people spend a significant part of their lives, are not only bad for the environment around them, they are bad for the people inside them. Their occupants are deprived of fresh air and natural light, and do not have personal control over the artificial substitutes for them. Nor do they even have a view to the outside. Designed only for efficiency, as defined in the narrowest terms, such buildings do nothing to foster any sort of community life.

Many modern building materials and components are toxically polluting in manufacture and when installed, poisoning the environment and their occupants, creating 'sick building syndrome'. Green buildings do not use materials that are polluting to the air, earth or water, or to people, plants and other creatures. Such buildings and the materials they are made of would also be devised to be cleaned with non-polluting materials, unlike so many of the cleaning materials now in common use.

Green buildings are pleasant, healthy places for people. Companies moving into them typically report a considerable drop in absenteeism. They report reduced staff turnover, which saves money on training, as well as improved productivity, often the most dramatic and profitable benefit, but also the most difficult to quantify. At the most basic level, people are healthier because they are in an environment free of toxic materials and fumes. Psychological and social dimensions are important too. People value a sense of contact with the outdoors and its ever-changing conditions, as recognized in the 'blue-green' laws coming into force in various parts of Europe, whereby all workers are entitled to a view of the sky and vegetation.

People prefer it even more if they have control over personal comfort conditions. The concomitant recognition of people's enjoyment of fluctuations in temperature not only brings energy and cost savings, but has led to a long-overdue redefinition of comfort standards. These are now understood not in terms of constant ideal conditions, but of the pleasures of gently varying sensual stimuli.
Community and Connection

The mind set that tolerated our destruction of the natural world and the legacies left to us by history depended on the suppression of a sense of connection with each other, nature and the cosmos, as well as to past and future generations. If a green architecture is to help bring about a sustainable culture, it must regenerate a sense of community and connection to, even communion with, the natural world.

The opportunity for communities to form and function needs to be designed into all levels of the built environment, and is a challenge to planners and urban designers as well as architects. At the architectural level, all sorts of building types increasingly must stress the community dimension. In part this is because as we do more and more at home—including work, play, shop and exercise—the major reason to go elsewhere is to meet other people.

A major element of green architecture should be not just to work with and be gentle to nature, but also to make conspicuously visible its workings and cycles. This will educate people about, and make them more sensitive to nature, and also give them a sense of connection with and rootedness in nature. The ultimate ideal would be an architecture that fostered in various ways a deep sense of communion with nature and the cosmos. Such an architecture is not only good for the planet, it is also the only one in which people can develop into their full potential, discovering themselves in interaction with others and opening into contact with the most ennobling of human sensibilities as they experience their connections with the larger scheme of things, and the ways in which this unfolds from past into the future.

The creation of a green architecture is much more than a merely technical issue: it is essentially concerned with delivering a much-enhanced quality of life, to be enjoyed now and capable of continuing into the future. It is only this broader vision of cultural transformation promised by a truly green architecture that will convince people to move forward to sustainable lifestyles.
Buildings in the Exhibition

Beyeler Foundation Museum
Riehen (Basel), Switzerland
1991-1997
*Renzo Piano Building Workshop, Paris*

**Commerzbank Headquarters**
Frankfurt am Main, Germany
1991-1997
*Foster and Partners, London*

**Cotton Tree Pilot Housing**
Queensland, Australia
1992-1994
*Clare Design, Sydney*

**Götz Headquarters**
Würzburg, Germany
1993-1995
*Webler + Geissler Architekten, Stuttgart*

**Hall 26**
Hanover, Germany
1994-1996
*Herzog + Partner, Architekten, Munich*

**Minnaert Building**
Utrecht, The Netherlands
1994-1997
*Neutelings Riedijk Architecten, Rotterdam*

**Mont-Cenis Training Center**
Herne-Sodingen, Germany
1991-1999
*Jourda & Perraudin Architectes*
*Jourda Architectes, Paris*
*HHS Planer + Architekten, Kassel*

**Slateford Green Millennium Project**
Edinburgh, Scotland
1996-2000
*Andrew Lee for Hackland + Dore Architects Ltd., Edinburgh*

**University of Nottingham**
Jubilee Campus
Nottingham, England
1996-1999
*Michael Hopkins & Partners, London*

Four North American Houses

**Cotulla Ranch House**
La Salle County, Texas
1995-1996
*Lake/Flato Architects, San Antonio*

**Palmer House**
Tucson, Arizona
1997-1998
*Rick Joy Architect, Tucson*

**Westcott-Lahar House**
Bolinas, California
1996-1998
*Fernau & Hartman Architects, Berkeley*

**Howard House**
West Pennant, Nova Scotia
1995-1998
*Brian MacKay-Lyons Architecture*
*Urban Design, Halifax*