School of Architecture
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

KEN YEANG

PLYM DISTINGUISHED PROFESSOR IN ARCHITECTURE, UNIVERSITY OF ILLINOIS, 2006

Editors: David Chasco, Botond Bognar and John Stallmeyer

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Contributors
Steve Featherstone
Lord Norman Foster
David Chasco
Paul J. Armstrong
Botond Bognar
Kisho Kurokawa
Ken Yeang
Jack Pringle

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Contents

Preface

This volume is the latest in a series of monographs that our School of Architecture has been publishing to document the work of the growing number of Plym Distinguished Professors, with whom we have had the privilege to collaborate throughout the years. Disseminating vast knowledge, expertise, and wisdom, all have invariably contributed greatly to the curriculum and academic life in our School.

The current issue introduces the research and architectural practice of Dr. Ken Yeang, our most recent Plym Professor 2006. His involvement in the School, just like his longstanding pioneering work, has focused on ecologically responsible design, or more precisely, "green architecture." In doing so, Dr. Yeang's collaboration with us has indeed been well timed, giving also special significance to the publication of this mini-monograph.

It is our hope that this issue, featuring Dr. Yeang, beyond demonstrating our School's commitment to environmental issues in architecture, will also raise further the awareness of such issues within our profession and provoke others to be proactive in countering the harmful impacts of architecture on our environment. With that in mind, we in the School would like to express our appreciation, first of all to Dr Yeang, as well as to all the other contributors to this monograph.

Botond Bognar
Professor and Edgar A. Tafel
Chair in Architecture

Introduction

Ken Yeang practises deep green architecture. His work is informed by a legacy of thought that began in the late 1960s; long ahead of concerns about the environment that now occupy global interest. As others have now, rightly, also begun to integrate the principles of green architecture in their work, Ken Yeang has continued to innovate, explore and implement new ideas and products, now with us at Llewelyn Davies Yeang. Importantly, his built work remains wholly informed, structurally and thematically by the fundamental principles and possibilities of ecodesign. The work illustrated here further reveals the evolution of a formal architectural language that both reveals and expresses this knowledge, particularly for us in the European environment.

Steve Featherstone
Managing Director
Llewleyn Davies Yeang

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National Library Singapore
Singapore BCA Green Mark Platinum Award, The World Association of Chinese Architects Gold Medal

01


02

Ken Yeang's Architecture

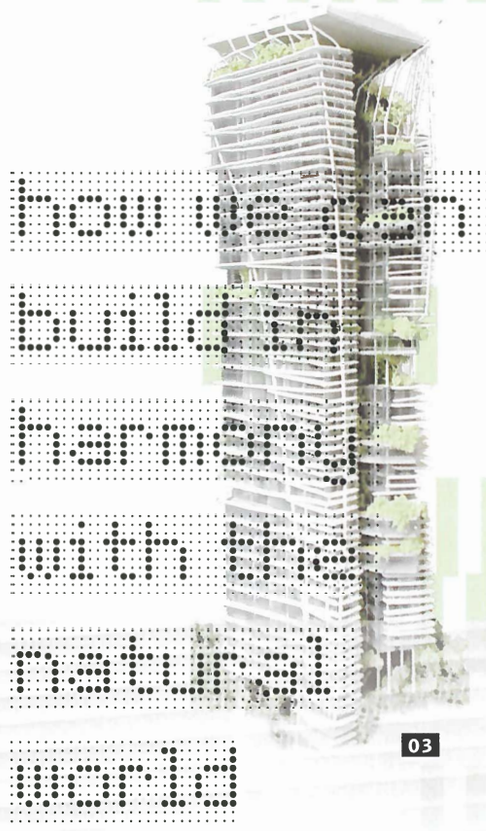
by Lord Norman Foster

Ken Yeang has developed a distinctive architectural vocabulary that extends beyond questions of style to confront issues of sustainability and how we can build in harmony with the natural world.

I recall that in 1997 he designed a watch for a charity auction at Christies that could tell the time at any longitude. Hinged over its digital face was a silver cover that incorporated a sundial for use, he said, when the world runs out of batteries. This watch, in many ways, I think provides the basic diagram for Yeang's architectural explorations. He has a commitment to new technology and the modern world, but is equally convinced that the simplest and most intuitive solutions can often be found by utilizing natural resources.

Among his many achievements as an architect, has been to show the world how the tall building can be reconceived as an environmentally sensitive mechanism. At the core of his approach is his reversal of the established model of the high-rise in tropical climates. In contrast with the hermetically sealed, air-conditioned tower, his high-buildings comprise vertical assemblages of spaces that are naturally lit and ventilated, linked to terraces, and interspersed with lush vegetation, even though they may be thirty stories above ground.

We share, in this sense, a vision of the future of urban life that is reinforced by Nature, not at odds with it, and where the buildings we create are environmentally responsive. These are themes that all architects must embrace if we are to find sustainable ways of building the future.



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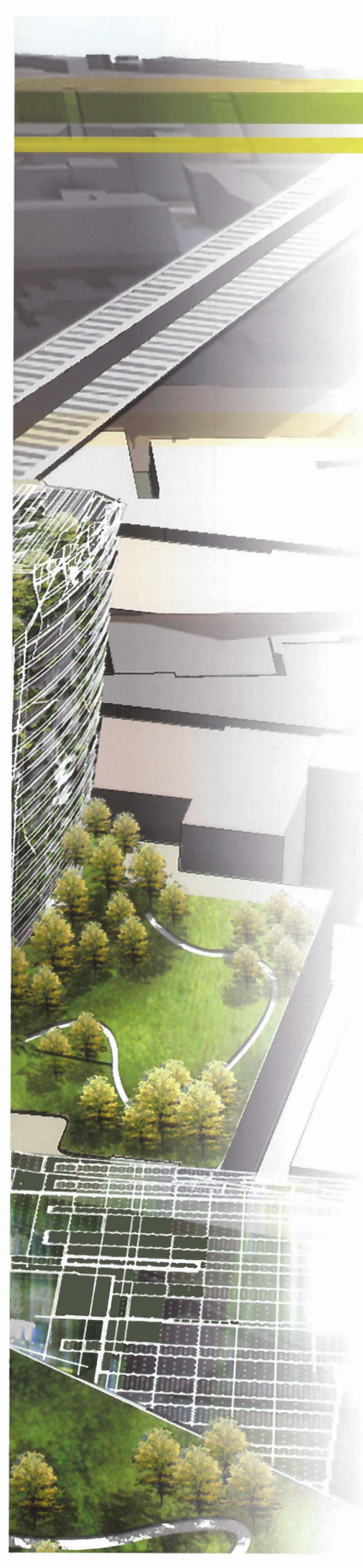

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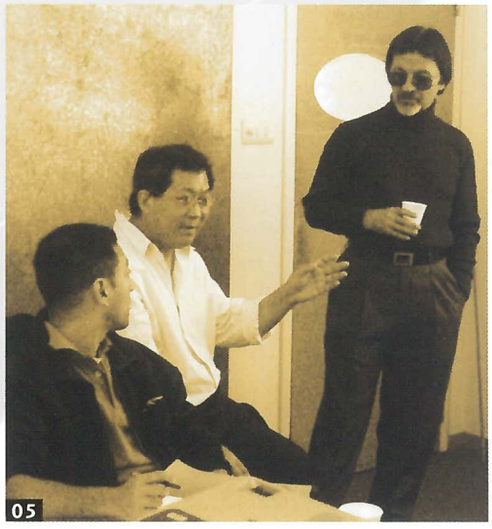
EC Tower, UK

The Plym Distinguished Professorship by Professor David M. Chasco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Great Ormond Street Hospital workshop: Dr. Yeang with Professor Botond Bognar (right) and student Prashant Gongal (left)

Students and the RAs (research assistants).
Matthew D. Bramstedt
Brett Bridgeland (RA)
Jonathan C. Cecelia
Emmanuel Desmazieres
Christopher J. Enck
Prashant Gongal
Christopher M. Grandy
Adam S. Groth
Amanda Harnitz (RA)
Miron Kam
Daniela Marcus
Bridgette M. Richardson
Cesar O. Salgueiro
Jin-Woo Shin
Grant Ullrich
Goran Vukovljak
Carmen L. Wong
Rong Wu

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BATC Towers, Malaysia

The Plym Distinguished Professorship is a very special position within the School of Architecture. It was made possible by a gift to the School in 1981 by the late Lawrence J. Plym of Niles, Michigan. Mr. Plym was past president of the Kawneer Corporation and the director of a number of companies before he retired. As many know, Plym is a very prominent name in our School. Mr. Plym and his family have a very warm association with the University of Illinois and our School.

The Plym Professorship is conferred on an architect who has a distinguished record of achievement and who can make a positive contribution to the enrichment of the professional education of students in the School. Our past Plym Professors have included Gunnar Birkerts, Paul Rudolph, Joseph Esherick, Minoru Takeyama, Edmund Bacon, Thom Mayne, Carme Pinos, Dominique Perrault, Frances Halsband and Norman Crowe.

The School of Architecture at the University of Illinois at Urbana-Champaign was delighted to appoint Dr. Ken Yeang, the architect, planner and scholar of ecological architecture, as the Distinguished Endowed Plym Professor in Architecture for the Spring Semester of 2006.

During this Spring Semester, Dr. Yeang led a graduate design studio with Professor Botond Bognar, where students conducted research in environmental-friendly and sustainable architecture, and designed a green hospital for children in London.

Dr. Yeang, AA Dip. PhD. (Cantab), APAM, FSIA, RIBA, ARAIA, Hon. FAIA, Hon. FRIAS, FRSA, is an internationally renowned architect specializing in the design of `green' architecture, or ecologically responsive large buildings and master plans. He is a principal of Llewelyn Davies Yeang (UK) and of its sister office, Hamzah & Yeang (Kuala Lumpur). He studied at Cheltenham College (Gloucestershire) and completed his architectural education at the Architectural Association School (London), and subsequently a doctorate in architecture on the theory for ecological design and planning at Cambridge University in the United Kingdom. Dr. Yeang has pioneered a new genre of tall buildings, referred to as the "bioclimatic skyscraper." His research has led to a number of patents pending. He has designed more than a dozen high-rise towers and over 200 projects worldwide. His design work is based on the ecological agenda and the pursuit of an ecological aesthetic. His recently completed National Library in Singapore received the Green Mark Platinum Award, the highest for a green and sustainable building, from the government of Singapore and the gold medal from the World Association of Chinese Architects (WACA). His firm has also received several other international awards including the Prinz Claus Award (Netherlands), the Aga Khan Award (Geneva) and the Royal Australian Institute of Architects International Award. Dr. Yeang has authored several books and articles on ecological design and on green skyscraper design, including Designing with Nature (1995), The Green Skyscraper: The Basis for Designing Sustainable Intensive Buildings (2000). His latest book, Ecodesign: Instruction Manual was published by Wiley-Academy (London) in 2006. He has served on the Royal Institute of British Architects (RIBA) Council, as President of the Malaysian Institute of Architects, and as Chairman of ARCASIA (Architects Regional Council Asia). He is also an Honorary Fellow of the American Institute of Architects and an Adjunct Professor at the University of Hawaii (at Manoa) and at the University of Malaya.

The School of Architecture was fortunate to have Dr. Ken Yeang enrich the program and lives of students in the spring semester of 2006. It was not a typical "semester visit" of solo endeavours. Instead Ken took the students on journey into his "design world." With Ken, students travelled to London and were further educated by members of his firm Llewelyn Davies Yeang. Ken also brought to the school a wide range of consultant experts in structures, hospital planning, and sustainability. Ken fully embraced the teaching mission of the School in conducting what he fondly characterized as the "longest workshop he has ever conducted." As a result of Ken's efforts, we are all the more learned.


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The Yin of Yeang

by Professor Paul J. Armstrong

The "Yin" of Yeang was summarized in his subtle "What is your idea?"

It did not take Dr. Yeang long to grasp the complexity of the problem facing the students.

"Use a metaphor to describe your concept," he suggested to one student. He had been observing sophomore students as they worked on the Nine Square project. Each square was defined by a proportional grid requiring a series of transformations from graphics to models. Furthermore, all nine squares had to be visually unified through geometry and continuity of compositional elements. Yeang watched as the students worked and listened patiently as they described their design intentions—and difficulties—of unifying the composition of squares. In character with beginning design students, they focused on specific problems in individual squares rather than describing their overall intention. Yeang's suggestion to use a metaphor as means to define a concept was simple and elegant. Yeang's design acuity is evident in his own work where his philosophy of "bioclimatic" architecture requires a complete integration of sustainable intentions with building materials and systems. For Yeang, integration does not simply mean coordinating one system with another. Rather, integration in the most complete sense means that one system functionally fulfills the role of two or more systems. If the architect is to achieve sustainability in the broadest sense, buildings must be conceived from their inception as fully integrated systems organically linked to their physical environments. Furthermore, the principles of aesthetics, form, spatial organization, and systems thinking should be applied at all architectural scales where qualitative issues can be linked quantitatively to outcomes.

His interaction with the students in Arch 272 underscored his belief in the interdependence of part-to-whole and his insistence that architecture must be guided by principle. Yeang's message to the students was simple: at the core of all architecture there should be a unifying concept. In the Nine Square, visual unity was achieved through geometry. Metaphors, such as "weaving," "layering," "transparency," "overlapping," were used to describe actions that formed the essence of his subtle but provocative question: "What is your idea?"

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Boustead Tower (IBM), Malaysia

Encounters with Ken Yeang and His Architecture

by Professor Botond Bognar

Ken Yeang is one of the most passionate designers of green buildings—and probably also one of the best and busiest ambassadors of an architecture of ecology today. In addition to running two offices, one in London and one in Kuala Lumpur, he regularly lectures, chairs committees, participates in symposiums, and holds exhibitions all over the world, as well as writes extensively to promote the cause of an environmentally responsible design and lifestyle.

I first met Ken—not surprisingly—in hectic circumstances. We both lectured in Vienna at a conference in 1999, where he had come in only for his presentation and left soon afterwards. Taking advantage of the few moments between his talk and dash for the airport, I cornered him and we agreed that I would visit him and see also some of his built works in Malaysia. This I was indeed glad to do not much later, and have done so several times since.

Reviewing Ken's works—both built and unbuilt—further affirmes my belief that a successful green architecture can and must go beyond the merely technological, (whether low-tech or high-tech), and simultaneously deliver high-quality architecture, which elevates human experience both aesthetically and physically. It was remarkable to see how Ken, with his in-depth scholarly knowledge, design skills, and total dedication to this field, has been able to develop a range of unique qualities in his designs, and at the same time contribute significantly to the pursuit of a deep-green architecture.

Nothing brought this home to me, and more convincingly so, than my most recent encounter with his architecture, and, in particular, one of his latest built works, the Singapore National Library of 2005. Enhanced by meticulous detailing and construction, the large complex is memorable for its built form and architectural style, articulate spatial configurations, and its sensitive response to its urban context in the Arts District of Singapore, aside from its green features and significant energy-saving performance. Based on the annually measured (and so proven) savings in operational energy costs, the building received the Green Mark Platinum Award, the highest award for sustainable architecture from the Singapore Government.

With all these precedents, it was clear that when the opportunity arose for us in the School, we were unanimous in seeking out Ken for the Distinguished Endowed Plym Professorship in Architecture for the Spring Semester of 2006. This he accepted despite his extremely tight schedule, and so began his almost weekly, though brief, visits to our campus to direct a graduate design studio, where his assignment for the students was to design a "green" children's hospital in London."

Responding to the rigorous challenges of the complex program, the need to rapidly comprehend the principles of designing green architecture, the accelerated research on hospital design, and to Ken's friendly, easy-going personality, the students launched themselves enthusiastically into the studio work. Their projects attest to their hard work and intensive learning during the semester.

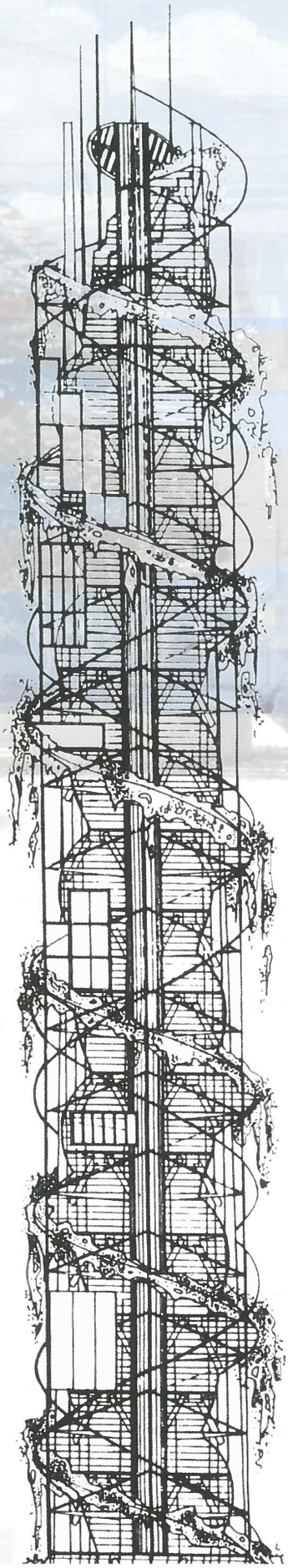
On a personal note, I should add that Ken led the studio pleasurably with an inimitable sense of humor and with a joke or story for every occasion and encounter.

Indeed, it has been good to have him here with us - even if briefly, for only one semester.

It is springtime in Illinois!

At the Forefront of His Profession

by Dr Kisho Kurakawa



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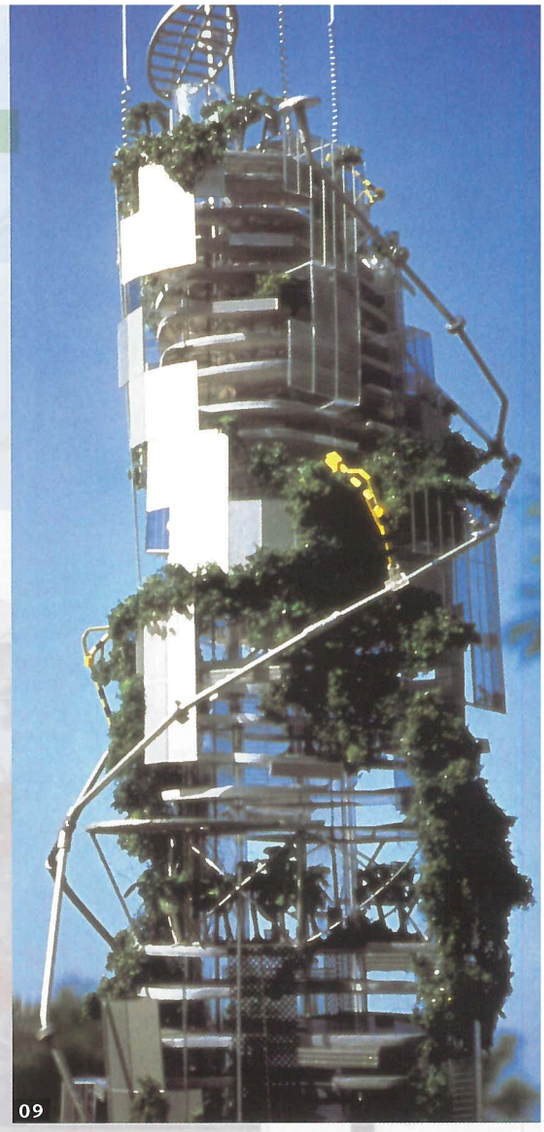
Ken Yeang is one of the finest architects in Asia. I first met him in London when I was giving a lecture at the AA. At that time he was taking a PhD at Cambridge.

In 1959, in the immediate aftermath of CIAM's collapse I wrote an article predicting a "shift from the age of machines to the age of life." At the time I believed that Metabolism (recycle) Ecology, Information and Symbiosis, concepts that I developed in the 1960s, would become the key concepts in the age of life to come. The Metabolism movement and my book *Philosophy of Symbiosis* are very important foundations for the age of life. I have the highest regard for Ken Yeang's book *The Green Skyscraper: The Basis for Designing Sustainable Intensive Buildings*, because it has many themes in common with my thoughts in *Philosophy of Symbiosis*.

Many challenges remain for developing an Eco-architecture and an Eco-city. For instance, although the introduction of green space into the subtropical climate zone of South East Asia is relatively easy, the low rainfall and low temperature climate zones face more difficult problems. Moreover, what we must do for the global environment in the 21st century is not to plan green areas, parks, and landscapes for a human dominated age but rather, preserve bio-diversity for the age of symbiosis. My idea for achieving this is the Eco-corridor, which is a connection between eco-systems that are separated because of urban development. The city park then functions as a place for symbiosis of a variety of small animals, insects and butterflies and could be a corridor for movement.

Dr. Yeang's early architectural works, including the IBM Plaza, were important in determining the direction for his theory. I spotted the potential of his exceptional talent when he was a student. I explained to him the importance of both research and creating architectural works. In addition I introduced him to friends and critics.

There are few architects who can conduct research, teach, publish books and create architectural works. I am so glad that Dr. Yeang is active at the forefront of all these and I wish all the best for his future.



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Tokyo-Nara Tower, Japan

On Green Design

by Ken Yeang

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Our work on green design although it shares the same aims as many other green designers, is quite different. The main differentiation is that it starts from the ecological perspective, as an ecologist.

The need to save our environment for future generations is one of the greatest challenges that humankind must address today; this task is fuelled by the growing realization that if we maintain our current rate of growth and consumption this may be our last millennium on Earth. Therefore the compelling question for any designer is: how do we design for a sustainable future?

Just as much as this question concerns the design professions, it is also a question that concerns industry; many corporations now anxiously seek to understand the environmental consequences of their current activities and attempt to envision what their impact might be if their business were sustainable. The most committed businesses must seek ways to realize their vision through ecologically benign strategies, new business models, production systems, materials and processes. An ecologically responsive built environment will undoubtedly change the way we work and will significantly impact the ecologically profligate way of life pursued by many of us in developed and developing countries.

The most effective ecological approach to business practice, as well as design, will develop through environmental integration. If we integrate everything we do or make in our built environment (which, by definition, consists of our buildings, facilities, infrastructure, products, refrigerators, toys, etc.) with the natural environment in a seamless and benign way, there will be no detrimental environmental impact whatsoever. Simply stated, ecodesign is design for bio-integration; this can be regarded as having three facets: physical, systemic and temporal. Addressing each of these facets successfully is, of course, easier said than done; but herein lies our challenge as designers.
We can start by looking at nature. Nature without humans exists in stasis. Can our businesses and our built environment imitate nature's processes, structures, and functions? Ecosystems have no waste; everything is recycled within the system. Thus by imitating the ecosystem, our built environment should produce no waste; all emissions and products would be continuously reused or recycled and eventually reintegrated with the natural environment. Designing to imitate ecosystems is ecomimesis. This is the fundamental premise for ecodesign: our built environment must imitate ecosystems in all respects.

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Linked Vegetation

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Mewah Oils HQ, Malaysia

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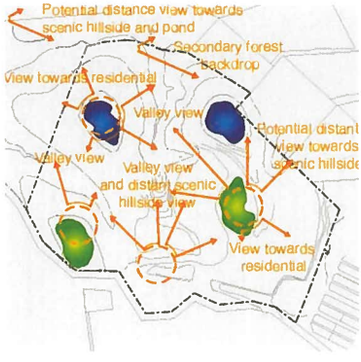
Roof Garden

Nature regards humans as just one of its many species. What differentiates humans from other natural organisms is their capability to force large-scale devastative change on the environment. Such changes are often the consequence of rapacious (manufacturing, construction) or superficially benign (recreation and transportation) activities.

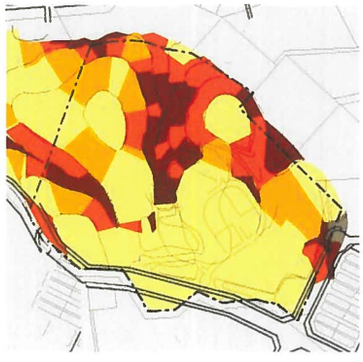
Our built forms are essentially enclosures erected to protect us from inclement weather and enable activities (whether residential, office, manufacturing, warehousing, etc.) to take place. Ecologically, a building is just a high concentration of materials extracted and manufactured, often using non-renewable energy resources, from some distant place in the biosphere and transported to a particular location and assembled into a built form or an infrastructure (road, bridge, sewer etc.) whose subsequent operations create further environmental consequences and whose eventual after-life must also be accommodated. There is a great deal of confusion and misperception as to what exactly constitutes ecological design. It is easy to be misled or seduced by technology and to think that if we assemble enough eco-gadgetry such as solar collectors, photovoltaic cells, biological recycling systems, building automation systems and double-skin facades in one single building that this can automatically be considered ecological architecture. Although these technologies are commendable applications of low energy systems they are merely useful components leading towards ecological architecture; they represent some of the means of achieving an ecological end product. Ecological design is not just about low energy systems; to be fully effective these technologies need to be thoroughly integrated into the building fabric; they will also be influenced by the physical and climatic conditions of the site. The nature of the problem is therefore site specific, there will never be a standard "one size fits all" solution.

The other misperception is that if a building achieves a high score on a green rating scale then all is well. Of course, nothing could be further from the truth; this attitude can engender self-complacency whereupon no further action is taken to improve environmental degradation. Green rating systems are useful in publicizing certain goals, however, they should be considered as threshold standards that designers should aim at achieving and exceeding.



View Analysis

Existing Vegetation



Slope Analysis

Proposed Landuse Zoning

In a nutshell, ecodesign should be viewed as the design of the built environment as just one system within the natural environment. The system's existence has ecological consequences; the way it functions and interactions with other systems over its entire life cycle must be benignly integrated with the natural environment. In this way it is the life-cycle analysis of the system, rather than its value at any one particular point in time, that gives a better idea of its cumulative effect on its neighboring systems.

Ecosystems are definable units in a biosphere; as such they should contain both biotic (living) and abiotic (non life-supporting) constituents acting together as a whole. Following this model our businesses and our built environment should be designed analogously to the ecosystem's physical content, composition and processes. For instance, besides regarding buildings as we do currently, as artistic endeavors or as serviced enclosures, we should regard them as artifacts that need to be operationally integrated with nature. It should be self-evident that the material composition of our built environment is almost entirely inorganic, whereas ecosystems contain a complement of both biotic and abiotic constituents, i.e. organic and inorganic components.
The enormous number of existing buildings as well as our current manufacturing and processing activities are making the biosphere more and more inorganic and increasingly simplified biologically. To continue doing what we have always done without balancing the abiotic with the biotic content means simply adding to the biosphere's artificiality, thereby making it increasingly inorganic and reducing its complexity and diversity. We must first reverse this trend by starting to balance our built environment with greater levels of biomass; by ameliorating biodiversity and ecological connectivity in the built forms and by complementing their inorganic content with appropriate organic biomass.

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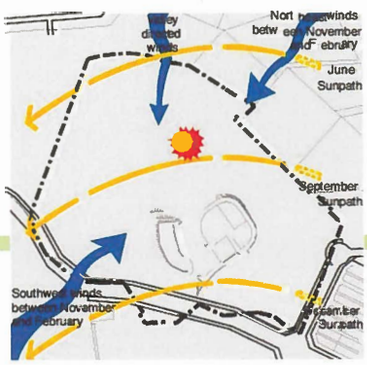
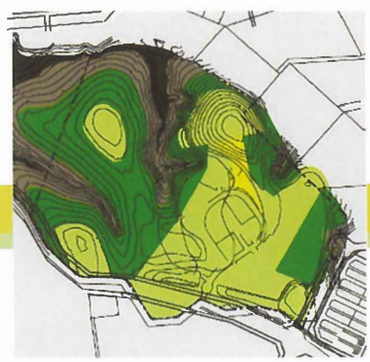
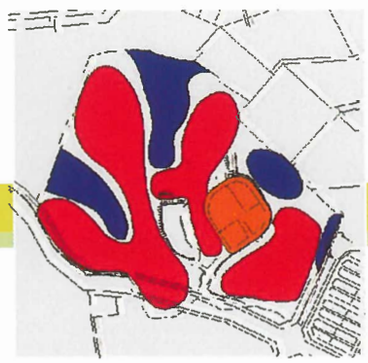
Nottingham University Campus, Malaysia
14
Nottingham University Campus, Masterplan

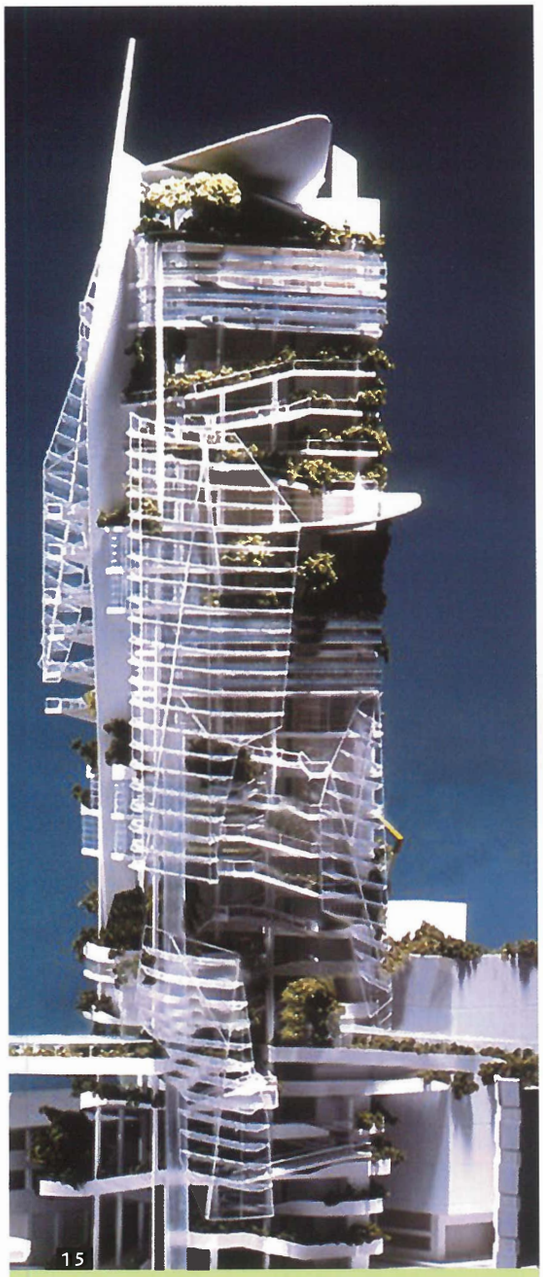


Solar Path & Wind Direction


Natural Drainage


Topagraphy Diagram


Composite: Land Suitability for Development



We should improve the ecological linkages between our activities, be they design or business processes, with the surrounding landscape in ways that connect them both horizontally and vertically. Achieving these linkages ensures a wider level of species connectivity, interaction, mobility and sharing of resources across boundaries. Such real improvements in connectivity enhance biodiversity and further increase habitat resilience and species survival. An obvious demonstration of horizontal connectivity is the provision of ecological corridors and linkages in regional planning which are crucial in making urban patterns more biologically viable. Besides improved horizontal connectivity, vertical connectivity within the built form is also necessary since most buildings are not single storey but multi-story. Design must extend ecological linkages vertically from the foundations to the rooftops.

More important than the enhancement of ecological linkages is the biological integration of the inorganic products inherent in the built environment with the landscape so that the two become mutually ecosystemic. In this way we can create "human-made ecosystems" compatible with nature's ecosystems and by doing so we will enhance the ability of human made ecosystems to sustain life in the biosphere.

Ecodesign is also about the discernment of the ecology of the site; any design or business activity should take place with the objective of integrating benignly with an ecosystem. In the case of site planning we must first understand the properties of the locality's ecosystem before imposing any intended human activity upon it. Every site has an ecology with a limited capacity to withstand the stresses imposed upon it; if stressed beyond this capacity he ecology will be damaged irrevocably. Stress can be caused just as much by minimal localized impact (such as the clearing of a small land area for access) as by the total devastation of the entire landscape (such as the clearing of all trees and vegetation, leveling the topography and the diversion of existing waterways).

To identify the capacity of a site to withstand human intervention an analysis of the existing ecology should be carried out; we must ascertain, for example, the structure of the site's ecosystems, energy flow and species diversity. Then we must identify which parts of the site, if any, have different ecosystems and which parts are particularly sensitive. Finally, we must consider the likely impact of the intended construction and use. This is, of course, a major undertaking however it needs to be done to better understand and appreciate the nature of a site. To be thorough and effective this type of detailed analysis should be carried out diurnally and seasonally over a period of a year or more. To reduce this lengthy process landscape

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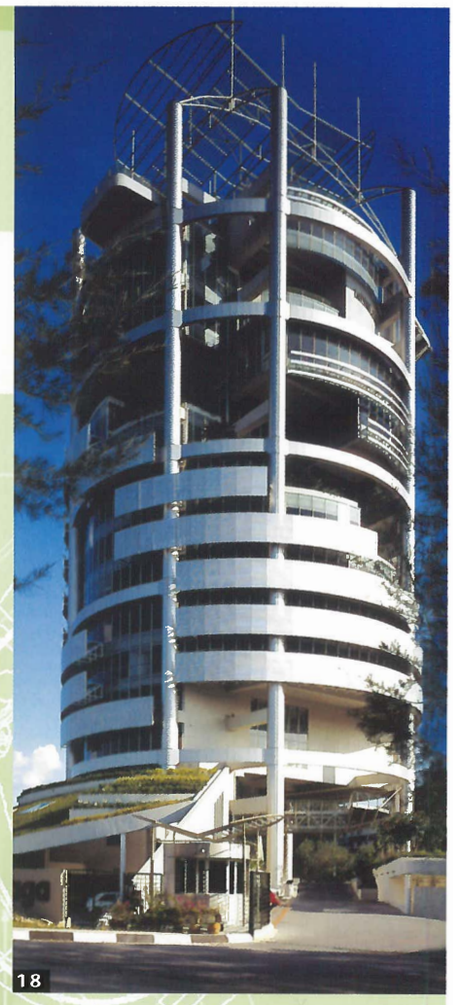
Editt Tower, Singapore
17
Menara Mesiniaga Tower (IBM), Malaysia
Planting Concept
18, 19
Menara Mesiniaga Tower (IBM), Malaysia
Axo plant

More important than the enhancement of ecological linkages is the biological integration of the inorganic products inherent in the built environment with the landscape so that the two become mutually ecosystemic.



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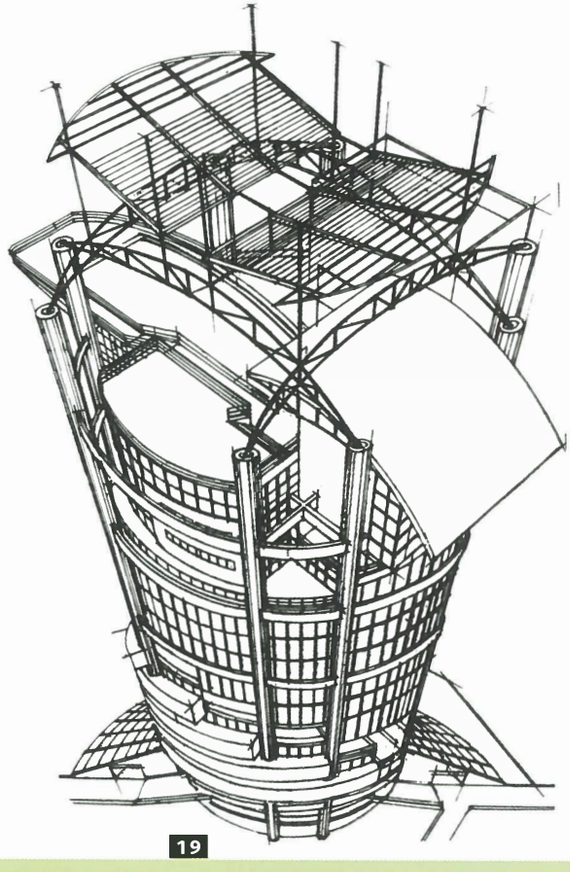

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As designers we should also look into ways of configuring built forms, the operational systems for our built environment and our businesses as low-energy systems.

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architects have developed the "layer-cake" method; this sieve-mapping technique enables designers to map the landscape as a series of separate layers that provide a simplified matrix for the investigation of a site's ecology.

As the layers are mapped they can be overlaid and the interaction of the layers can be evaluated in relation to the proposed land use. The final product of this study is a composite map that can be used to guide the proposed site planning (e.g. the disposition of the access roads, water management, drainage patterns and shaping of the built forms). It is important to understand that the sieve-mapping method generally treats the site's ecosystems statically and may ignore the dynamic forces taking place between the layers within an ecosystem. As mentioned above the separation of the layers is a convenient intellectual construct that simplifies the complex natural interactions between layers. Therefore the comprehensive analysis of an ecosystem requires more than sieve-mapping—the inter-layer relationships should also be examined.

As designers we should also look into ways of configuring built forms, the operational systems for our built environment and our businesses as low-energy systems. In addressing these systems we need to look into ways of improving the internal comfort conditions of our buildings. There are essentially five ways of doing this: Passive Mode, Mixed Mode, Full Mode, Productive Mode and Composite Mode, the latter being a composite of all the preceding modes.

The practice of sustainable design requires that we look first at Passive Mode (or bioclimatic) design strategies, then we can move on to Mixed Mode, Full Mode, Productive Mode and Composite Mode, all the while adopting progressive strategies to improve comfort conditions relative to external conditions.

Meeting contemporary expectations for office environment comfort conditions cannot generally be achieved by Passive Mode or by Mixed Mode alone. The internal environment often needs to be supplemented by the use of external sources of energy, as in Full Mode. Full Mode uses electro-mechanical systems often powered by external energy sources—whether from fossil fuel derived sources or from local ambient sources such as wind or solar power.

Building design strategy must start with Passive Mode or bioclimatic design as this can significantly influence the configuration of the built form and its enclosure systems. Passive Mode requires an understanding of the climatic conditions of the locality; the designer should not merely synchronize the building design with the local meteorological conditions but optimize the ambient energy of the locality to create improved internal comfort conditions without the use of any electro-mechanical systems. The fundamental nature of these decisions clearly dictates that once the building configuration, orientation and enclosure are considered the further refinement of a design should lead to the adoption of choices that will enhance its energy efficiency.

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National Library Singapore, Sky Court

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National Library Singapore, Reading Atrium

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National Library Singapore,
Sky Court Cross Section

If, as an alternative, a design solution is developed that has not previously optimized the Passive Mode options then these non-energy efficient design decisions will need to be corrected by supplementary Full Mode systems. Such a remedy would make a nonsense of low-energy design. Furthermore if the design optimizes a building's Passive Modes, it remains at an improved level of comfort during any electrical power failure. If the Passive Modes have not been optimized then whenever there is no electricity or external energy source, the building may be become intolerable to occupy.

In Mixed Mode buildings use some electro-mechanical systems such as ceiling fans, double facades, flue atriums and evaporative cooling. Full Mode relies entirely on the use of electro-mechanical systems to create suitable internal comfort conditions. This is the option chosen for most conventional buildings. If clients and users insist on having consistent comfort conditions throughout the year the result will inevitably lead to Full Mode design. It must be clear now that low-energy design is essentially a user-driven condition and a life-style issue. We must appreciate that Passive Mode and Mixed Mode design can never compete with the comfort levels of the high-energy, Full Mode conditions.

Productive Mode is where a building generates its own energy. Common examples of this today can be seen in the generation of electricity through the use of photovoltaic panels that are powered by solar power and wind turbines that harness wind energy. Ecosystems use solar energy that is transformed into chemical energy by the photosynthesis of green plants which in turn drives the ecological cycle. If ecodesign is to be ecomimetic, we should seek to do the same, however we will need to do so on a much larger scale.

The inclusion of systems that create Productive Modes inevitably lead to sophisticated technological systems that in turn increase the use of material resources, the inorganic content of the built form, the embodied energy content and the attendant impact on the environment.

Composite Mode is a combination of all the above modes in proportions that vary over the seasons of the year.

Ecodesign also requires the designer to use materials and assemblies that facilitate reuse, recycling and their eventual reintegration with ecological systems. Here again we need to be ecomimetic in our use of materials in the built environment: in ecosystems, all living organisms feed on continual flows of matter and energy from their environment to stay alive, and all living organisms continually produce 'waste'. However ecosystems do not actually generate waste since one species' waste is really another species' food. Thus matter cycles continually through the web of life. To be truly ecomimetic the materials we produce should also take their place within the closed loop

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Great Ormond Street Hospital, UK

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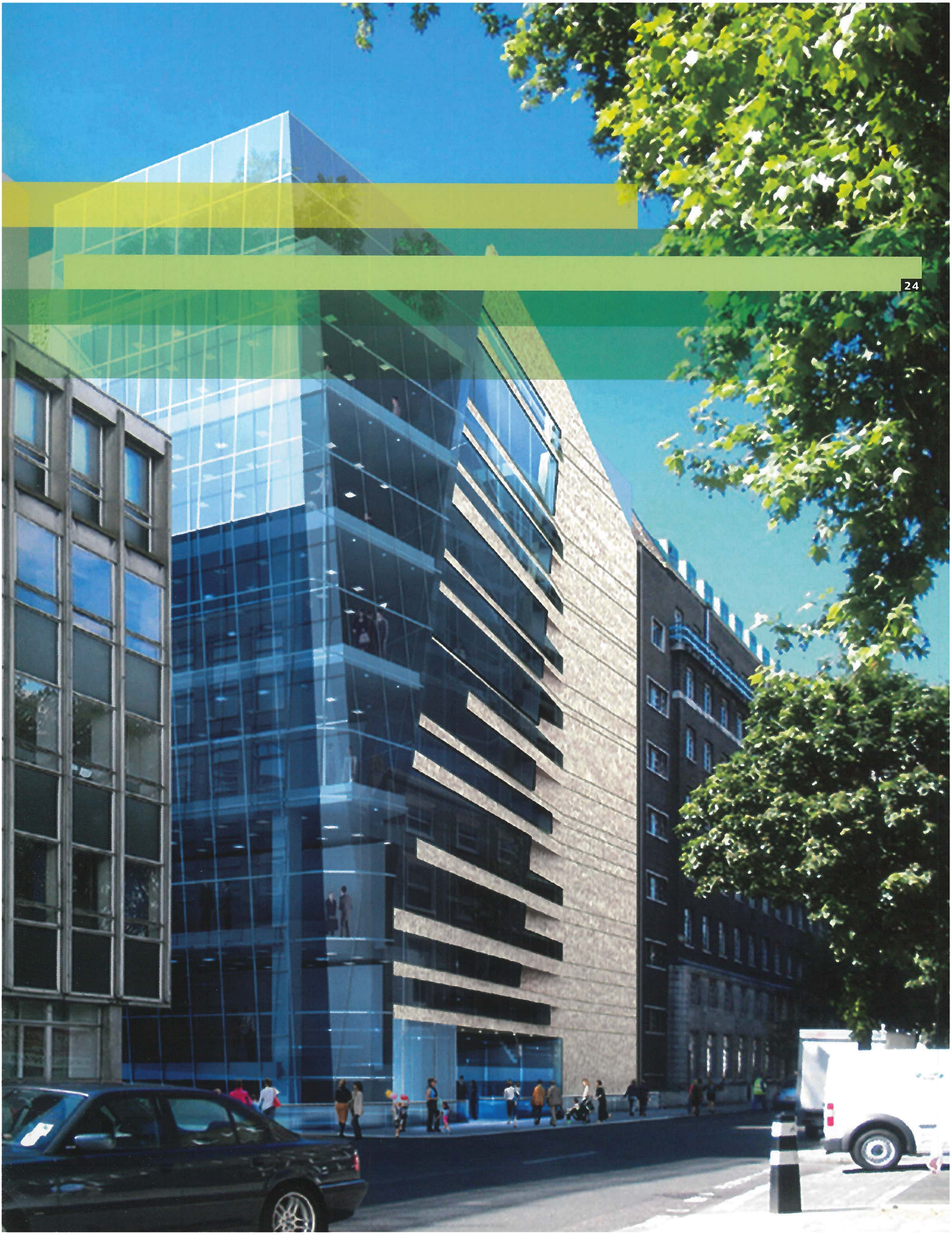
Great Ormond Street Hospital, UK
Flue Wall and green roofs



Ken Yeang

by Jack Pringle, President, RIBA

Ken Yeang has been a very early pioneer of low-energy buildings in tropical climates. In the context of our increasing understanding of global climate change issues and the emerging economies of the East, nothing could be more important at this time.

where waste becomes food.
Currently we regard everything produced by humans as eventual garbage or waste material that is either burned or ends up in landfill sites. The new question for designers, manufacturers and businesses is: how can we use this waste material? If our materials are readily biodegradable, they can return into the environment through decomposition.

If we want to be ecomimetic we should think, at the very early design stages, how a building, its components and its outputs can be reused and recycled. These design considerations will determine the materials to be used, the ways in which the building fabric is to be assembled, how the building can be adapted over time and how the materials can be reused after the building has reached the limits of its useful life.

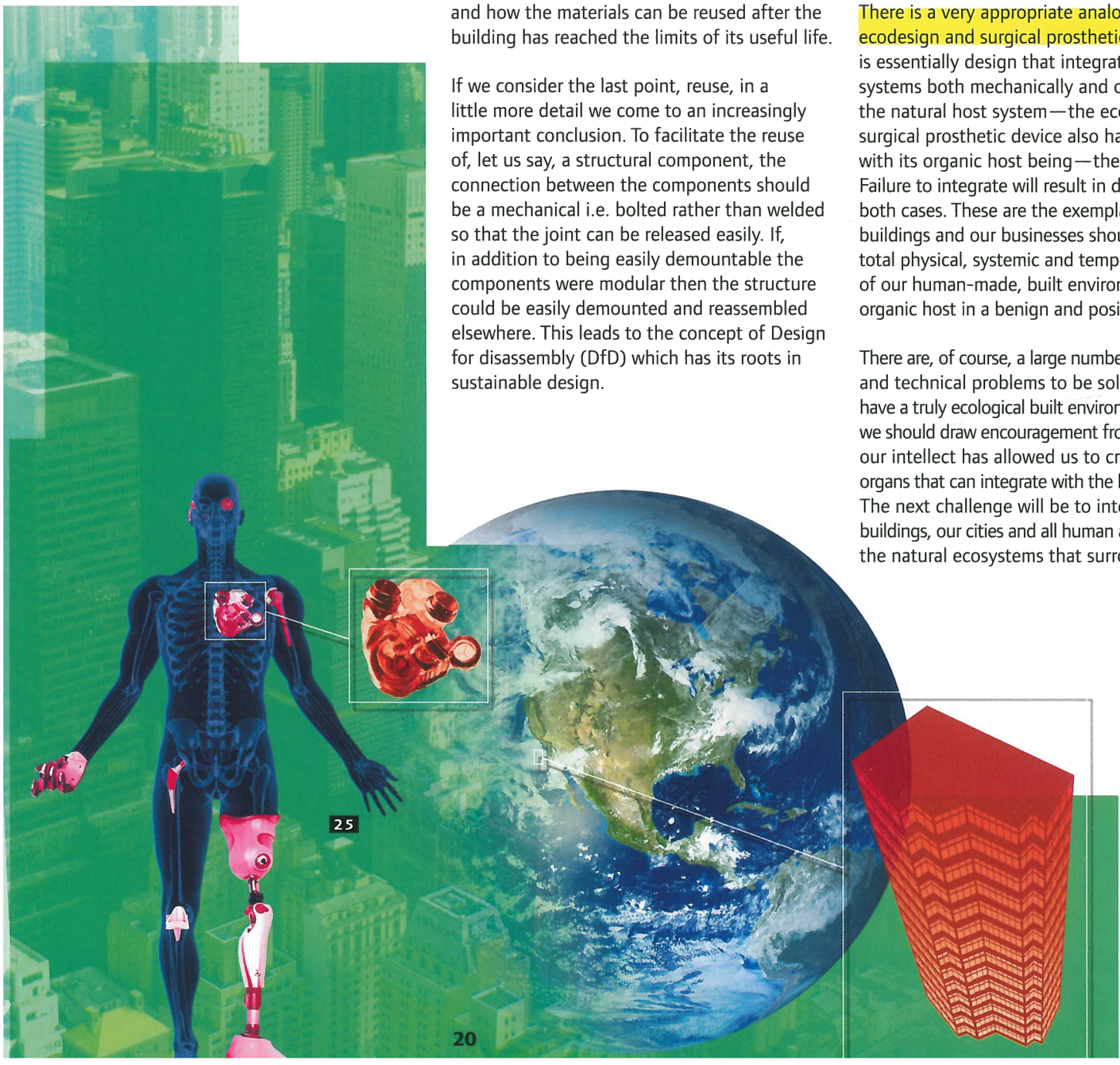
If we consider the last point, reuse, in a little more detail we come to an increasingly important conclusion. To facilitate the reuse of, let us say, a structural component, the connection between the components should be a mechanical i.e. bolted rather than welded so that the joint can be released easily. If, in addition to being easily demountable the components were modular then the structure could be easily demounted and reassembled elsewhere. This leads to the concept of Design for disassembly (DfD) which has its roots in sustainable design.

Another major design issue is the systemic integration of our built forms, operational systems and internal processes with the natural ecosystems that surround us. Such integration is crucial because without it these systems will remain disparate artificial items that could be potential pollutants. Unfortunately many of today's buildings only achieve eventual integration through biodegradation that requires a long-term process of natural decomposition.

While manufacture and design for recycling and reuse relieves the problem of deposition of waste, we should integrate both the organic waste (e.g. sewage, rainwater runoff, wastewater, food wastes, etc.) and the inorganic waste.

There is a very appropriate analogy between ecodesign and surgical prosthetics. Ecodesign is essentially design that integrates man-made systems both mechanically and organically with the natural host system—the ecosystems. A surgical prosthetic device also has to integrate with its organic host being—the human body. Failure to integrate will result in dislocation in both cases. These are the exemplars for what our buildings and our businesses should achieve: the total physical, systemic and temporal integration of our human-made, built environment with our organic host in a benign and positive way.

There are, of course, a large number of theoretical and technical problems to be solved before we have a truly ecological built environment however we should draw encouragement from the fact that our intellect has allowed us to create prosthetic organs that can integrate with the human body. The next challenge will be to integrate our buildings, our cities and all human activities with the natural ecosystems that surround us.



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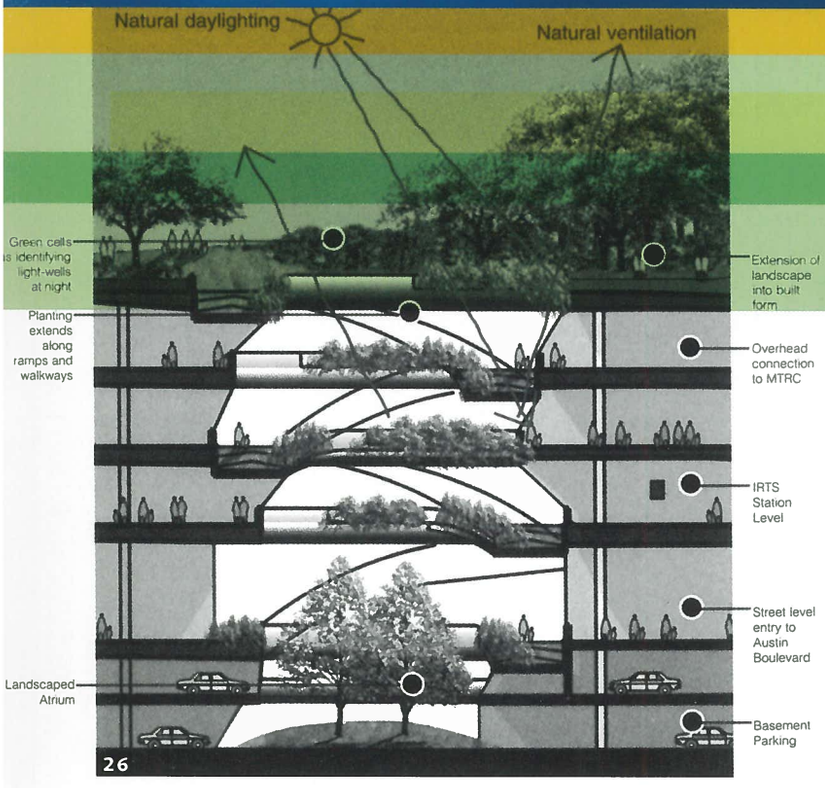

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Biointegration as prosthesis design

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Details of Ecolles

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West Kowloon Waterfront Vertical Park, Hong Kong

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