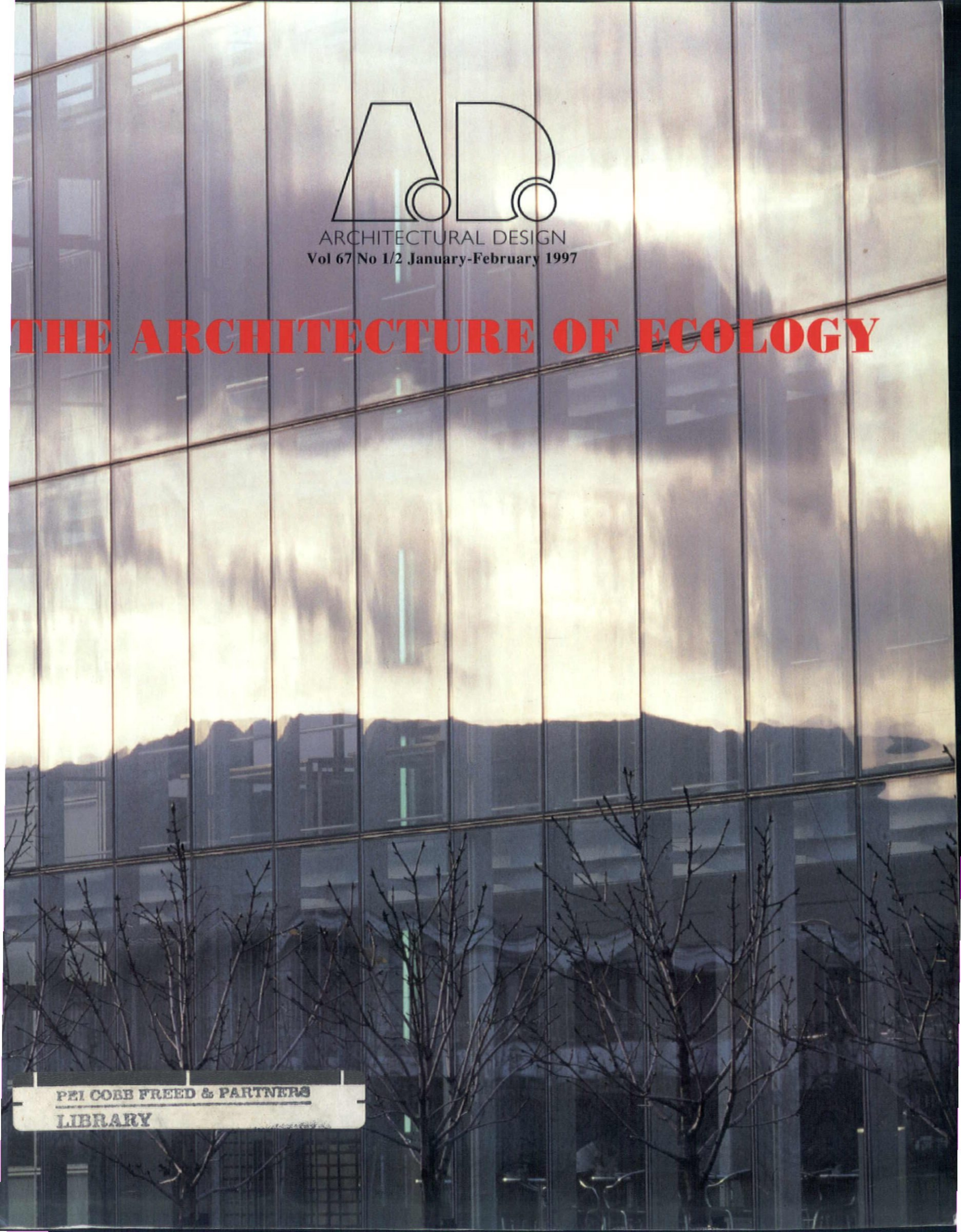
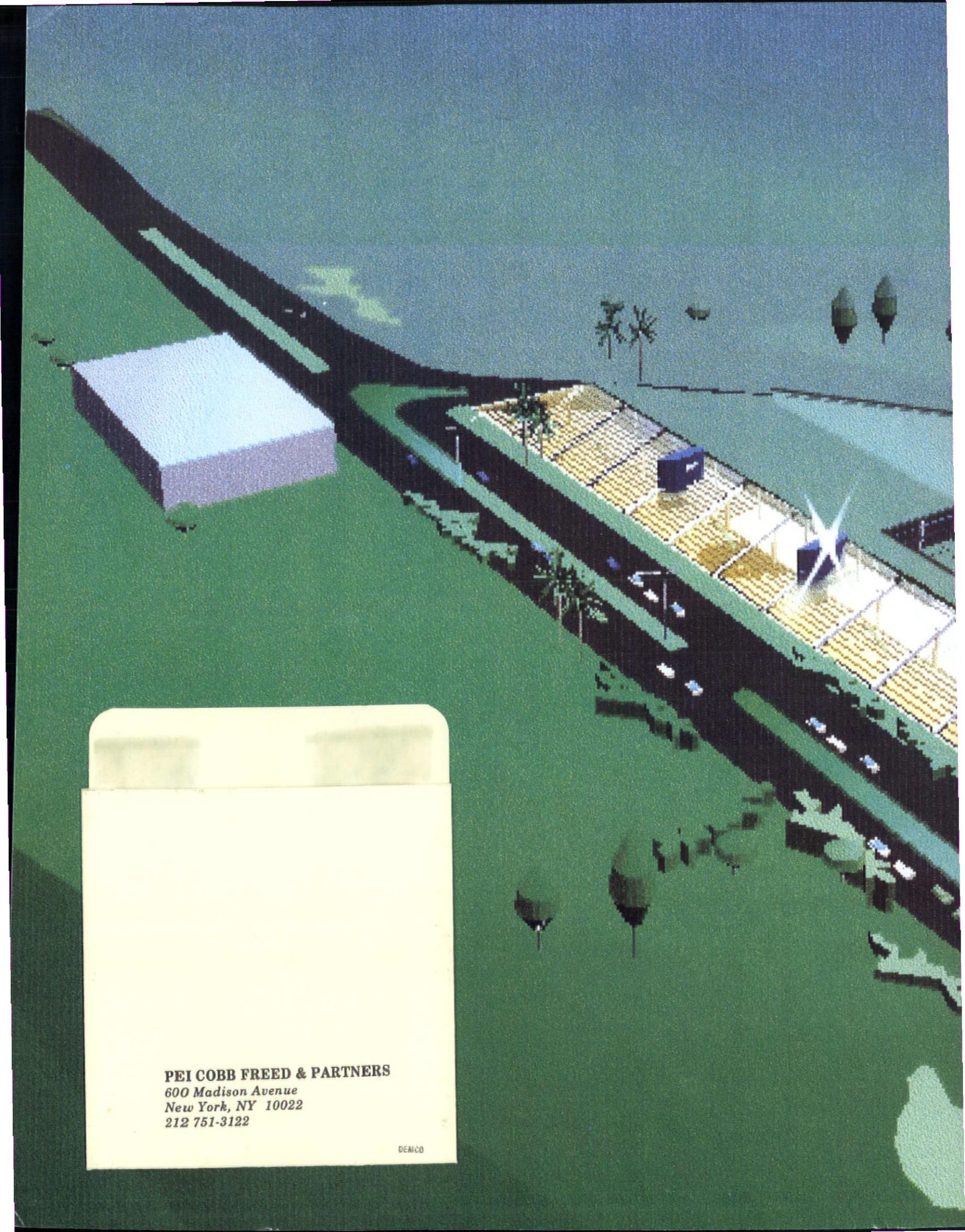


ARCHITECTURAL DESIGN
Vol 67 No 1/2 January-February 1997

THE ARCHITECTURE OF ECOLOGY



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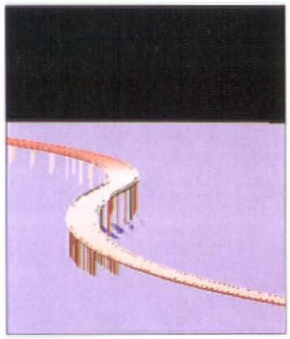
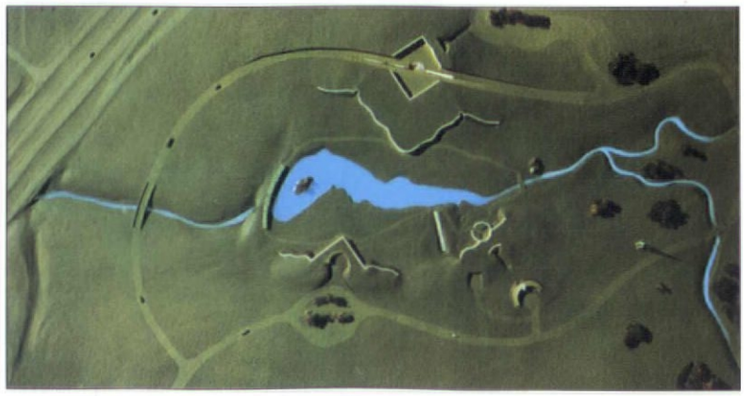
ARCHITECTURAL DESIGN
Vol 67 No 1/2 January-February 1997

CONTENTS



Battle McCarthy, Poole Harbour Bridge Competition

Bill Dunster, Hope House, East Molesey, England
Photograph: Dennis Gilbert



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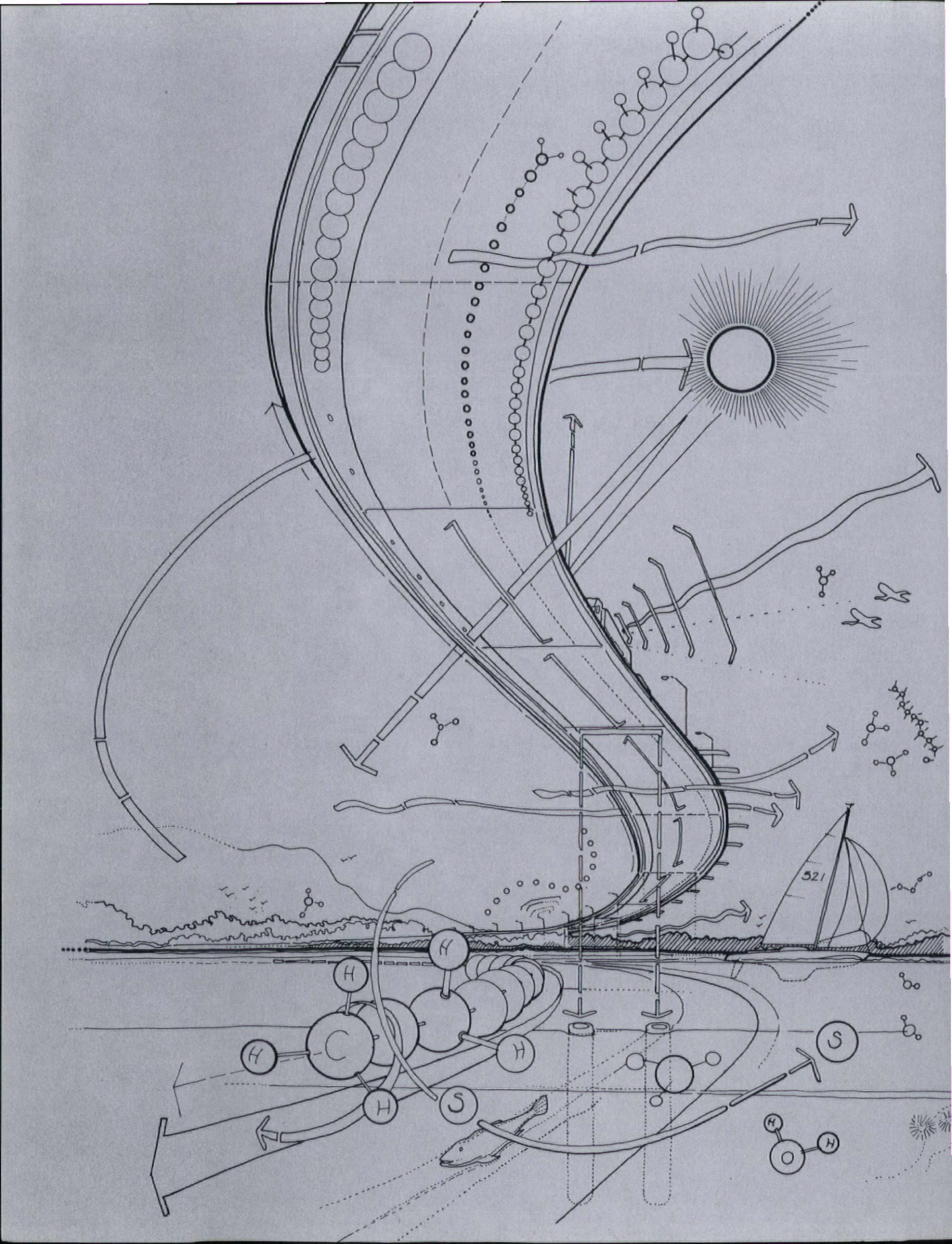
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BATTLE McCARTHY

MULTI-SOURCE SYNTHESIS

More for Less

As the Millennium approaches, designers are conscious of three fundamental influences on the planning and design of new bridge structures: concern for the environment; innovation in technology and materials, and financial constraints. The Poole Harbour Bridge Competition presented an opportunity to reflect these issues and to provide a contemporary bridge design that is fully suited to its setting, aesthetically pleasing and cost-effective to construct and maintain. The elegance of the scheme lies in its double curved plan and its lightweight construction, which reflects its sensitivity to its internationally renowned environment.

The design of major structures is often dominated by consideration of one or two issues, such as structural form or cost. This scheme integrates a range of considerations into this process, and places environmental concerns alongside engineering and economy on the design agenda. The resulting structure is as much a response to local wildlife and archaeology as it is to structural performance criteria and the retention of shipping lanes.

The use of the long gentle double curve is a consistent feature of British art, especially popular when used in landscape settings. As John Summerson stated in 1963: 'They possess an elegance and humanity derived to the straight of the too embracing curve.' William Hogarth summed up the value of the double curve in his *Analysis of Beauty* in 1753 when he stated that: 'It leads the eye in a wanton kind of chase.' In addition, he recognised the need to find the optimum alignment: 'Though all sorts of waving lines are ornamental when properly applied: yet strictly speaking there is one precise line properly called the line of beauty.'

This preferred alignment, neither too curved nor too slight, is the basis of the design. Using this plan, the bridge becomes a dynamic part of the landscape and opens up new visual opportunities that would otherwise be missed by a simple, straight structure.

Journey as an experience

Modern motorway geometry often precludes, or denies, the potential for creating sculpture in the landscape. However, this double curve conforms to design standards and provides elegance to an otherwise very simple structure.

The alignment of the curves 'throws' the views from the bridge either outwards towards Poole Harbour and the wider world, or inwards towards Holes Bay. This complements the sense of leaving, or entering, the country, and creates a distinct split in the visual character of views gained in each direction: increasing the sense of natural intimacy to the north, and urban activity to the south. The double curve also allows the high point of the structure to coincide with the location of the navigation channel used by shipping.

The bridge

The road deck is supported on a simple 'goal post' structure and maintains a constant depth and profile. Visual interest is maintained through the variations in the bridge's height along its length. Similarly, the intention is to develop different qualities and spatial characteristics at either end of the bridge, further enhancing the environment and thus the visual sequence enjoyed from the bridge.

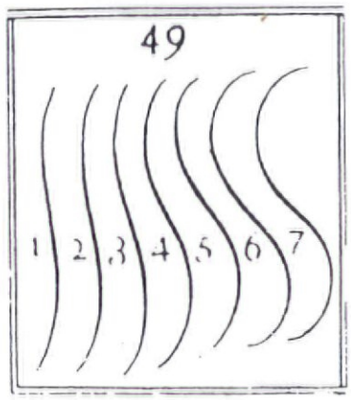
North landfall

Here, the various approach roads climb up new embankments to an elevated roundabout, giving dramatic views of the bridge and Holes Bay. To facilitate this the designers have maintained an open aspect in the area, with minimal tree planting. The land beneath the bridge will be developed as an esplanade to reinforce the current use by shore anglers and pedestrians. This hard urban structure will be softened by its close proximity to the rich grassland and heath.

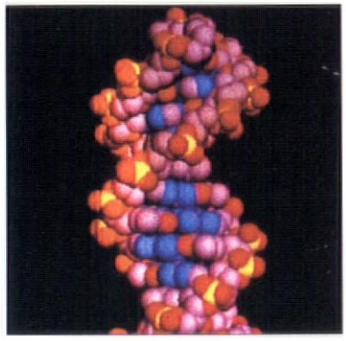
South landfall

In contrast to the northern landfall, the southern approaches will not offer spectacular views of the bridge but will be surrounded with a soft woodland environment. The sense of enclosure, between the shoreline and the roundabout, will be reinforced with earth embankments.

The bridge gradually merges with the landscape in a gentle way, that blurs the distinction between Holes Bay and dry land. The landscape is designed to disguise the definition of the flood protection core and to create a seamless succession of natural environments: from open water to woodland.

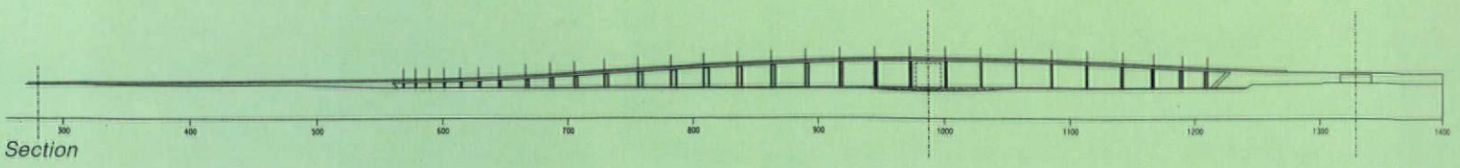


Hogarth, Lines of Beauty, *1753*

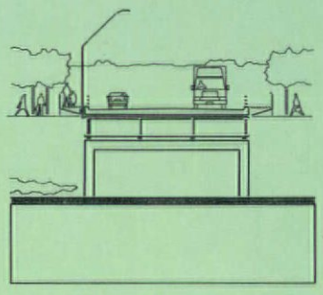


DNA spiral model, 1953

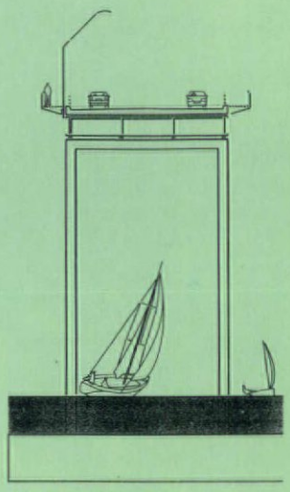
Natural/urban interface



Section

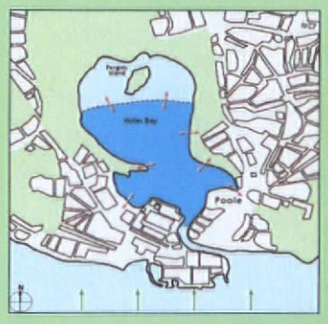


Low level section



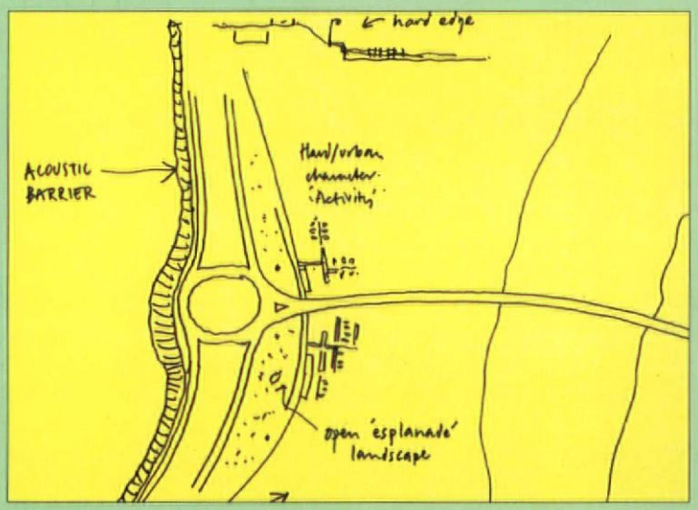
High level section

Site plan



Main visual area

Regeneration & conservation



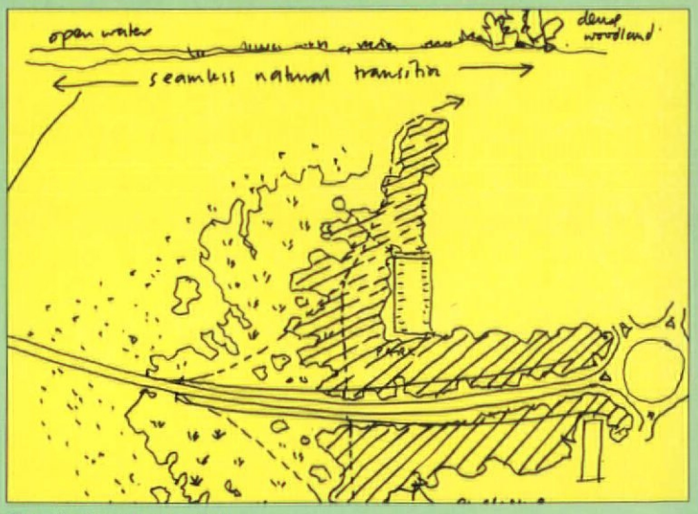
Detail of north landfall

Principal roosting areas

Recreational access

Land use

International context



Detail of south landfall

This natural landscaping reflects the existing habitats while attempting to increase their scope. In addition, the scheme recognises the potential for the creation of a public park, in front of the old Poole Power Station site, to further reinforce the setting of the bridge. This strong woodland framework will also screen views of the remaining transformer buildings.

Structural efficiency

The structural objective is to get vehicles safely and efficiently across the bay, while allowing adequate space beneath for shipping. The proposed scheme provides the minimum structure necessary to meet these basic needs.

Structural economy

The proposals distribute the financial expenditure for maximum environmental and structural benefit. The intention is to show how the money is spent through the appearance of the scheme by minimising foundations and hidden structures.

Three material options have been considered for the bridge's superstructure: all steel; steel columns and deck with carbon fibre walkway, and all carbon fibre. An engineering value analysis – assessing cost, buildability, maintenance and durability – will determine the most appropriate solution.

The design team has also explored the possibility of incorporating intelligent systems within the primary structural elements. In this scenario state of the art sensors, such as fibre optics, would provide detailed on-line information about internal stress, strain, temperature and vibration. This information would be monitored by signal processors programmed to alter actuators – elements capable of altering their shape, stiffness, frequency and other mechanical characteristics – to counter the effects of structural deformation.

Ecology

This bridge responds to the ecology and landscape that occurs in the bay. The proposed landscaping is intended to build upon this natural foundation, creating an enriched environment for wildlife and people.

The method of construction and the design of components will be tailored towards the most energy efficient and environmentally acceptable methods. Applying the principles of ecosystem planning and management, the designers have adopted techniques that will minimise waste, avoid excessive use of energy, and prevent pollution of the environment.

The limited tidal range of Holes Bay – 1.8 metres approximately – precludes the use of barges and caissons and – despite the polluted nature of the mud and the tidal nature of the bay – most of the construction for the foundations and bridge piers will be carried out from causeways built on the mudflats. Once the foundations and piers have been constructed, these will be removed and the material reused in the construction of embankments and approach roads.

The authors wish to acknowledge the help of Douglas Broadley in the preparation of this article.

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Hydrology

Sea aster in the salt marsh

Oystercatcher on the mud flat

BILL DUNSTER

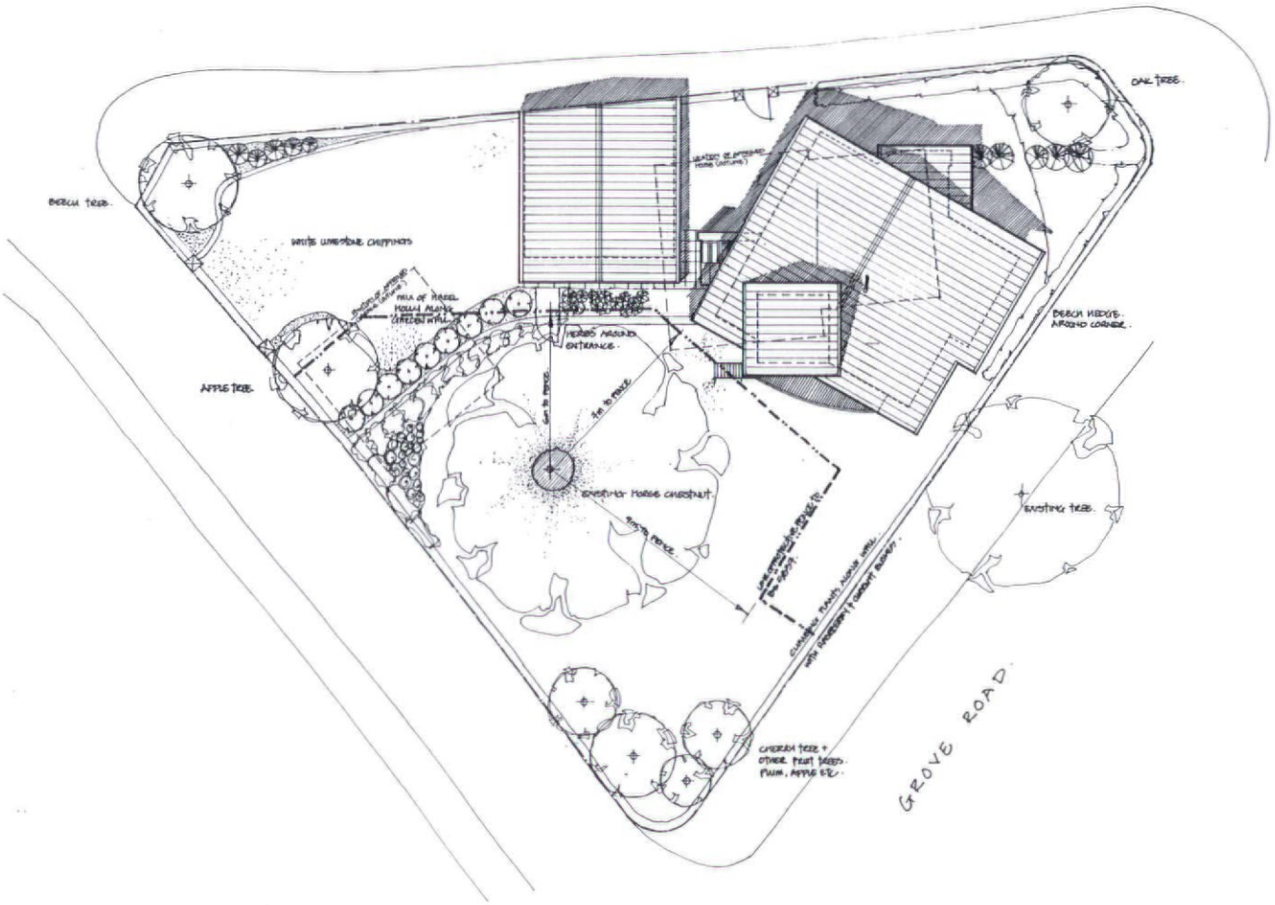
HOPE HOUSE

East Molesey, England

The largely self-built Hope House establishes a coherent relationship with the landscape by maximising views of the river, despite coping with a very tight site, changes in level and the privacy of neighbouring plots. All available south-facing apertures are designed to maximise solar energy and daylight. These sustainable resources are used for space heating, food cultivation, illumination and as a source of electricity. Additionally, the domestic sunspace provides a thermal buffer zone which, occupied seasonally, provides extra living space. This feature is a development of the self-irrigating, self-ventilating and self-shading conservatory built by the architects as an extension to an existing suburban house.

In response to emerging socioeconomic trends, especially large-scale unemployment and changes in employment patterns caused by information technology, this house effectively merges the traditional allotment with the leisure generated conservatory. In fact, it uses these two ingredients, already essential to a typical suburban lifestyle, to create a more sustainable urban typology. Despite using materials with a low embodied energy content, the house was built on a very low budget and 95% financed through the local building society. Active water-cooled photovoltaic solar systems and a rainwater thermal store will be added to the scheme when the client has the available funds. The architects have incorporated elements of this house into a higher density urban terrace which is part of the Hopetown sustainable city environment.

FROM ABOVE: Conservatory, 6 Hurst Road, Molesey, England; model, Hopetown
Photographs: Dennis Gilbert


BEECH TREE.
OAK TREE.
WHITE LIMESTONE CHIPPINGS
PATH OF PAVING
HOLLY PLANTS
LIMESTONE WALL
HEDGES AROUND ENTRANCE
BEECH HEDGE AROUND GARDEN.
APPLE TREE.
EXISTING HORSE CHESTNUT.
EXISTING TREE.
CHERRY TREE + OTHER FRUIT TREES PLUM, APPLE ETC.
GROVE ROAD

EXEDRA *ds*

ENVIRONMENTALLY FRIENDLY HOUSES: THE REALITY

There is more to designing an ecologically friendly, speculative house than having a developer who is convinced of its virtues. Typically, he is more than willing to accommodate passive design solutions and environmental ideals, provided it can be done economically. One difficulty stems from the process of developing ecological architecture when compromises to the basic design criteria are needed to entice the consumer. Whilst the purchasing public may be educated in environmental issues and their benefits, the problem is convincing a mortgage lender that a property which, for example, does not have a conventional central heating system may be better, not worse, than a standard speculative house.

Treating the building as a speculative house, with minimising cost being the ultimate criteria, is still viable and pragmatic if the architect avoids hi-tech solutions and returns to basic passive design principles. The integration of solar collection, distribution and storage, together with ventilation and auxiliary heating, can be simple and economic to achieve.

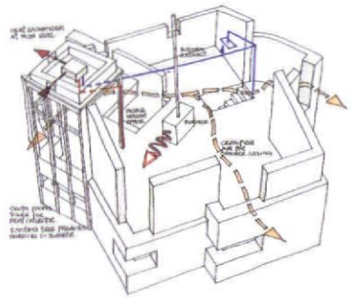
All of these factors have been realised in the following residential design in Bristol. The site is a redundant piece of urban land formerly occupied by a substation, surrounded by roads at the brow of a hill. The design is based upon solar path orientation, and luckily this best suited the views across the city. A mature horse chestnut tree located at the western end of the site was exploited to provide solar shading in the summer, while not inhibiting what solar energy is available in winter. The occupants of the house will live with the seasons.

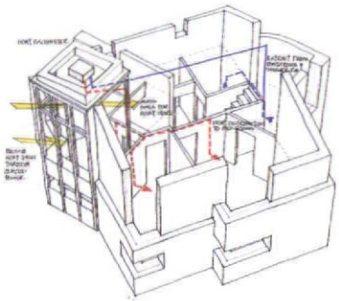
To facilitate these aims the house was constructed using only simple building techniques and holistic materials: a criterion based on the natural resource of the raw material, the energy used in harvesting and refinement, and the long-term effect on the environment, including recyclability. This can all be achieved without reducing profit margins.

Designing against the norm, the building is turned on its head with the bedrooms on the ground floor, surrounded by thermally massive stone walls. These absorb heat passively during the day and release it at night. The heavily insulated areas on the first floor provide splendid views from the common rooms, while conveying the feeling of living within the branches of a mature tree. Similarly, whereas standard speculative houses utilise the 'condom' approach to building – using plastic vapour checks to prevent moisture entering the fabric – this house uses breathable walls to control moisture migration through the construction.

A built-in conservatory rises through the southern elevation to maximise solar gain. This punctuates the main roof and provides a heat collector. As hot air rises through the building it passes through a simple heat exchanger, warming the incoming fresh air. This supply air is distributed to the ground floor bedrooms to provide heating and ventilation. The passive heat sources are backed up by a solid fuel stove, whose output is capable of maintaining the whole house at a comfortable temperature even during the winter. To achieve the speculative appeal of a family home, night storage heaters have been included even though they will never be used.

The market for speculatively built, energy efficient and ecologically friendly homes, whilst small, has the potential to develop rapidly. The problem is mortgage lenders who are unsure of the market and reluctant to add any premiums to their valuations for energy efficiency.





OPPOSITE, FROM ABOVE: Rendered elevation; site plan; FROM ABOVE: First floor environmental strategy; ground floor environmental strategy

SUSAN ROAF

SOLAR HOUSE

Oxford, England

The Solar House is very ordinary looking and, except for the internal planning, is certainly not very 'architectural'. This is because the architects wanted to reach out to the person on the street and provide them with an ecological building they could relate to. The house is also intended to be incongruous, reinforcing the point that designers should tread lightly within the environment.

The house cost £800 per square metre, including all the solar equipment, which is typical for an unpretentious architect-designed house. However, to achieve this considerable rationalisation was necessary. For example, the design is orthogonal, with a simple roof form, making it simple to construct and detail.

The very high levels of insulation and large thermal mass ensure that the house has a stable internal temperature throughout the year. The other advantage of the high density concrete walls, combined with the triple glazing, is that the residence is basically soundproof.

The house does not overheat, because there are no windows to the west and the roof of the conservatory is only 66% glazed: based on research carried out on the Domus solar homes in Germany. The airflow in the building allows excess heat to escape and permits good cross ventilation in summer.

The design diminishes the inside/outside penetration of space by avoiding the contemporary 'patio door' approach. This makes the house feel very safe and ensures that all the air entering the building envelope is preheated, reducing thermal loss.

The photovoltaics generate more electricity than the house uses, and the solar heating system provides over 70% of the hot water. Similarly, the temperature in the house can be maintained using the three radiators for one hour a day and the kakkle oven.

GALBRAITH•WHALLEY

PRIVATE RESIDENCE

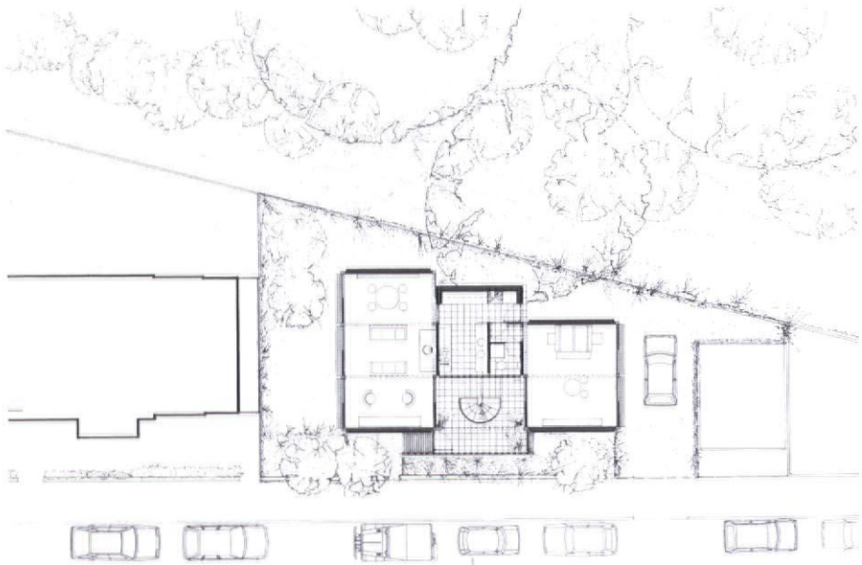
London, England

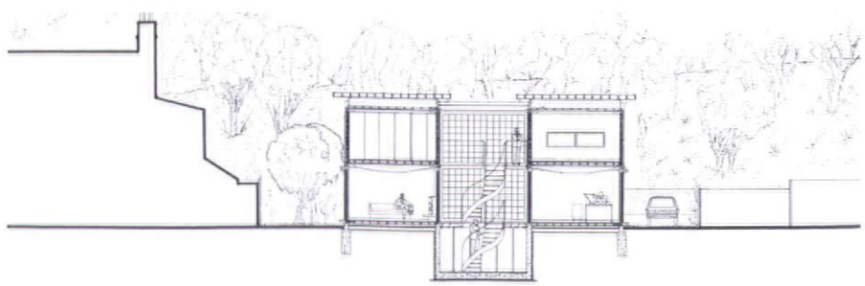
The architects were interested in developing a family house that was reasonably economic to build, with plenty of space and natural light, particularly sunlight. It had to be able to open up in the summer and close down in the winter. Although in a busy London area they wished to create an oasis: a retreat in which to live and work.

At the centre of the house is a dense concrete service core accommodating the kitchen, bathrooms and vertical circulation. Along with structural rigidity it provides a thermal sink for the passive solar gain. To each side of the service core are highly insulated timber pavilions, constructed from plywood panels: the standard module minimising the amount of material used and waste produced. The upper levels are clad with a pressed aluminium rain screen. Air handling units and heat exchangers, located in the basement, are used to minimise energy requirements by circulating the solar heated air. Zoned dampeners ensure that this energy is not squandered. All the air that is circulated round the house is filtered before use.

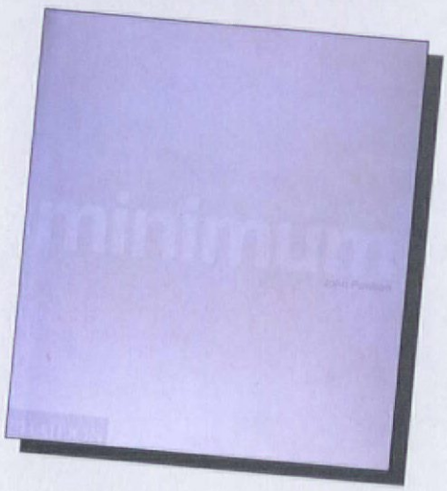
The northern elevation is almost entirely solid and highly insulated, while the southern elevation uses acid-etched glass blocks to maintain privacy without affecting sunlight penetration. These blocks are used internally for partitions, enabling the majority of the house to be naturally illuminated. There is a large number of movable glass screens that allows the building envelope to open up to the garden, increasing ventilation and allowing the interior to be heated by the sun. Electrically operated, insulated shutters keep the house secure and warm at night, particularly during the winter.

The roof was used to articulate the distinct parts of the house and follows the same modular rationale used throughout. This gives the building a scale and massing that reflects the rhythm of the Victorian houses on the street.





FROM ABOVE: Ground floor plan; longitudinal section



Books Received

Cybercities, M Christine Boyer, Princeton Architectural Press, 240pp, 5 b/w ills, HB, ISBN 1 56898 048 5, £24.00

Ex-cavating Modernism, Black Dog Publishing Ltd, Ed Richard Bentley and Alex Coles, 200pp, 32 b/w ills, PB, ISBN 1 901033 05 8, £9.95

Enric Miralles: Work and Projects 1975-1995, Enric Miralles, The Monacelli Press, 272pp, 100 colour and 300 b/w ills, PB, ISBN 1 885254 43 1, £27.50

Paradise Transformed: The Private Garden for the Twenty-First Century, Guy Cooper and Gordon Taylor, The Monacelli Press, 224pp, 180 colour ills, Cloth, ISBN 1 885254 35 0, £35.00

Chora L Works, Jacques Derrida and Peter Eisenman, Ed Jeffrey Kipnis and Thomas Lesser, introduction by Bernard Tschumi, The Monacelli Press, 208pp, 60 ills, PB with die-cuts throughout, ISBN 1 885254 40 7, £27.50

Form Follows Finance: Skyscrapers in New York and Chicago, Carol Willis, Princeton Architectural Press (New York), 217pp, b/w ills, PB, ISBN 1 56898 044 2, £15.00

Finance and architectural theory seldom go hand in hand, but in Carol Willis' book, *Form Follows Finance*, the different typology of skyscrapers in New York and Chicago is analysed in a clear and lively account of the economic factors that shape building form. It is finance and the prosaics of municipal codes and real estate speculation, argues Willis, rather than issues of style or design philosophy, that have shaped the different skylines of New York and Chicago since the 1890s.

New York's Flatiron Building (1903) and Chicago's Conway Building (1915), for instance, are paired in the book to illustrate the differences between the formal development of the skyscraper in both cities. Although by the same architectural practice and with almost identical classical facades, there are fundamental differences in the massing of these two buildings: the tall and slender form of the Flatiron Building, resulted from smaller building plots and a *laissez-faire* approach to the city's municipal codes in New York, while the more squat Conway Building, with its central light well, was generated by larger average plot size and building height restrictions in Chicago. Both buildings were 'machines to make the land pay', generated by the requirement to provide the maximum amount of rentable office space at the highest possible return.

Old postcards, with their standardised perspective views of soaring skyscrapers, and the grouping of iconic plans are used throughout the book to illustrate case examples, and provide strong visual communication of the book's central arguments.

To a readership in the architectural profession in the UK – still imbued with the curse of the 'gentleman architect', and with a history of unwillingness to engage itself with the details of cost – Carol Willis' book, beyond being an elegant and scholarly study of building typology, is especially interesting because it offers a valuable insight into the history of a different architectural world where, for good or bad, finance has always been more dominant in shaping buildings. For this reason the book provides the basis for a comparison between the relative merits and demerits of architectural practice and product in Britain and the United States.

While Ruskin and Morris were pondering craftsmanship in England at the end of the 19th century, the American Institute of Architects was being addressed by the editor of *Engineering Magazine*, who told them in 1893: 'Current American architecture is not a matter of art, but of business. A building must pay or there will be no investor ready with the money to meet its cost. This is at once the curse and glory of American architecture.'

In 1996 it could be said that both the curse and the glory of British architecture lies in its distance from the issues of economics.

Ellie Duffy

Minimum, John Pawson, Phaidon Press (London), 272pp, highly illustrated colour and b&w, HB, ISBN 0 7148 3262 6, £60

Lavishly illustrated and coolly designed, *Minimum* is destined to become the interior designer's coffee-table essential. Pawson aims to present a distillation of his thoughts on the notion of simplicity. His selection of images to whisk us through the world of Minimalism is broad in range, and the text, reflecting the subject, is easily accessible.

An introductory essay is followed by hundreds of large images organised into eleven chapters under such unusual headings as 'Ritual: Voluntary Poverty and its Enduring Appeal' and 'Expression: Silence as a Language'. Within these are some photographic gems: the aerial shot of New York presented as a gatefold is simply stunning and the image – again aerial – of a farmer ploughing his field has a wonderful formal pattern.

How much it is possible to learn about the concept of Minimalism from all this – and the relevance of all these extraordinary photographs – is, however, arguable. One might also question specifics, such as whether Jodrell Bank or the work of Giorgio de Chirico represents simple Minimalism or not; though the reason for their inclusion lies in the very personal organisation of the book, and it is none the worse for that. However, one rather curious aspect remains: photographs of Pawson's own architecture are casually leafed in amongst the other 'inspirational' images – and to the uninitiated their authorship is not immediately obvious.

While the book is certainly a beautiful object, the choice of a white dust jacket isn't entirely successful: it soon loses its refined impact and pristine appeal with use.

One also wonders whether the book is aimed at architects; as Pawson openly admits, he has not had many opportunities for new building, his clients unfortunately seem to back out at the last minute: one in Los Angeles dropped a project with Pawson and bought a Frank Lloyd Wright house instead. The major emphasis of his executed projects is on interior design – the incredible remodelling of the Calvin Klein store in New York – and I imagine that this is also where the book's prime market lies. Though whoever the buyers turn out to be, they may well end up feeling a little short-changed: the price is none too minimum.

Maggie Toy

DRAWING ACROSS OLD CURTAINS
Hani Rashid and Yuri Avvakumov
The Frank Lowe Lectures: The Bartlett School of Architecture, London

The juxtaposition of two architects from either side of old Cold War divisions invited a variety of observations that were instructive in many subtle ways. Hani Rashid of Asymptote, who was on first, was a 'presentation pro' with much of the work projected directly from his Powerbook and supported by a narrative that was evocative and poetic. One project was 'haptic and untraditional', while another featured a 'fuselage theatre'. Half the projects shown were situated in the Pacific Rim, and were an indication of both the fertile real estate and the intellectual ground to be mined in this new context of fast, wired, yet culturally bifurcated cities. The work of Asymptote is choreographed by the speeding bullet train, highway shootings, harmonic digital screens and diaphronous membranes: the architecture of the splinter and the shard.

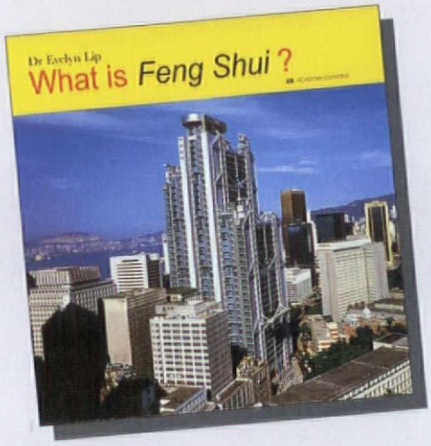
Conversely, Avvakumov seemed largely unaffected by the asymptotic digital technologies. His manipulation of dynamic forces was not that of highway spaghetti clovers, or satellite framed views, but the politics of present day Russia, and – vicariously – Central and Eastern Europe as a whole. He is trying to find methods of expression and iconography that reflect swift and radical cultural change, as his country battles with itself in its attempts to buy [sic] into the West's pervasive 'democratic' capitalism (if such a an expression is not oxymoronic). Here was work essentially handmade and rough hewn, that successfully used its artisan-like construction to achieve a resonance that could not be ignored. This surreal simplicity contrasted sharply with Asymptote's contorted geometries, and it was interesting how each architect dealt with the issue of monumentality. Avvakumov was static yet full of poise and powerful political undertones; utilising, as he does, rereadings of Tatlin's Tower and the invention of new monumental typologies and tactics, such as his diving tower submerged in water ('it's safer that way'). Asymptote's search lies in an attempt to reconcile the disparate fragmented typologies, topologies and events of the networked first world city: its shrapnel peppering its trajectories. His is a quest not for the focal iconic point, but for the 'mediating structure' that floats in the invisible information lymph that bathes the great urban conurbations and fuels their extensive cyber-tendrils.

Both architects expose social dichotomies, not just in the subject of the work but also in the manner of its authors' presentations and their means of representation. These two 'Architectural Eyes' – usually staring at each other over a rusted and patinated open curtain – but here placed side by side, were an eloquent reminder that architecture does not always need the sleek finely crafted and digitally inspired product. It can be made of sticks, ladders and leaves and still be concerned with simple but complex human issues such as death, oppression and heaven, and even the immortality of paper architecture as a cherished cultural text.

For Asymptote the scale of projects is becoming smaller, from the huge 'LA Gateway' to the much smaller but still relatively large Aarhus Festival canopy. For Avvakumov the projects are small, from the 'Dolls house of Cards' to the still modest recent staircase interventions. What is not in doubt is the scale of their ambitions.

Neil Spiller

FROM ABOVE: Yuri Avvakumov and Yuri Kuzin, Red Tower, *metal, 1987; Asymptote, (detail)* Hyperfine Splitting 006, *1992*



WHAT IS FENG SHUI?

Dr Evelyn Lip

Feng Shui is the ancient art of placing a habitat, a house, a commercial complex, factory or multi-storey office block on to a site that is in harmony with other man-made structures and in balance with nature. It has its roots in Chinese cosmology and is still deeply embedded in oriental culture. Indeed, no architect working in the Far East would dream of starting construction without first getting a Feng Shui consultant to look at the plans.

Dr Evelyn Lip, author of the best-selling *Feng Shui: Environments of Power* and recognised authority on the subject, delves into the mysteries of Feng Shui – one of the five areas of influence that the Chinese believe determine one's success – and clearly outlines how it relates to architecture in the West. This is a book written for people from all walks of life – for designers, architects and engineers – on a subject that is rapidly gaining in popularity.

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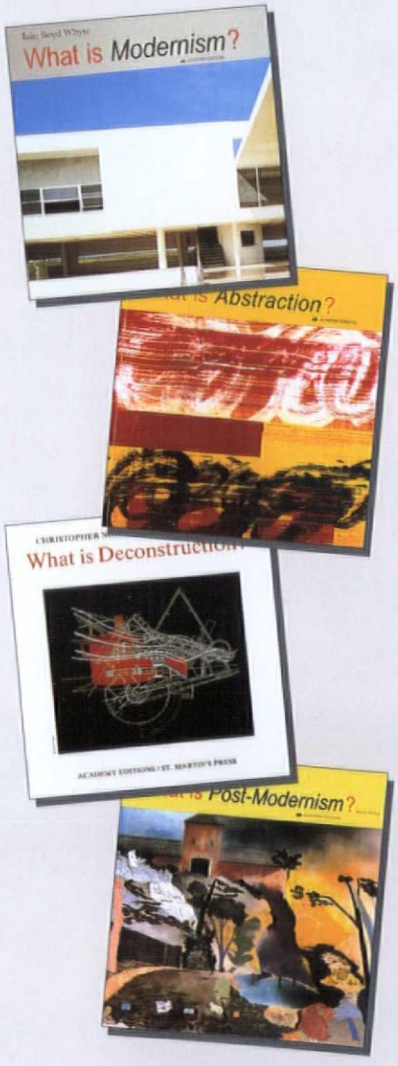

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Charles Jencks

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THE ARCHITECTURE OF EMPOWERMENT

People, Shelter and Liveable Cities

Ismaïl Serageldin

The challenges of urban growth, and the increasing alienation of people from the city environment, requires a thorough reassessment of the dominant patterns of planning and architecture. This book argues that a new paradigm of empowerment is required, to mobilise the poor and the destitute, and in the process, to humanise our cities and save their character and distinctiveness. Architects, as well as planners and bankers, can help in that process as much as their past attitudes have hindered it.

In his detailed introduction to *The Architecture of Empowerment,* Ismaïl Serageldin examines the similarities and differences between the cities of North America and Europe with those in the developing world, uncovering the dynamics of urban decay and the means of renewal.

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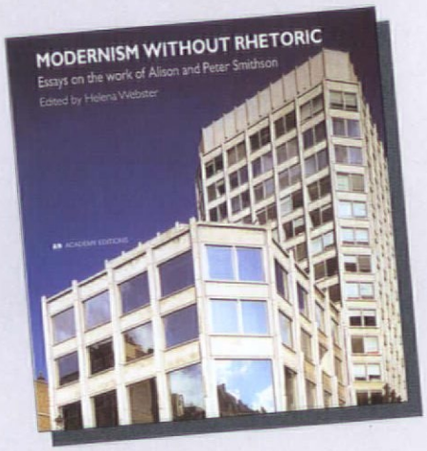

MODERNISM WITHOUT RHETORIC

Essays on the Work of Alison and Peter Smithson

Edited by Helena Webster

Alison (1928-94) and Peter Smithson (1923-) formed a partnership in 1950 and their work together became known internationally as the paradigm of the British new brutalist aesthetic. They were responsible for three of the most important postwar buildings in Britain: the Mies van der Rohe inspired, Hunstanton School, Norfolk (1950-54); The Economist Building, London (1964), and housing at Robin Hood Gardens, London (1964).

The Smithsons, influential members of The Independent Group and Team 10, have written much, built comparatively little, and never ceased to champion the progressive ideas of the modem movement. What they have built, has been variously termed 'ordinary' or even 'ugly', accounting for the absence – until very recently – of the public acclaim that they deserve. However, they have undoubtedly been a major influence on two generations of British architects, possibly more so than any other teachers or practitioners.

Helena Webster's book is the first critical appreciation of the work, and influence of this partnership, which has occupied a leading role in British architecture for over half a century.

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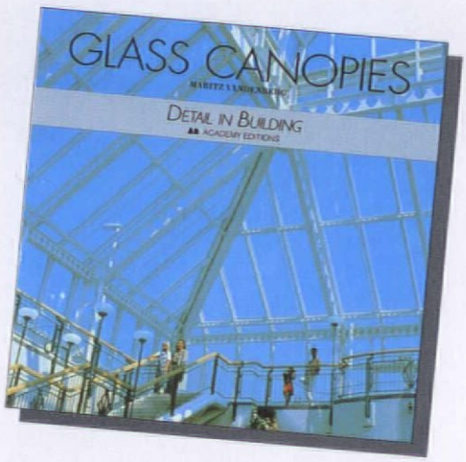

GLASS CANOPIES

Detail in Building

Maritz Vandenberg

Glass, one of the most entrancing materials available to the architect, has yet to be exploited to its full potential. This book, focuses on the use of glass as a horizontal weather shield and shows what can be achieved with currently available techniques. Taking in the whole dimensional range, from the small entrance canopy to the roofed-street, or glass enclosed landscape, the author outlines the basic design principles and illustrates examples of excellence designed by leading architects from around the world.

This text, supported by photographs and detailed drawings, will be of benefit not only to practising architects and students, but also to a wider audience – engineers and site agents who need a concise explanation of new technology, and prospective clients. This is the third title in the successful *Detail in Building* series.

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To be published March 1997

BATTLE McCARTHY

MULTI-SOURCE SYNTHESIS

Ecology Fights Back – With Clubs

Dried by years of drought and pulverised by the machine-drawn gang disc plows, the soil was literally thrown to the winds . . . The winds churned the soil, leaving vast stretches of farms blown and hummocked . . . They loosened the hold of the settlers on the land, and like particles of dust drove them rolling down ribbons of highway

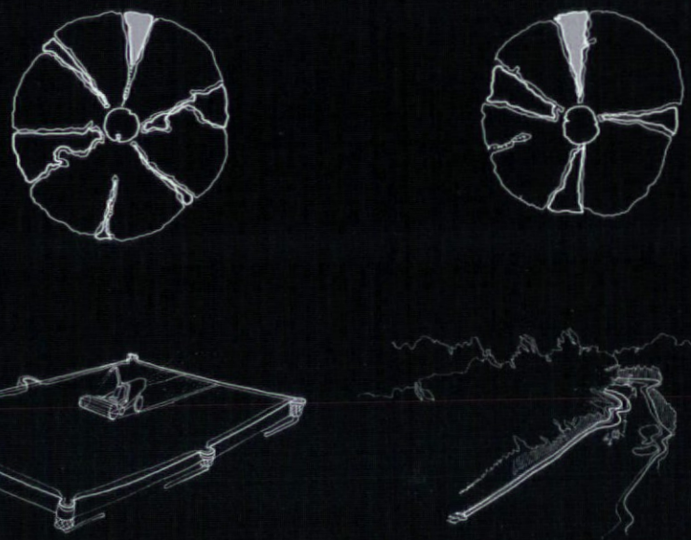
Dorethea Lange, *American Exodus*, 1939.
A record of human erosion in the 30s.

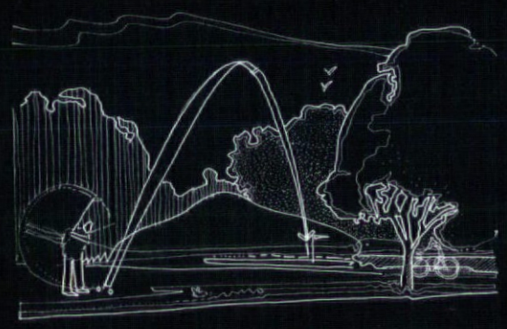
It would seem time has come for the creation of a vast new public landscape . . . By interweaving man's construct with the profuse phenomena of nature – water, geological formations, plants and animals in their natural habitats – it might be possible to shift away from a world oriented to power and profit, to a world oriented to life

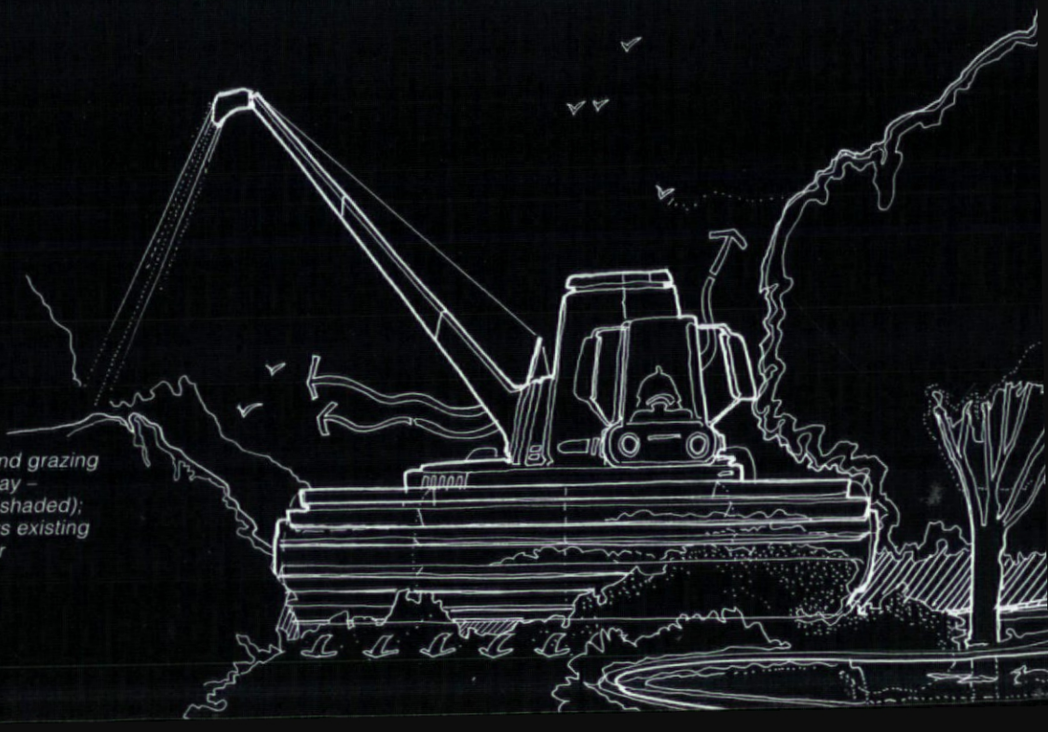
Patricia Johanson, unpublished manuscript for *House and Garden*, 1969.

To forget how to dig the earth and tend the soil is to forget ourselves

Mohandas K Ghandhi

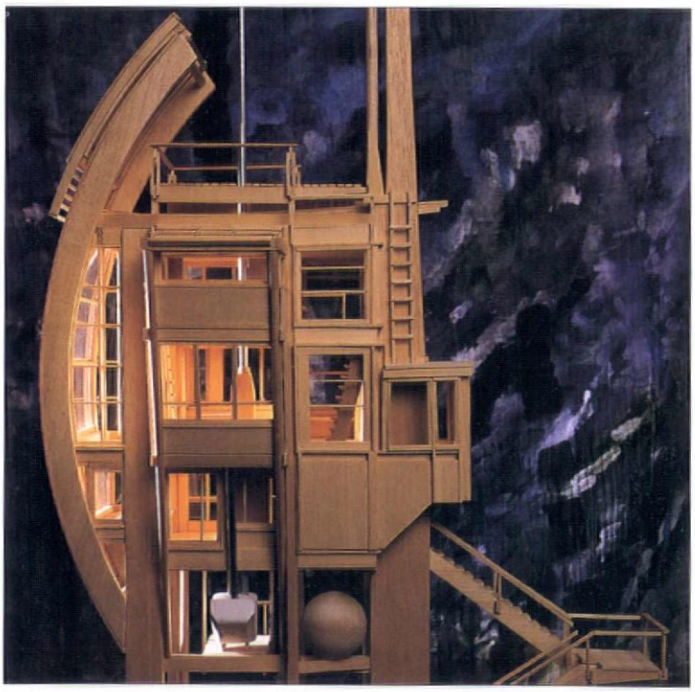






FROM ABOVE, L TO R: Historical – arable and grazing ground linked to centre (shaded); present day – leisure and wildlife habitat linked to centre (shaded); mechanisation of the countryside; golf allows existing environment to flourish; environmental golfer

THE ARCHITECTURE OF ECOLOGY



STEVEN JOHNSON, FOREST HOUSE, SCOTLAND

Architectural Design

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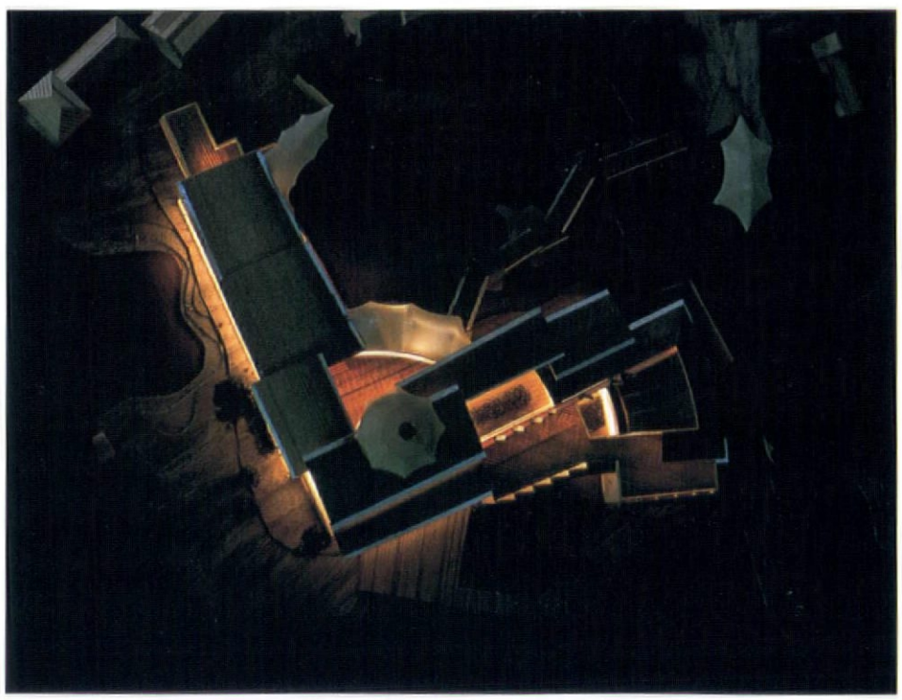

OPPOSITE: IMRE MAKOVECZ, HUNGARIAN PAVILION EXPO'92, SEVILLE, SPAIN;
ABOVE: ECD ARCHITECTS, WILDFOWL AND WETLANDS CENTRE, SLIMBRIDGE, ENGLAND

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Contents

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THE ARCHITECTURE OF ECOLOGY

EDITORIAL

MAGGIE TOY

Even a cursory look at the daily newspapers cannot fail to impress upon us the bleak ecological future of our planet if current trends continue. We must be prepared to take measures to redress this. The Habitat conferences – most recently 'Habitat II' in June 1996 – and the Rio Earth Summit have already made valuable contributions in raising international awareness across the spectrum of governments and professions. They have succeeded in focusing attention on the way we approach ecology and the built environment, and it is imperative that the architectural and planning professions build upon their recommendations.

The contributions that we can make as individuals vary in scale and scope, but all are important. Architects and planners are often in a position to influence energy consumption in construction and client-use from small-scale projects to masterplans. New materials and concepts of architectural design allow us to greatly improve the energy performance and to reduce the environmental impact of materials used in buildings. Recycling technologies can facilitate greater efficiency in the use of resources. It is up to us to ensure that architecture which combines climatic responsiveness with a pleasing experience becomes widely accepted. In answer to those who claim that any measures that the building professions are able take are too small to make any difference, this issue presents views, facts, figures and above all projects which suggest otherwise.

After communicating the fateful state of our environment with horrendous statistics – such as London uses 20 million tonnes of oil equivalent each year and discharges around 60 million tonnes of carbon dioxide – Herbert Girardet demonstrates how the building professions now have the historic opportunity to implement technical and organisational changes to establish a viable relationship between humanity and the global environment.

The work of those architects who do aim to build with ecology in mind tends to fall into two camps. In one camp are those who use earth or organic forms, architects such as Christopher Day and Imre Makovecz. They tend towards a spiritual focus and construct buildings which have an organic appearance. Day's house is roofed with turf and appears warm and cosy within. He is passionate about the ecological issue, and claims that 'architecture matters too much to be left to the stylistic preoccupations of architects'. Makovecz's churches can often be read in terms of human form, something that is not surprising since in Hungarian many building terms are derived from animal names. These natural associations are immediately perceived to be ecologically friendly. So too, traditional and vernacular methods, and materials are often seen as the panacea for all environmental ills. While this is certainly not always the case, Linda Watson presents a persuasive argument in her essay for the return of adobe which can work for today's climate and lifestyle.

In the other camp, the 'hi-techs' – such as Michael Hopkins and Future Systems – are also contributing to the protection of our environment. They use the modern technology and materials available to them – in addition to recycling where feasible – in such a way as to minimise the strain on the environment. True green design is more than a technological add-on. Intelligent buildings are designed to incorporate and facilitate the advanced protection of the world's energy. For example, glass that responds to heat and light levels, and the implementation of nano technology to transform buildings into a myriad of tiny automatic self-regulating systems, both modify the environment at potentially little energy cost. Of course there are architects who straddle both camps: the work of Robert and Brenda Vale is commonly seen to employ the imagery of the former while using the technology and materials of the latter. Either way, the aesthetics of ecological architecture have to be addressed. Why are revelations in hydrology or geology not used as sources for architectural inspiration when the contours of a fuselage or the structural crane are considered visually appropriate? Is it a question of fashion?

The task of addressing ecological issues does not lie just with architects, however, it depends upon the money men, the politicians and the public alike. The interventions in Curitiba, Brazil, demonstrate what is possible when a mayor and a community decide to instigate significant changes. The author of this scheme, Jorge Wilheim, calls for the architect not to be a victim of fashion and encourages instead a reassessment of architectural design, stressing such issues as the implementation of intelligent building systems.

Arising from our increased ecological awareness the theme of sustainability is becoming central to architectural discussion. However, such dialogue often seems to revolve around speculative methods: the use of new materials and structural systems which have no track record and therefore no proof of sustainability. It is vital that we study the implications and consequences of their use. SITE has been undertaking pioneering work in this area for over two decades and now bring to our pages some of the results of the combination of their accumulated knowledge and their design skills.

We are still at a stage where effective solutions are not clearly defined. A cohesive global ecology movement and a unified course of action have yet to be established but there is considerable pressure exerted on governments around the world, and the fact that people increasingly like to see themselves as pro-environment is a hopeful sign. The process of awakening the clients and decision-makers is under way. Although progress in environmentally conscious architecture is likely to be not only incremental but also contentious (rather than revolutionary), it has begun and should continue to be encouraged.

Villavision, Taastrup, Denmark

In the red or the green? The typical urban lifestyle, with its linear metabolism, puts us in the red on the resources scales for future generations. To make the needle swing the other way we must devise circular metabolisms, using green principles

HERBERT GIRARDET

SUSTAINABLE CITIES

A Contradiction in Terms?

In June 1996 Istanbul seemed to be the centre of the universe. From all over the world 20,000 people – politicians, architects, town planners, urban officials, NGO representatives from 180 countries – congregated for 'Habitat II', the UN City Summit, to draw up guidelines for cities and settlements in the 21st century. Most significantly, the *Habitat Agenda* was completed and signed by officials of all nations represented, an essential tool for improving living conditions in the world's cities, and for reducing their impact on the global environment.

Twenty years ago the UN held its first global conference on human settlements: Habitat I in Vancouver, Canada. At that time there was still hope that rapid urban growth could be curtailed. Habitat I drew international attention to problems in all kinds of settlements, rural as well as urban. 'Habitat II' built on this effort and focused on the urbanisation process itself, at a time when cities and towns are coming close to accommodating a majority of the world's population. Urbanisation has turned into the dominant feature of the human presence on earth, but how can we make a success of an urbanising world in both social and environmental terms?

Governments world-wide are increasingly aware that efforts to improve the conditions of the earth's environment must focus on the major urban centres. Cities today dominate global resource consumption. They take up only 2% of the world's land surface, yet they use over 75% of the world's resources. Sustainable urban development is, therefore, the most pressing challenge facing humanity in the 21st century. Could the vast appetites of cities for resources, and their huge waste discharges, be curtailed? Can they become a resource and energy efficient home for humanity? Could efforts to improve the environmental performance of our cities also create new opportunities for urban employment, for planners and architects?

Architectural issues – the materials used in buildings, the compatibility of architectural design with climatic conditions, energy use and environmental performance of buildings – were key aspects of 'Habitat II'. But the debate also extended to issues such as the ecological footprint of cities, the effects of urbanisation on human lifestyles and the relationship between cities and the country. All of these issues found their way into the 180 page *Habitat Agenda* to be published shortly.

The impact of cities is felt locally and globally. City populations, as major users of energy, cause both regional and world-wide air pollution, with dramatic impacts on the health of people and of the biosphere. On a local scale, various forms of air pollution are a problem in most of the world's great cities. Globally, the big issue is the increase of carbon dioxide in the atmosphere which, is now recognised as the major culprit in the process of global warming. The world community acknowledges that carbon dioxide discharges must be stabilised and even reduced, yet currently urbanisation and industrialisation in large parts of the world, such as in Asia and Africa, is actually further increasing global carbon dioxide output into the atmosphere.

Agenda 21, signed by the world community at the 1992 Rio Earth Summit, explicitly states that sustainable urban development is of critical importance for establishing a viable relationship between humanity and the global environment. Cities today have the historic opportunity to implement technical and organisational measures to this effect. In Chapter 28 of *Agenda 21* the following statement is made:

> Because so many of the problems and solutions being addressed by *Agenda 21* have their roots in local activities, the participation and co-operation of local authorities will be a determining factor in fulfilling its objectives . . . As the level of governance closest to the people, they play a vital role in educating, mobilising and responding to the public to promote sustainable development.

Building on *Agenda 21*, the *Habitat Agenda* will strongly influence the way we run cities and construct buildings. The *Habitat Agenda* states:

> Human settlements shall be planned, developed and improved in a manner that takes full account of sustainable development principles and all their components, as set out in *Agenda 21* . . . We need to respect the carrying capacity of ecosystems and preservation of opportunities for future generations. Production, consumption and transport should be managed in ways that protect and conserve the stock of resources while drawing upon them. Science and technology have a crucial role in shaping sustainable human settlements and sustaining the ecosystems they depend upon.

Autonomy or collectivity?

Of course, the debate on these issues has gone on for many years. In the early 70s, when the discussion first surfaced in the media, architects came up with ideas for all sorts of ways in which to reduce the impacts of buildings and settlements on the environment. The idea of the autonomous house was born.

Many of us actually thought that the best way to respond to the environmental crisis was simply to abandon the cities and to start afresh with a cottage on a plot of land or some idyllic new village deep in the countryside. Getting away from it all was a deep instinct of many who saw the explosive growth of urban consumerism and its destructive effects on the environment. In response to the demand for new ecologically oriented lifestyles in the early 70s new designs for eco-efficient buildings started to appear in the press.

Although not an architect, I too developed some concepts for an ecological architecture in the design of the Radial House. This was meant to be a house design for new villages, rather than for an urban context, because the idea was to come up with new ways of living sustainably, rather than just building sustainably. We did not have movies like *Independence Day* to make us feel insecure about city life, but there was a very powerful sense that

a tranquil life in the countryside promised more of a future than the urban rat race. Getting back to the land was a powerful motivation for many of us, in fact, the statistics in the censuses of the mid-80s show clearly that millions voted with their feet, or rather their car tyres, and moved into empty cottages, derelict farmhouses and converted barns, all over Britain. The idea was to live close to nature, grow your own food, bring up your children in a rural setting and, ideally, to do all of this living in a house with a built-in greenhouse where you could grow some of your vegetables, where you could produce much of your hot water from solar energy and where you could be happy ever after.

My one design of the Radial House received a lot of publicity and even ended up as the only example of solar architecture in the *International Encyclopaedia of Science and Invention*. It was designed for a new village context in which each house would be surrounded by gardens and orchards. The idea was to obtain greenfield sites where new villages could be built to provide access to the countryside for those who wanted to get away from the cities. Many of us interested in these ideas were blissfully ignorant of the power of planning laws preventing precisely this type of scattered, low density settlement in Britain's precious countryside. What are now being called 'low impact settlements' were meant to counter the seemingly excessive level of urbanisation in Britain. We felt that it was all part of helping people gain new livelihoods in an era of growing unemployment and anxiety about the future.

Several new village projects came close to being realised in Britain in the late 70s and early 80s, though, to be compatible with planning regulations, they were to be built on disused airfields, or in the vicinity of new towns, rather than on rural greenfield sites. At Milton Keynes a project called Green Town was supported by both the Town and Country Planning Association (TCPA) as well as by leading officials of the Milton Keynes Development Corporation. This was to be a village built by its future inhabitants – Open University lecturers, teachers, potters, computer programmers, architects – all of whom were interested in growing vegetables and fruit trees as well. There were many meetings and discussions by its potential inhabitants on what kinds of houses they wanted to build and what sort of layout they preferred – a large garden of their own, or shared sites for wildlife parks and allotments. But it all came to nothing: the corporation was being dissolved and the government insisted that land had to be paid for at market values, making it impossible to afford for an experimental eco-village project.

However, another new village project did get built in the mid-80s, called Lightmoor Village at Telford. Again the partners were the TCPA, and the Telford Development Corporation, together with the prospective inhabitants of the village. Being located on the edge of Telford, planning permission was not an issue. The unique thing about Lightmoor was that the future inhabitants designed the layout of the site, built their own homes, shared decision making and were able to create a village to meet their own special needs. It became a unique experiment in self-determined development. Today Lightmoor is a thriving community, with 30 families living on 25 acres of ground with plenty of communal space. Each house has its own garden, and most families grow a large proportion of their own vegetable needs. The concept was summed up as having a computer in the kitchen and a pig in the back garden. Many people work from home, with the village community as their main support network.

Britain was not the only country where eco-village projects were being dreamed about and, in some instance, turned into reality. Across Europe, the USA and Australia hundreds of new villages have been built or old ones redeveloped. The eco-villages movement has its own Internet service, regular conferences and newsletters. It was very actively represented at 'Habitat II' in Istanbul.

In my own work I came to realise increasingly that green islands may be wonderful for the individual or the community involved, but would not make much of a contribution to reduce global housing problems or urban environmental impact. Worldwide we are seeing a dramatic trend of ever larger numbers of people moving to large cities, with progressive rural depopulation strongly apparent in many countries, as agriculture becomes more and more mechanised. The Habitat I conference in Vancouver in 1976 was specifically concerned with trying to stop the trend towards urbanisation, but, so far without success. Today the issue is increasingly how we can try and make sure of achieving an environmentally and socially sustainable form of urbanisation whilst also helping rural communities to stay intact and supporting the option of new eco-villages as well.

In my own work I have come to explore how existing cities, where most people now live, can be made environmentally and socially sustainable.

The statistics are certainly staggering. In 1990 the world's 100 largest cities accommodated 540 million people and 220 million people lived in the 20 largest cities, mega-cities of over ten million people, each extending to hundreds of thousands of hectares. In addition, there were 35 cities of over five million and hundreds of over one million people. In the 19th and early 20th centuries, urban growth was occurring mainly in the northern hemisphere, as a result of the spread of industrialisation and the associated rapid increase in the use of fossil fuels. Today, the world's largest and fastest growing cities are emerging in the southern hemisphere, because of urban-industrial development, and rural economic and environmental decline.

Cities and their global impact

City growth is changing the face of the earth and the condition of humanity. Can the planet accommodate an urbanised humanity drawing its resources from an increasingly global hinterland? And can humanity learn to cope with urban growth and density whilst maintaining a stable relationship with the biosphere?

In one century urban populations have increased tenfold to some 2.5 billion people. Cities today are centre-stage in the global environmental drama of pollution, land degradation and loss of species diversity. Concentration of intense economic processes and high levels of consumption in cities both increase their resource demands. Beyond their boundaries, cities also profoundly affect traditional rural economies and their cultural adaptation to biological diversity. As better roads are built, and access to urban products is assured, rural people acquire urban standards of living and the mind-set to go with this. I have no doubt that the world's major environmental problems will only be solved through new cultural approaches to the way we conceptualise cities.

Recently the Canadian economist William Rees started a debate about the ecological footprint of cities, which he defines as the land required to supply them with food and timber products, and to absorb their carbon dioxide output via areas of growing vegetation. I have examined the footprint of the city

where I live, London, which also happens to be the 'mother of mega-cities'. Today London's total footprint, following Rees's definition, extends to around 125 times its surface area of 159,000 hectares, or nearly 20 million hectares. With 12% of Britain's population, London requires the equivalent of Britain's entire productive land. This land, of course, stretches to far-flung places such as the wheat prairies of Kansas, the soya bean plantations of Mato Grosso, the manioc fields and teak forests of Thailand, and the copper mines of Zambia.

The critical question today, as humanity moves to full urbanisation, is whether living standards in our cities can be maintained whilst curbing their environmental impacts. To answer this question it helps to draw up balance sheets quantifying and comparing urban resource flows. It is becoming apparent that similar sized cities supply their needs with a greatly varying throughput of resources. Most large cities have been studied in considerable detail and in many cases it won't be very difficult to compare their use of resources. Use depends on the way cities function, as well as their living standards. The metabolism of most modern cities is essentially linear, with resources flowing through the urban system without much concern about their origin, and about the destination of wastes.

In conventionally run cities, metabolic processes are usually linear – inputs and outputs are considered as largely unrelated. Trees are felled for timber or pulp, and forests are not replenished. Raw materials are extracted, combined and processed into consumer goods that end up as rubbish which can't be beneficially reabsorbed into the environment. Fossil fuels are extracted from rock strata, refined and burned, their fumes discharged into the atmosphere. Nutrients are taken from the land as food is grown, and not returned. All too often urban sewage systems are linear, collecting human waste and discharging it into rivers and coastal waters down stream from population centres. Today coastal waters are enriched with human sewage and toxic effluents as well as the run off from mineral fertiliser applied to farmland feeding cities all over the world.

The linear metabolic system of most cities is profoundly different from nature's circular metabolism where every output by an organism is also an input which renews and sustains the living environment. Cities which develop a self-regulating, sustainable relationship with Gaia will adopt circular metabolic systems concerned with the continuing viability of the environments on which they depend. Outputs are also inputs into the production system, with routine recycling of paper, metals, plastic and glass, and the conversion of organic materials into compost, returning plant nutrients to keep farmland productive.

Some cities in history adopted sustainable relationships with their hinterland as the only assured way in which to assure their continuity. This applies to medieval cities with their concentric rings of market gardens, forests, orchards, farm and grazing land. Chinese cities have long practised the return of night soil onto local farmland as a way of assuring sustained yields of foodstuffs. Today most Chinese cities administer their own, adjacent areas of farmland and, until the recent rapid urban-industrial growth, were largely self-sufficient in food.

Some cities have made circularity and resource efficiency a top priority, installing sophisticated equipment for resource recovery. Cities right across Europe are installing waste recycling and composting systems. Austrian, Swiss and French cities have taken the lead. In German towns and cities, at this point in time, 27 composting plants are under construction with a combined annual capacity of 600,000 tonnes. Throughout the developing world, cities have made it their business to encourage recycling and composting of wastes. Brazil's Curitiba is often cited for its energetic efforts towards urban sustainability, not only in waste management but also in creating a system of fast, convenient bus routes, persuading drivers to leave their cars at home.

Urban energy use

Demand for energy defines modern cities more than any other single factor. All their key activities – transport, electricity supply, heating, services provision and manufacturing – depend on the routine use of fossil fuels. London, using 20 million tonnes of oil equivalent per year, discharges some 60 million tonnes of carbon dioxide. Its per capita energy consumption is amongst the highest in Europe, yet the know-how exists to bring down these figure by 30-50% without affecting living standards, whilst creating up to tens of thousands of jobs in the process over 20 years.

To make them more sustainable, and to reduce their footprint and their impact on the biosphere, cities today require a whole range of new resource efficient technologies. These include combined heat and power systems, heat pumps, fuel cells and photovoltaic modules. Enormous reductions in fossil fuel use can eventually be achieved by the use of photovoltaics. London could supply most of its current summer electricity consumption from installing photovoltaic modules on the roofs and walls of its buildings. Today the costs are still too high, but large scale production of photovoltaic modules would massively reduce unit costs.

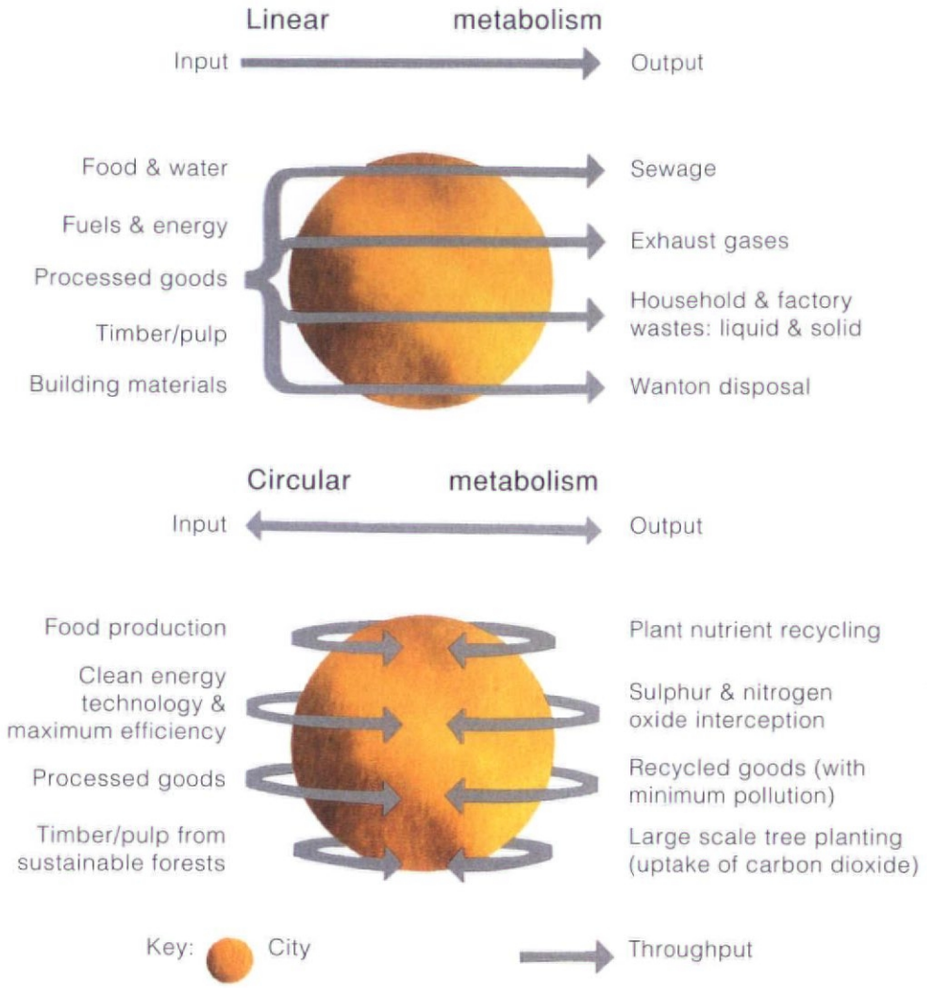
It is here that architectural design has huge new opportunities. All over Europe buildings kitted out with photovoltaic modules, typically produce some 40% of their annual electricity requirements from their rooftops, even in northern countries such as Germany and Holland. In Britain, so far, we only have just a few examples. Even buildings with minimal use of air-conditioning and in-house combined heat and power systems are still thin on the ground. British architects are designing buildings with novel energy systems for European clients, but in Britain itself we see, as yet, very little of this kind of development.

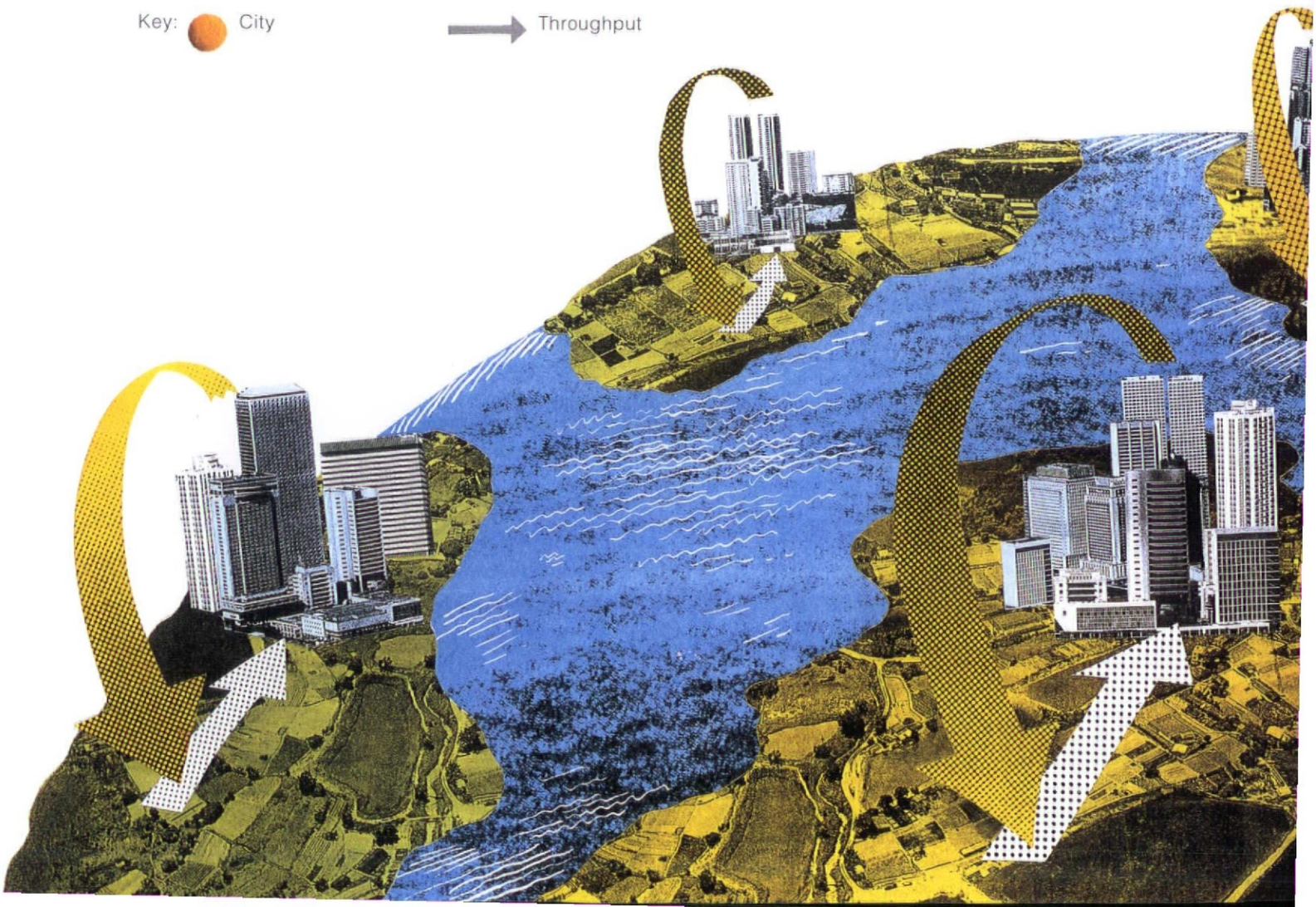
Architects and planners have a great responsibility to help create receptiveness for the emergence of a new kind of architecture that combines climatic responsiveness with functional efficiency and a pleasing appearance. This is an ethical responsibility that transcends the traditional brief of the profession. With cities as our main home today, we have to redefine their cultural and environmental function.

The cities worthy of a new millennium will be energy and resource efficient, as well as culturally rich and socially responsible. In mega-cities in the northern hemisphere, such as London and New York, prudent inward investment in resource efficiency will contribute significantly to achieving higher levels of employment. In cities in the southern hemisphere, significant investment in infrastructure will make a vast difference to health and living conditions. Cities, particularly those in the northern hemisphere, have yet to prove that they can be a home for humanity that is compatible with a healthy biosphere. This is an unaccustomed challenge for business people, planners, architects, politicians, and citizens.

From mobilisation to civilisation

Some writers have argued that cities can actually be better for the global environment than adjacent rural areas. They emphasise the impressive range of plant and animal species often


Linear metabolism
Input
Output
Food & water
Fuels & energy
Processed goods
Timber/pulp
Building materials
Sewage
Exhaust gases
Household & factory wastes: liquid & solid
Wanton disposal
Circular metabolism
Input
Output
Food production
Clean energy technology & maximum efficiency
Processed goods
Timber/pulp from sustainable forests
Plant nutrient recycling
Sulphur & nitrogen oxide interception
Recycled goods (with minimum pollution)
Large scale tree planting (uptake of carbon dioxide)
Key:
City
Throughput



present in cities; in back gardens, on railway embankments and on vacant sites. They also suggest that their very density makes for energy efficiency in home heating as well as in transport. Systems for waste recycling are more easily organised in densely inhabited areas. And urban agriculture, too, if supported, could make a significant contribution to feeding cities, as it already does in many parts of the world.

The great problem with cities today is that, as never before, they have become centres of mobilisation rather than civilisation. They are nodes of an increasingly global economic activity, with urban companies controlling a vast global trade network: today one eighth of world oil consumption is used simply to shunt goods across the planet, from urban centre to urban centre; surface and air transport networks begin and end in cities, with the volume of travel having reached unprecedented levels in recent years; global financial transactions emanate from cities, with banks and finance house investing globally for maximum return; urban based media mobilise the human mind, which has become restlessly preoccupied with the pursuit of personal gain.

The city of the future, to be sustainable, will have to move towards a new concept of civilisation, with greater dependence on local production for local consumption, with much greater concern for the liveability of local environments, and with a greater emphasis on creating public spaces for people to enjoy, with streets as living spaces as well as transport routes. The task for urban governments, planners and architects, responding to primary human needs, is to create cities where we want to spend much of our time and from which we don't want to get away at the first opportunity.

The tools for making cities into centres of civilisation rather than mobilisation are not just in the hands of architects and planners; they are held by all the stake-holders in a modern urban society.

Eco-technology

The construction and refurbishment of cities for environmental sustainability is one of the great tasks ahead of us, whether we are concerned with transport or sewage systems, or the provision of adequate housing. World-wide, hundreds of millions of people are continuing to be housed in little more than a human storage sheds. Housing means much more than just a roof over one's head; it also means privacy, adequate space, security, structural stability and durability, with proper lighting and ventilation, as well as an adequate infrastructure, sanitation and waste management. This is a crucial area for the ingenuity of architects to come to fruition, in close consultation with those in need of housing.

Designing buildings with human needs foremost in our minds will change the briefs of architects and designers.

Another case in point is the use of urban technology. Urban growth in the last two centuries went hand in hand with pioneering technologies, such as fossil fuel-based transport, electricity and gas supply, piped water supply, and sewage and solid waste disposal systems. Many of these technologies have hardly changed over the last few decades, yet are out of date in an age demanding sustainable urban development. Energy supply systems and transport systems are often highly inefficient, discharging inordinate amounts of waste gases. Our sewage systems, typically, dispose of valuable plant nutrients that ought to return to farmland where crops for urban consumption are grown. And too much solid waste is just dumped and not recycled into useful products.

Today we have a great opportunity to use a whole new range of environmentally friendly technologies in our cities. Efficient energy systems, such as combined heat and power generators, fuel cells and photovoltaic modules, are now readily available. New materials and concepts of architectural design allow us to greatly improve the energy performance and to reduce the environmental impact of materials used in buildings. Recycling technologies for small and large, rich and poor cities, can facilitate greater efficiency in the urban use of resources. Transport technologies, too, are due for a major overhaul. Fuel efficient low emission vehicles are at a very advanced stage of development. Rapid urban transit systems are starting to reappear in cities that had come to depend almost exclusively on private transport.

In addition, international treaties such as *Agenda 21* and the *Habitat Agenda* are becoming key points of reference for urban decision making the world over. Thousands of cities now have local Agendas 21 programmes, with the potential to reduce the overall environmental impact of cities whilst offering new business and job opportunities.

Life in the cities of the 21st century will be greatly influenced by decisions made at the end of this century, in the same way in which we are still crucially affected by decisions made in the 19th century. It is vital, therefore, to get things right. In a world of cities, the decisions they take on how to use energy, how to supply themselves with resources and how to deal with their wastes are crucial for humanity, and, indeed, for the biosphere on which it depends.

Herbert Girardet is a writer and film maker working mainly in the field of cultural ecology. At the 1992 Rio Earth Summit he received a UN Global 500 Award for Outstanding Environmental Achievements. His documentary on London's metabolism, Metropolis, *was shown on Channel 4 in June 1994. In 1995 he wrote a report for* London First *on how London could improve its resource efficiency. His most recent book,* The Gaia Atlas of Cities *(Gaia Books, London, 1993) was adopted for the UN Cities Summit, also known as 'Habitat II', held in Istanbul in 1996.*

By establishing set criteria for urban sustainability, cities could compete for 'best' environmental performance. The most resource-efficient cities could achieve the best economic performance

JORGE WILHEIM

DESIRING GLOBAL CHANGE

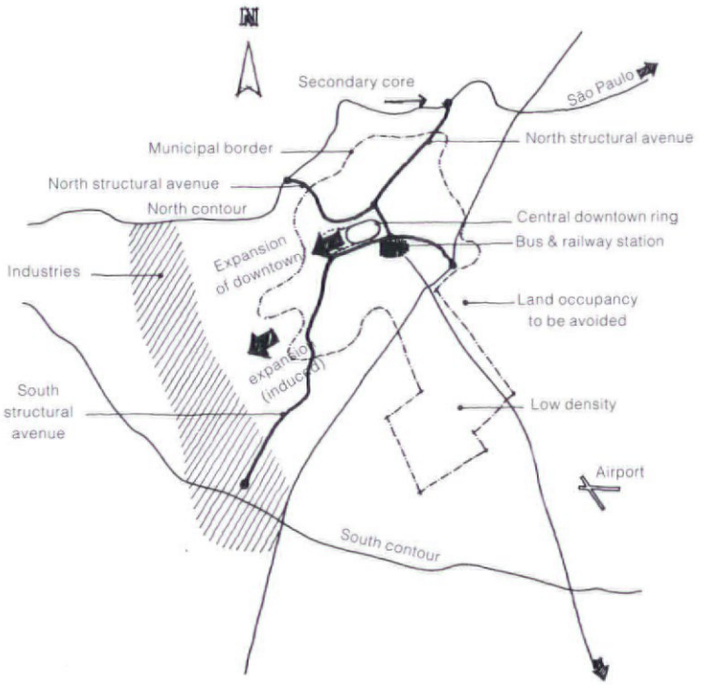
From an Interview by Jane Richards

Jorge Wilheim believes that for a project to be deemed worthwhile – that is eco-friendly – it should always consider its physical setting in relation to its site, and in an intelligent way. This belief stems from his many vastly important political roles in Brazil over the years, and from his role at the United Nations (UN). It is also a consequence of his work as an architect, and in particular from one of his most important initial positions: that of Chief Planner for the southern Brazilian city of Curitiba. This city has undergone many important ecological projects implemented by the Municipality and the Environmental Secretary, but it was Wilheim's innovative eco-friendly designs which initiated this chain of events. Indeed, it was to make Wilheim and his designs famous for developing the concept of a 'city worth living in'.

Wilheim believes that his professional voice was at its most effective in the debate for sustainable urban dwelling when he was Deputy Director of 'Habitat II'. He even resigned from his position as Director for Metropolitan Planning in Brazil to follow this route, and yet when he is asked about Curitiba he will admit that this scheme was the inspiration for his future role within the ecological world-wide debate.

The Curitiba urban development began as a competition initiated by the Municipality of the city in 1963. Wilheim was awarded the chance to redesign the urban plan because his approach differed so obviously from the other competitors. His main consideration was to approach the planning through a system of developing priorities. Through his basic plan, Wilheim was responsible for the pedestrianisation of the town centre and for the intellectual efforts to preserve the lowlands from any future housing developments. This in turn encouraged the city's growth in a more desirable southwesterly direction.

> In the 1964-65 basic plan of Curitiba I tried to socially identify who acted upon its urban development and how these forces could be geared in favour of a certain urbanistic approach. I also tried to physically identify how to structure the expected growth, from the existing population of 350,000 to the expected one million in a decade, whilst avoiding the occupation of the vast lowlands to the southeast [the valley of the Iguassu river]. These lowlands were cheap to commercialise, but difficult to drain and impossible to maintain free from occasional floods.
>
> Two main sets of existing roads were identified to be transformed into structural axes, [after some minor links and gradual widening] capable of carrying the basic future traffic. They were also tangent to a downtown ring that could be gradually expanded to the west, in order to facilitate and induce the urban growth towards the south-west. This induced urban growth would alleviate the problems of an excessive occupation of the lowlands of the Iguassu River, leaving them free to be transformed into a huge regional park.



FROM ABOVE: Basic plan of Curitiba, proposed by Wilheim 1964-65; perspective of the pedestrianisation of Augusta Street in São Paulo, proposed by Wilheim 1975

Today these existing structural avenues have a central free access lane reserved for mass traffic [electric buses], and along their axis a high density building zone was encouraged. The structural avenues end at secondary centres which are presently poles of new development.

I also proposed to pedestrianise the main downtown street as well as a whole network of connected public spaces of historical significance, traditionally used by the population. The pedestrianisation was implemented some years later, following the basic plan.

A methodological aspect of the plan should also be underlined for its importance in the successful implementation of the basic plan. As consultants, we had set up since the beginning of the project a local group which was transformed in 1965 into the core of the newly established Institute of Urban Research and Planning responsible for detailing the basic plan. Architect Jamie Lerner, presently State Governor, was a member of that group, firstly as the head of the institute and then three times Curitiba's mayor.

Wilheim's clear objective was to create a 'human city'. Jamie Lerner, in his role as mayor, then developed this approach through his clear support in the allocation of funds for parkland, tree planting and the pedestrianisation of the roads. The aim was to generate the citizen's pride in their city which would subsequently encourage its better upkeep. Indeed today Curitiba is cited as an important example of a sustainable urban design for the rapid increase in the development of our cities.

Wilheim controlled the urban sprawl of the city through the development of a system of priorities and in particular his main concerns were for the pedestrian, the quality of life in the central dwellings and the new public transport system. He also maintained this system of priorities in his design projects for sections of São Paulo, Brazil.

Sometimes a busy commercial street, like Augusta Street in São Paulo, seems to be carrying a high quantity of traffic, but in reality it is just a congested slow-traffic street and unimportant from the transportation view. Its pedestrianisation therefore, would not affect transportation but would widely enhance the quality of life of its users.

The pedestrianisation project of Augusta Street in 1973 had still to be implemented, although it was still possible and desirable. However, in São Paulo [unlike Curitiba] there is the need to have a political will to achieve these changes.

In the proposed design I established meeting points, as well as taking advantage of the slope to create several terraces . . . suitable for the young users of this zone.

Wilheim's projects, both in Curitiba and São Paulo, were staggered over a number of years as the implementation of change always had to be approved by the political will at the time. The pedestrianisation of these cities continued to develop with an

FROM ABOVE: Barigui Park, one of the 12 major parks around Curitiba; Green Exchange Programme in Curitiba, which helps unprivileged families by swapping recyclable garbage for food

important project called 'One tree, Four Alleys', which allowed for no through traffic.

> Proposed to the Municipality of São Paulo in 1975, it is actually applicable to any street grid. The main purpose is to give physical identity to a group of house dwellers, and to create for them a better and safer common space. In other words, to transform their common space into a sense of their place.
>
> The graphic sketch is clear: the aim was to interrupt through traffic in each second street, planting a tree at its crossing – or more than one, creating a small square etc – by which four cul-de-sacs are created at almost no cost. The drastic decrease in traffic allows children to play and socialise on the sidewalks and street. The square would then be designed following a programme established by the surrounding dwellers: either a garden, or a football and volleyball space, or shadowed benches for grandparents to tell stories to their grandchildren. Some of these streets were implemented at the initiative of the Municipality, or by pressure from the dwellers. As always, there has to be a political will. 'Public interest is not the same thing as the interest of everybody' [JJ Rousseau].

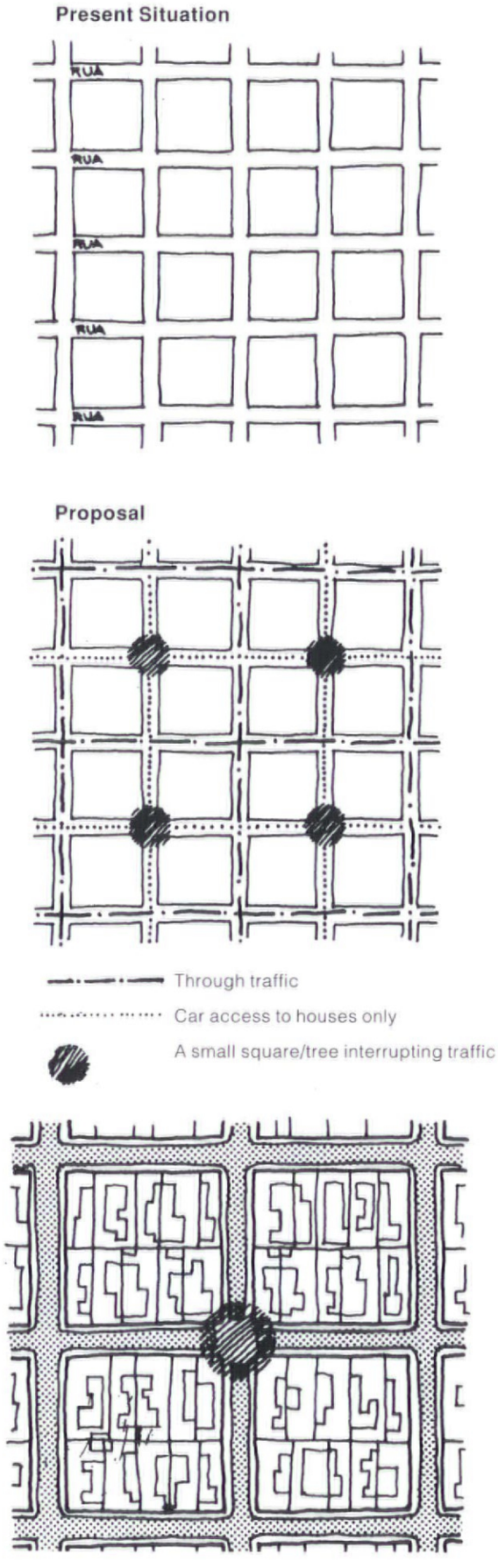
Wilheim went onto become Chief Planner of São Paulo and State Secretary of the Environment for Brazil. In 1994 he was appointed Secretary General of the United Nations Centre for Human Settlements, which had been created after the initial 'Habitat' conference in 1976. Wilheim's task in joining this branch of the UN was to organise 'Habitat II' the second conference to be held in Istanbul, June 1996.[1]

The goal of 'Habitat II' was to involve all the member state's governments in a re-evaluation of urban policies and the use of their resources. The belief was, that to attain a sustainable living environment a key factor must be the involvement of the citizens. This is particularly relevant considering that by the year 2000, there will be 21 mega-cities in the world, each containing at least ten million people. The UN recognised that there exists scant understanding of these new forms of human settlement, and even less political recognition of their decisive role in environmental, social, economic and cultural affairs. 'Habitat II', with the aid of Wilheim's organisation, aimed to strengthen the resolve not only between nations, but also between central and local governments, and other non-government organisations (ie, professional bodies such as the architectural profession).

This would seem to be a step removed from his work as an architect, but Wilheim would disagree:

> Working for the UN has been very gratifying and I am now fully aware that this organisation means development as well as peacekeeping . . . The political side of my professional life has always been important. Firstly, because we are all 'political animals' [Aristotle]. Secondly, because I was always socially concerned and politically active. Thirdly because from time to time I was called and appointed to governmental posts that give the opportunity for very relevant ecologically aware actions, which cannot be dismissed if you are really concerned to make the world better! The Istanbul experience didn't change my point of view, but it vastly widened my experience and my knowledge.

Wilheim left Nairobi in October to resume his private practice of urbanism and consultant work, although he will continue his link with the UN whilst he is based in São Paulo. As for his views on the effects of 'Habitat II' he strongly believes that: 'The confer-



Pedestrianisation, 'One tree, Four Alleys', Wilheim, 1975

ence is spearheading a definite change in the UN; opening the system outwards beyond the direct involvement of the member state governments.' As Boutros Boutros Ghali said at the opening of the conference, this new direction signals a new beginning in the way the UN operates and their approach to the growth of world cities: 'There is no way back'. Knowledge, expertise and political will must be jointly engaged with a new less hierarchical approach to the urban problems if anything is to be achieved.

Understandably, Wilheim is quite proud to have imagined, proposed and acted towards this aim: 'I could not have dreamt that it would be so effective.' He also sincerely encourages non-government organisations (NGOs – including professionals and the private sector) to become involved in any further UN action. On a more personal level Wilheim becomes quite philosophical about the effect of the conference. He believes that mankind is in the midst of a difficult transitional period in which we will experience more secularisation and violence in our cities than ever before. He also believes that this isolation is in danger of making us all prisoners of our own fears, as 'Cities are the stages upon which mankind acts out its humanity.' Yet the conference was vital in providing 'a unified global moment to pause for reflection upon the role of our cities in society today and in the future.'

It has become a common reflex never to discuss development without placing the word sustainable before it. Yet this has already become a reflex without meaning. Wilheim urges architects to address their professional role and responsibilities very carefully. Architects must engage themselves in the endeavour to make cities better, not stressing the exclusivity of space but making them convivial, public spaces. In other words the architect must; 'transform space into place'.

Basically, the problems facing the city today are threefold. Firstly, resource problems, of which Wilheim is most concerned with the diminishing water supply of the world. Secondly, the energy problems which are being explored and taken on board by some architects, but not wholeheartedly. And finally, the problems of the environment, especially the lack of intelligent buildings and a failure to comprehend the rapid urbanisation of the world's developing cities.

For the architect facing environmental problems there are two options. The first is to reassess their approach to architectural design, such as introducing intelligent building schemes which ultimately cost less for the client in the long run. As more examples of these are set, the results can be quite significant. Wilheim also urges the architect to place fashion as a secondary concern. They must not respond to the dictates of fashion, producing environmentally awkward designs such as the demand for high density glass office blocks, without the necessary acknowledgements of the effect of the weather; the need for shade, the need for air-conditioning which has a very detrimental effect on the environment, and the lack of solar and photovoltaic panels. If designs continue to adhere to aesthetic dictates then positive ecological implementations must be encouraged.

There is however a second more global option for architects and one which Wilheim more readily admits would make a more real impact upon the problems. He believes that architects must use their professional voice and responsibility to affect urban policies, land use and the choice of construction materials. The debate for architects must take on a wider base than the current trend either towards techno-centrics – hi-tech, intelligent buildings – or the eco-centrics – a return to earth materials and traditional ways of construction.

> My personal opinion on the present role of the environmental cause involves the challenges society has to face in the present and near future, during this transitional period of history, which go beyond ecological preservation or environmental concerns. This is not to diminish their importance, but the challenge will be a mainly socioeconomic issue involving the mass changes in employment as a result of (a) the change of production structure and technology (b) the ambivalence of the globalisation of the economy. Thus it would be partial, and not too correct, to limit any analysis or prognosis of the urban future just on environmental grounds. It would be seen as a gross mystification or as an unreal approach.

Wilheim believes that the social responsibility of the architect must be emphasised and interestingly he cites Richard Rogers as an architect whom he admires and who he invited to the world summit to chair a debate on the appearance of the city of the future. Wilheim also acknowledges that whilst cities may be viewed as the epicentres of unease and conflict it would be wrong to assume that he only sees a bleak future ahead.

Wilheim argues that we are all working towards a new and more positive period. He would even go so far as to call this a 'New Renaissance', which will be human centred and holistic, rather than specialised and segregated. Indeed this New Renaissance figure would have realised and integrated all new technologies into our everyday environment – perhaps this person would even be the architect of the future?

In Wilheim's book, *Fax: Messages from a Near Future*, he places all these ideas within a fictional framework.[2] The 'New Renaissance' is pinpointed to the year 2018, which equals the year of hope. Wilheim is able to communicate, via fax, with a man in a similar position to his own living in this future period. They discuss the many varied attempts over the years at ecological sustainability, noting that finally in 2018 the triumphs seemed to be outweighing the failures. Whilst this story is fictional, it is clearly an indication of the impetus behind Wilheim's unwavering commitment to the ecological sustainability to the future of our cities.

Notes

1 Interestingly the word ecology derives from the Greek words *oikos* which means house or habitat and *lagos* which translates as doctrine. Therefore Habitat was a very suitable title for the UN's conference on human settlements in more ways than one.

2 J Wilheim, *Fax: Messages from a Near Future*, Earthscan Publications Ltd, (London) June 1996.

JOHN FARMER

TOWARDS A GREEN AUDIT

Just as the architects of the twenties never found the entirely simple and inexpensive 'house per se*', so, the form of the 'natural' house has still to be found today; not surprisingly, since only a few architects are searching for it anyway.*[1]

This essay is concerned with the idea of a green audit. There is no conclusive definition of what 'green' means, but on the whole ecological architecture either explicitly or subliminally references itself in relation to nature. Our relationship to the natural world has been brought into sharp focus in the last 30 years by both the anticipation and experience of environmental damage and disaster. At the macro level of global and governmental assessment, environmentalism and sustainable development have come into common usage. At the micro level of individuals adopting 'green' attitudes and lifestyles we can see a continuity of the movements from the 19th century through to the 1960s and into the current breadth of action from green consumerism to radical alternative communities.

The weight of depressive speculation is towards the impossibility of a better future, or of any future at all. Whether the threat is from war, economic collapse or ecological disaster, all readily corroborated if the documentary material is studied, architecture, the social art, which builds for us to live now, has to shake itself free. There are good signs.

Making an environmentally sound building by choosing suitable materials and ways of putting them together involves more than having ideas about which resources are scarce or unrenewable. An holistic attitude towards the balances within nature is needed. The practical problems are great, from defining what in nature is inviolate, to sorting through the increasing mass of environmental data. This in turn is framed by political and social issues, that architects and their buildings can effect marginally at best.

There appears to be a real re-ordering of thought as we approach the Millennium, with science itself leading the way. The Cartesian logic which led to the development of ever more specific and defined specialist disciplines is being challenged by the new physics which views the universe as a fluid and dynamic amalgamation of inter-relationships. Biologists such as Rupert Sheldrake are returning to the 'whole' after finding that the traditional scientific methodology of examining the 'part' not only failed to substantiate orthodox theories but refused to acknowledge many of the phenomena so obvious to the naturalist. There are those who are clinging to mechanistic analogies such as Richard Dawkins in *The Selfish Gene*, but these scientists are beginning to appear reactionary in a time of scientific revolution, rigid in a time of flexibility and fluidity. Physics is again paralleling philosophy.

Architecture sits between the macro and the micro but is influenced by both. As a cultural activity it cannot stand apart from the concerns and aspirations of the societies that produce it. The purpose of the Green Audit research project is to map where, when and hopefully how the mass of social, technical, economic and formal activities being carried out under the 'green' banner are influencing architectural design and built form. The audit has a policy of inclusion rather than exclusion and will also track projects and ideas which although not claiming an environmental agenda might be evaluated as being relevant to the focus of design and nature.

From the initial investigations certain strands are emerging. The strongest is undoubtedly still the technical response. In his Reith Lectures of 1995, Richard Rogers exemplified the view that current and future advanced technologies could redress the problems created by the cruder processes and products of industrialisation. This view is dominant at the global and governmental scale and exemplified in much that came out of the Earth Summit at Rio in 1992. In architectural terms this is the greening of hi-tech. The legacy of Buckminster Fuller, the metabolists and Archigram is clearly alive in projects such as Rogers' unsuccessful proposals for twin 150 metre towers in Vienna in 1994. The emphasis is on meeting 'the needs of the present without compromising the ability of future generations to meet their own needs'. *The Brundtland Report* is the basis of this position.

The notion of sustainable development is an alluring one, especially to growth-imperative economists who also tend to refer to sustainable growth. At the micro scale it is the world of the ethical consumer, taking the best of current technology and attempting to select future developments through either the action of the 'free market' or governmental intervention of the carrot and stick variety. At the level of the individual house, that by Bambek and Bambek, built in the base of a disused stone quarry outside Stuttgart, is an interesting example. Set over a newly formed lake, a biotope[2] which has been filled with fish and frogs, a slender platform is suspended over the water to form an external eating space. Clad in highly reflective profiled metal cladding on a steel frame, the angular building shimmers amidst the ever growing vegetation.

In terms of green building, most projects published in the architectural press are of a more prosaic type. The house by Brenda and Robert Vale in Nottingham freely utilises current technologies such as photovoltaic cells on the pergola and highly processed krypton filled double glazing. The emphasis is on energy efficiency and the reduction of overall energy consumption. The designers described their building as:

> A building that tries to minimise environmental impact without waiting for any further developments of technology and without asking society to bend its existing rules with regard to building standards.

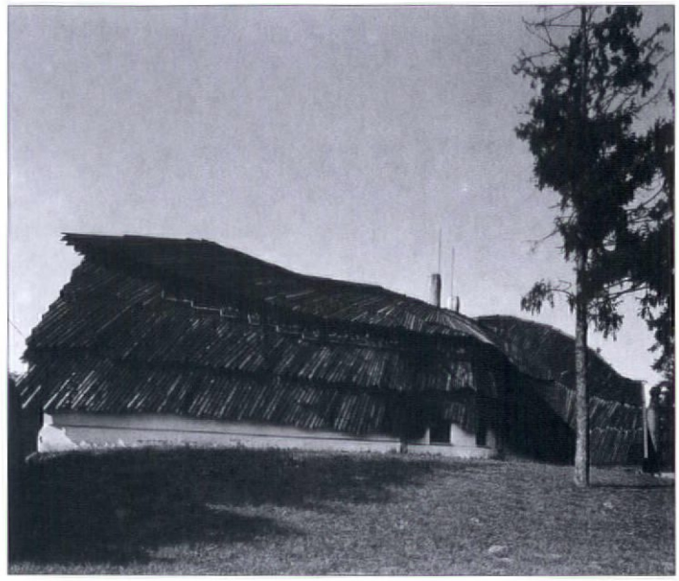
The form of the Vale house can at best be described as neutral. Whilst the materials, super-insulated brick and block cavity walling, clay pantiles and a timber-framed conservatory, have been selected on quantitative assessments of embodied energy value and sustainable sources, the final building form is mute.

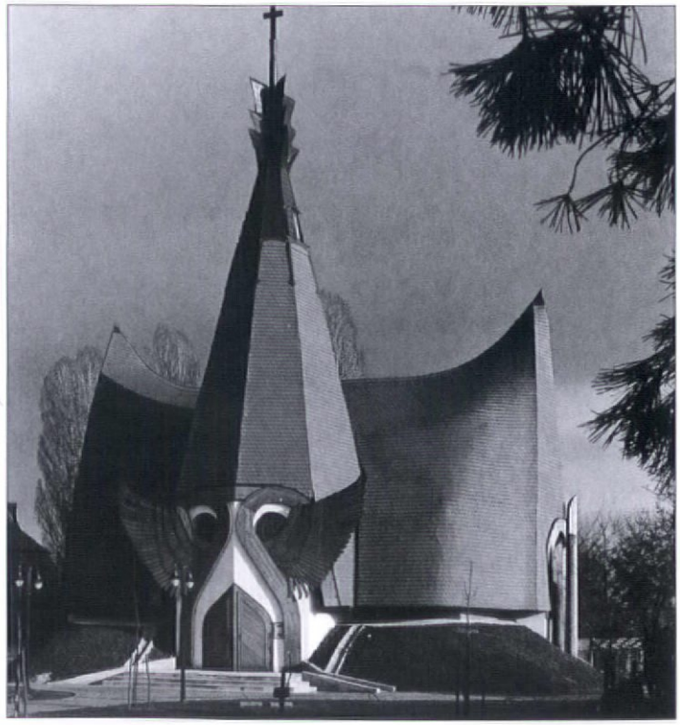
The most radical gestures are to invert the living and sleeping accommodation and use a composting lavatory for human waste. Its justification in journals has been on a numerical assessment of its physical performance rather than on any expressive statement of organic empathy. The lean-to conservatory is perhaps the most telling element of the house. The living spaces are only connected to the conservatory by relatively small triple glazed, openable windows and two separate doors from the ground floor bedroom and hallway. Whilst there is an indication that the conservatory might be used as an additional living area, or as a winter garden, the house fails to use the possibilities of a conservatory as envisaged in the much earlier Autarkic House of the 1970s. The contribution of the Vale house is still considerable in technical terms, as it has been designed and built in accordance with current building norms and procurement procedures, even though it seeks to limit itself to certain technical issues and works within the parameters of existing legislation and lifestyles.

Other houses which have extended the agenda include the self-build houses, such as that built by John Broome, for his own use, in south London. Broome had worked for some time with the Walter Segal self-build housing venture which had enabled many who would otherwise have been excluded from our home-owning society to build their own homes, utilising a timber system developed to allow unskilled labour to build with a minimum of industrial plant. He has continued his work with Architype, an architectural practice which has expanded the self-build possibilities of the Segal designs to achieve high levels of thermal performance and use of sustainable materials. One of the interesting issues is that this type of building connects back to the ideals of the Arts and Crafts movement without copying the forms. The reintegration of the designer and builder is part of the social development of green building and parallels other integrative elements of the new sciences. Broome uses similar parameters to those of the Vales in choosing the materials for the house. Low embodied energy and sustainable sources are important but are also interpreted through the imperative of their being relatively easy and safe to work by hand. As design is integrated into construction, opportunities have been seized throughout the building phase.

It was intended that Broome and his partner, as the occupants, would complete their home around them, analogous to the making and maintaining of a nest or burrow. We replicate this process through DIY or the decorating and furnishing of our homes. Yet despite being seriously addressed by the Arts and Crafts and then later in the 1960s and early 1970s, this process rarely figures in contemporary architectural design and theory which remains defined as a professional activity.

In form, the house addresses itself to more than function and performance. Broome states that he wishes the house to make connections between what he does and what he stands for. This philosophical connection is evident in the building in both plan





FROM ABOVE: Imre Makovecz, Bak Community Centre, Bak, Hungary, 1985-88; Imre Makovecz, Siófok Lutheran Church, Siófok, Hungary, 1986-90

and detail. The overall footprint of the house is defined by the presence of existing trees on the site. A regular grid of columns is set out across the site and the ground floor accommodation angles and splays between and around the grid to maximise view, capture sun or enclose and protect external space. The columns themselves are of Douglas fir with the minimum of working. The bark is stripped from the trunks but these vertical posts are still clearly trees similar in diameter to the trunks of the surrounding trees. These main posts pierce the first floor to carry the roof, giving the interior spaces, with floors and fitted furniture of timber boarding, the qualities of a tree house. The flooring of the ground floor is oak from the vats in a redundant vinegar factory, and the staircase makes visual reference to the ladder and trestle of the orchard. Small windows open into internal spaces as well as to the outside. The technical term for the wall construction is a 'breathing wall', a term that is especially appropriate for this house. The roof is covered with soil and planted with grass and wild flowers providing both poetic and practical shelter, the roof eaves extending to shade and protect as required. The Broome house is a humane and gentle proposition for the future dwelling, but it follows within the traditions of the villa and suburb rather than the density of urban existence. Its simple forms are reminiscent of the *favela* and squatter settlement, and its reliance upon manual labour over industrial production, combined with the use of local and second-hand material, points to the possibilities for habitation in a time of enforced leisure, the current euphemism for unemployment.

There is little in the area of high density and large scale housing which could be considered green, other than refurbishment projects from the Netherlands, France and Spain or the projects which retain an orthodoxy in planning terms and upgrade the external envelope to limit the energy requirements for environmental control. However projects such as the Engineering Building at De Montfort University by Short, Ford and Associates is an example of a large and complex building which has not only developed environmental control to minimise energy usage and maximise passive environmental control, but which has eschewed the overt use of technology as imagery for the building. It has been described as being clothed 'in historicist apparel', making reference to Ruskin and Viollet-le-Duc in its choice and use of materials.[3] The vibrant red brick and tile hung facades, with their Gothic windows, are read against the forest of brick chimneys which form the flues for the passive ventilation system. Each of these is topped by a large louvred aluminium hood reminiscent of the helmeted chimneys of Gaudi's Casa Milà or the stacks atop Le Corbusier's Unité apartments.

For those architects who have maintained a spiritual focus in their designs, such as Christopher Day, the interest in ecologically sound design has brought their work to a wider public. The Rudolf Steiner design methods are producing consistently interesting buildings across Europe, America and Australasia. In Places of the Soul (1990), Day makes an impassioned plea for the recognition that architecture matters too much to be left to the stylistic preoccupations of architects: 'In terms of spiritual nourishment deeper than the glossy cosmetic, much of our daily surroundings approach bankruptcy.' Whilst not operating under an exclusively green banner, the works of Day and others who are using Steiner methods make for a wider spectrum of building types and all have a resonance unique to their belief in the holistic nature of human existence. The anthroposophical basis to the Steiner way of designing recognises the earth as a living being:

> Every new building deprives a plot of earth of the healing forces of the sun, wind, rain and animal life. The building must redeem this by its own qualities.[4]

The opening up of the Eastern Bloc has also revealed designers who have, through the vagaries of the systems within which they operated, been able to maintain the true organic craft traditions lost to western Europe with industrialisation. Imre Makovecz from Hungary is one such designer. His magnificent churches and community centres are like the buildings of organic dreams. They are realised through the hands of local craftsmen who build, use and enjoy them; they are the closest realisation to the halls in William Morris' *News from Nowhere* completed to date. Although Makovecz has received many offers of work outside his native area, he has found as yet, that the skill resource necessary to create his designs is inadequate. He readily acknowledges nature as his inspiration and uses metaphors of bird or animal to generate the extraordinary forms of his buildings. Wherever possible, branching tree trunks are used as vertical supports; his community centre in Bak planned on the form of an eagle is as strong as Herb Greene's house despite its completion some 25 years later. It may be that these forms are so specific to the Hungarian experience that they would not transfer to other locations. But their potency connects to far deeper roots than the last 200 years of industrialisation. There is no need for any justification in terms of ecologically sound design as they are part of the nature that surrounds them. They reek of nature and of man's ability to reach new heights of creation through working with nature rather than trying to dominate it.

The images and forms of technology are often illusory. Although 'intelligent buildings' have been anticipated for some 20 years, the prohibitive costs of many of the technologies involved has limited their realisation. Intelligent glass that responds to external light and heat levels has been in production for many years. High performance glass that can withstand fire for considerable periods of time is also available. The possibilities of nanotechnology could transform buildings into a myriad of tiny automatic, self-regulating systems which could produce a subtly changing and modifying environment at apparently little energy cost. What is clear, however, is that truly green design is more than a technological add-on. The social, political and economic

structures which underlie the making of buildings will have to be reformed to enable designers to use their skills to provide ecologically sound environments in the broadest sense.

The practical, ecologically aware experiments made by building single or small groups of housing, usually in suburb or country, are important both for their role as prototypes and in sorting out problems and for their demonstration of the possibility of greener living. Care will be needed to ensure they do not experience the same problems as Biosphere II, the experimental recreation of a microcosm of the earth's ecosystem, which apparently foundered at the human, social level rather than the technical level.

The *ad hoc* use of energy-efficient materials and construction are still useful, but all these green trials are patchy and as yet not fully backed by systematic investigation. Assumptions made now about what is the most environmentally favourable material or constructional method may not be deemed correct in a few years time, as our perceptions of the damage we are doing to ourselves becomes more clear. Nonetheless we must begin the task of testing all our current and future assumptions against complex criteria.

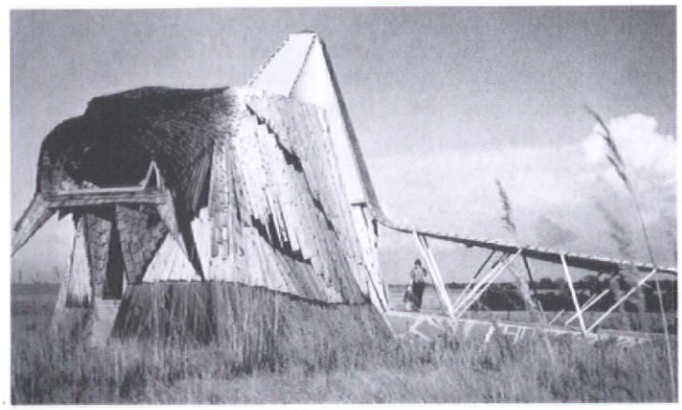
Software programs may be useful to evaluate the relative importance of the many factors involved, such as durability, maintenance needs and embodied energy costs (including that needed to transport materials or components to site and put them together). Studies can be done as to the effects of resource extraction and depletion on the natural habitat and which materials degrade biologically. Qualitative assessment can be made of the energy required for further processing, if materials can be recycled.

A centrepiece of the Green Audit will be a critical cross comparison of the factors – the material, economic, contextual and aesthetic – that go to make the Gestalt of a building and landscape.

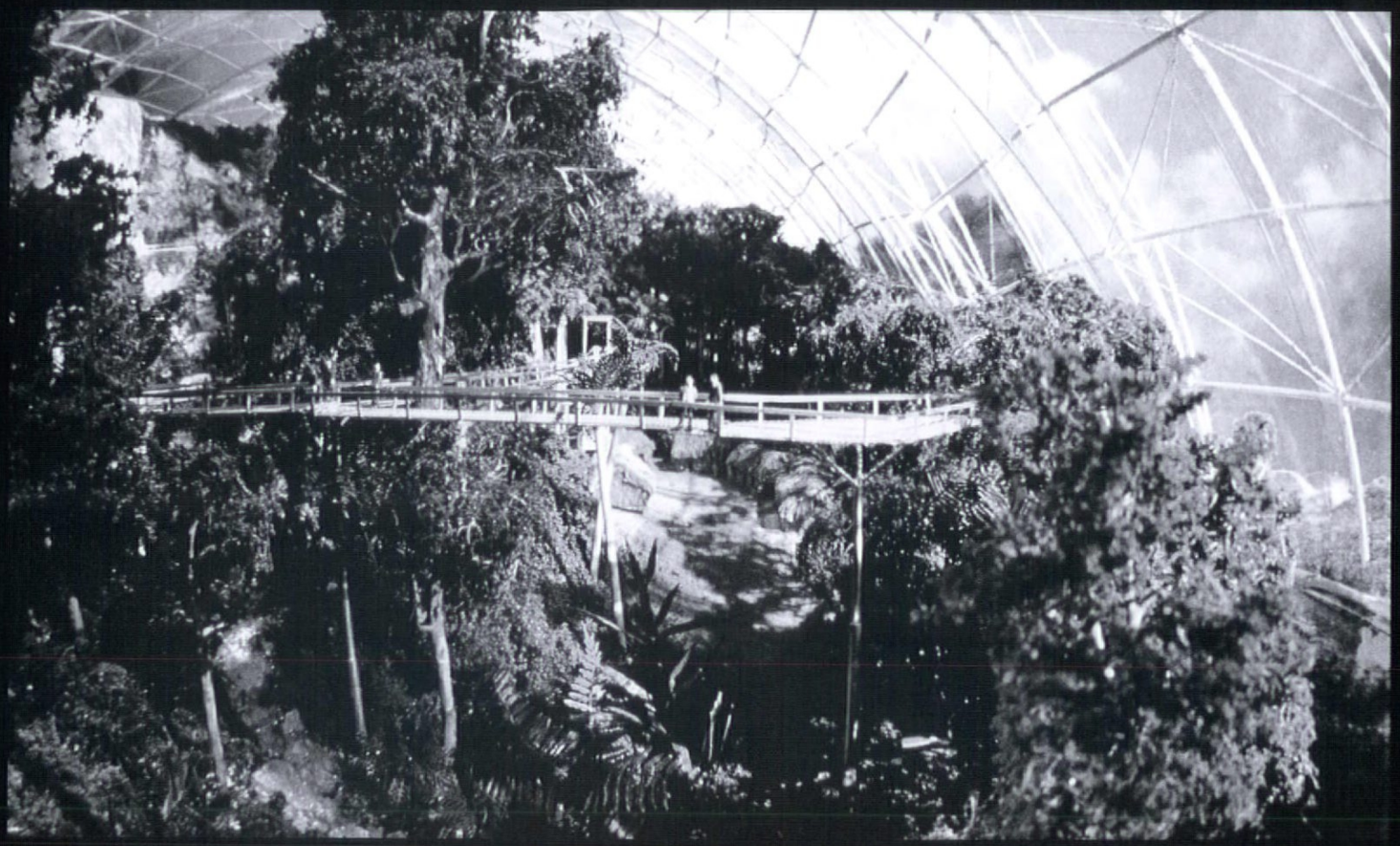
Only man can decide what are to be the social, ethical and cultural green values. It may be that some materials and methods assumed to be green would fail such searching evaluation and other less obvious possibilities succeed. It is probable that no absolute or universal solutions are possible. It may be a question of steering in the right direction.

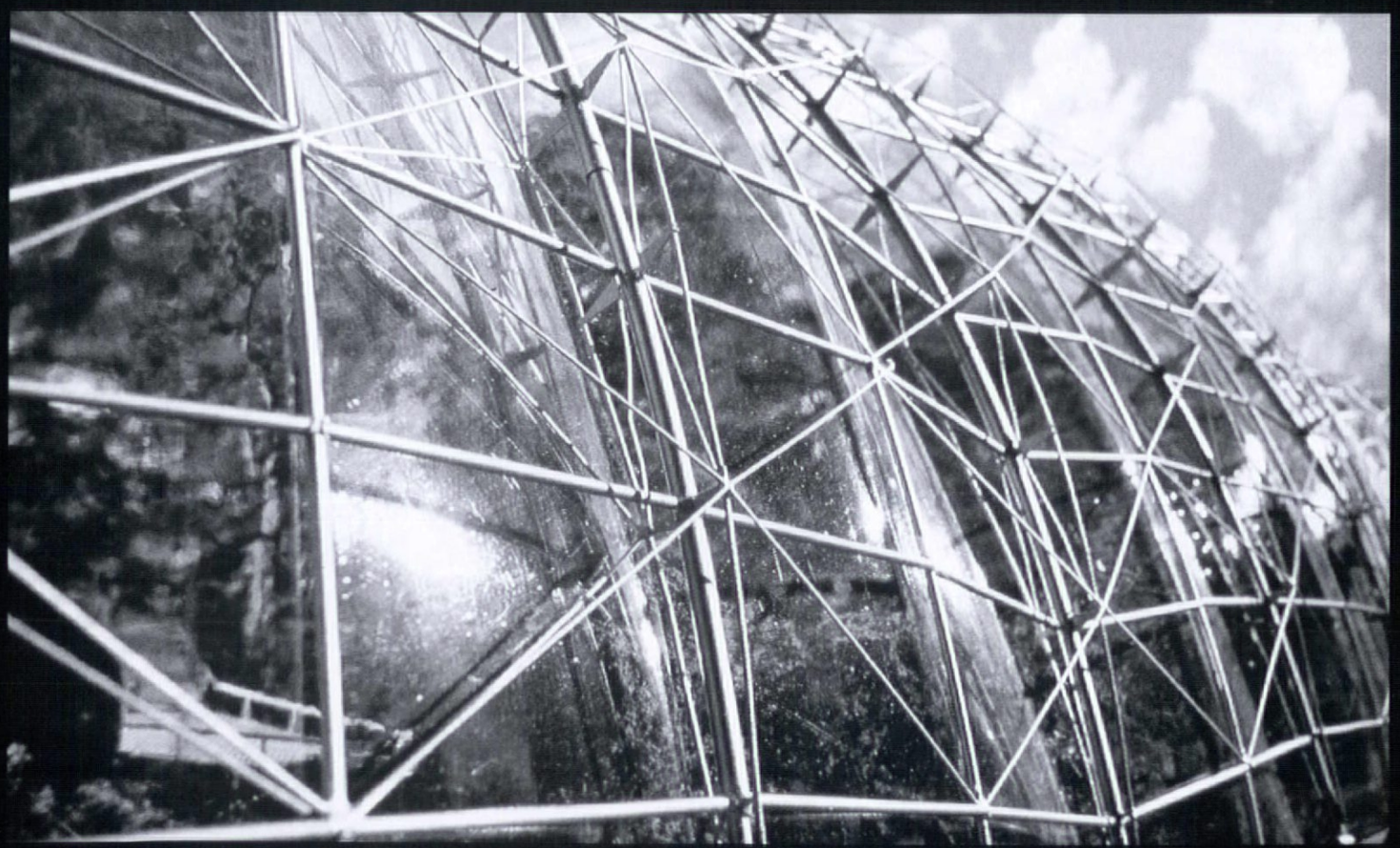
Notes

1 Otto Frei, 'The New Plurality', *World Architecture*, London, 1989.
2 A biotope is a limited ecological region or area in which the environment is suitable for specific forms of life.
3 Dean Hawkes, *The Architects' Journal*, London, 9 March 1994.
4 Kenneth Bayes, *Living Architecture*, Trowbridge, 1994.



FROM ABOVE: Herb Greene, Prairie House, Norman, Oklahoma; plan of John Broome's own house, London





Nicholas Grimshaw & Partners, The Eden Project, St Austell, England

JOHN BRENNAN

GREEN ARCHITECTURE

Style Over Content

Whilst a new maturity begins to emerge in safeguarding the environment, it is not as yet widely reflected in architectural expression. 'Green' is a nebulous, much abused term, having the magic property of investing ecological value on anything without discrimination. Such an emotive word, with its connotations of lush vegetation, nature and well-being, has become the ultimate placebo and none so much when employed as green architecture. Is there such a thing? Its origins like a headache remotely remembered, lay in the oil crises that galvanised many into radical thought and action, and instilled the belief that the West had outlived its welcome and only autonomous self-sufficiency would permit, grudgingly, the survival of an undisclosed fraction of the human race. This was expressed architecturally by a rejection of style and precedent. With the ensuing clean slate, firmness was tolerated and commodity worshipped, but delight reeked of reckless consumption and extravagance and was thus cast out into the wilderness. Buildings such as Rybczynski's Ecological House of 1974 and the University of Cambridge Autarkic House, whilst ingenious, revelled in their cult of exclusivity. They proclaimed an innate ecological superiority that could only be replicated if one were a 'true believer' and was willing to engage the lifestyle of the virtuous monastic.

In the years that followed, green architecture was characterised as energy conscious design. As catastrophe had somehow been averted, energy was now a precious and, more to the point, expensive commodity. It required of buildings high levels of insulation and complex means as to the collection and storage of what was termed 'free' energy from the sun. Such a single-minded approach to architecture had resonances with specific pressure groups against say whaling; focusing on the particular rather than the more complex relationship with the remainder of the environment. Science proved a blunt tool in predicting the interface between climate and structure, and this lack of subtlety reflected itself in the architectural expression. Like a mantra, 'mass to the north, glass to the south' was chanted – although sensibly restricted to the temperate zones of the northern hemisphere.

That green should be synonymous with energy conservation dates from the late 70s. The last decade has thankfully heralded a more holistic approach. It has been recognised that energy use in the making of buildings is as equally important as that expended in use. The embodied energy within some industrial buildings being greater that the total expended during its life. Pollution by the built environment, from sewage treatment to the biodegradation of materials, is also a valid concern of both governments and their electorate. Sick Building Syndrome, has highlighted the often hazardous environments unwittingly created by the designer. The spectrum of environmental factors to consider is now more complex than it has ever been, its synthesis in architecture however is tired and cliche ridden. Any inherent meaning a green building may have is dependent entirely on its physical content and performance, and such meaning is difficult to express visually.

'One must touch this earth lightly' is an Aboriginal saying quoted by the Australian architect Glenn Murcutt. It is a phrase steeped deeply in Aboriginal culture and profoundly specific. It is however also pregnant with ecological meaning, and Westminster Lodge at Hooke Park by Edward Cullinan Architects is a prime example of this philosophy applied to a European context. The phrase is taken literally, producing a raised structure which has no need to ingratiate itself with the ground. It has all the accoutrements of greenness, and in the words of Deyan Sudjic: 'attempts to tiptoe across the land on legs of bundled-together tree trunks. The way it rears up is not actually meant to disturb the land, but actually makes you more aware of the lodge's bulk.' However, lightly touching the earth, too literally in this case, overemphasises the building's impact on the surrounding forest despite the timely intervention of a grass roof.

The turf roof purports to be a truly natural architectural element. Philosophically it postulates that through it, building does not take from the site, but merely raises its surface, literally to a higher level. With such justification, grassing the top of one's architecture is the green equivalent of gilding the lily. It is iconic in demonstrating the environmental concern of the designer, earthy and genuinely natural. In reality for the turf roof to function properly, it depends on a plethora of waterproof membranes and substrata. It is as technologically complex and industrially intensive as any modern roof, yet, to the outside world it paints a picture of idyllic nature. Below the roof the structure is manfully coping with a dead weight of topsoil. Inevitably it will have been strengthened especially for the task, expending yet more of the earth's all too scant resources, but, to the observer, what more sustainable way to build than with common earth? The iconic nature of turf and timber give rise to the question that, if there is a green style, why is it almost exclusively rural in its expression? More importantly its expression of greeness is not necessarily an authentic statement of its true ecological impact.

Both the terms vernacular and green have the dubious quality of being employed to give a warm glow to architectural expression that misleads. Victor Papanek describes six forms of misinterpretation of the vernacular. In a locale where the primary built form is indigenous, to build in context requires not only an echoing of form but some sympathy with the function of the surrounding buildings. Like the supermarket that wants to be a medieval barn, a house that radically seeks to redefine the way we live, but, at the same time, slavishly apes its surroundings abuses much of what the vernacular is about. The Autonomous House by Robert and Brenda Vale is a radical statement as to a self-sufficient existence. Its *raison d'être* is of straight lineage from the Autarkic House 25 years previously. It is a building that has no connection to any water supply, generates its own electricity and expends as little energy as possible. It recycles

rainwater, receives power from photovoltaic cells and features a composting toilet. The motivation for such a building must be questioned. Is it merely an attempt to experiment with academic notions of autonomy or is it meant as template for a more sustainable architecture? The architects have in the past criticised architecture with a capital 'A' as being peripheral, and are of the belief there was a breakdown in the linkage between true architecture and a concern for resources as early as the beginnings of the classical tradition. It seems fitting therefore that such a building should have such understated expression. To the observer it has a comforting familiarity, apart from the tell-tale conservatory, yet, beyond the facade, demands much of the user and in that respect becomes an abuse of the vernacular form. If seen as a demonstration of sustainable living it has an aura of exclusivity. Like much in the green style it ignores completely the urban, a view that is emphasised by the Vales in the following statement: 'In essence the city represents the most extreme example of not working with nature that people have yet produced on the planet.' The Autonomous House offers no clues to an approach to sustainability which embraces the community be it town, village or city. If the vision is of sustainable seclusion that is neither possible nor desirable. If its function is to popularise sustainability in architecture it must be entirely counterproductive.

Whilst seeming to be the antithesis to the overtly naturalist form of the green style, the marshalling of high technology to the green aesthetic shares the same roots. Hi-tech originally meant the utilisation of existing manufactured components from an industrial background, usually a variation on a hundred different uses for discarded ductwork. The approach was ideally suited to the reuse of otherwise scrap components. In this sense it is profoundly within the sustainable tradition, if unconscious to the fact. Buckminster Fuller, as a fabled technological polymath, appealed to both the adherents of the industrial and the natural green style. He examined the most efficient ways of enclosing space, most famously in the guise of the geodesic dome. It was the antithesis of a stylistic approach which allowed all architectural theory to be sidelined in favour of objective scientific analysis. The new efficiency of geodesic design appealed to anti-consumption sentiments, in the form of the Drop City settlements, while to the hi-tech pioneers it allowed designers to enquire how much one's building weighed as if it really meant something. Fuller's domes could be as small as the nomadic hemisphere, constructed from recycled car parts, or large enough to enclose Manhattan all in the cause of climate control.

As the domestic green style can be caricatured as symphonies in timber and turf, so that new building type the environment centre resides within in its own seemingly voluntary ghetto. Be it Future Systems' earth centre, Grimshaw's science centre, at Derby, or Farrell's Centre for Life, they all offer variations on the transparent, often blancmange-like, sky-dome and include the word centre as if there were a clue in the syntax to the built form. In this context, consumption apparently is less of an issue as the economy of material consumption, given its deployment at the limits of its physical performance, is eminently less wasteful. The large areas of glass, which seem to be obligatory in this approach, act not as a climatic stabiliser but aggravate climatic conditions unless heavily controlled. The response to this problem, squaring the circle of climatic response and transparency, has been merely technological. In the case of the projected ecological centre at St Austell, the panacea is ethylene-tetrafluoro-ethylene held in place by a low pressure air system. Again, whether this system will function properly is incidental to the basic question that green design seems to dictate that the designer work within one of two compounds at opposite ends of stylistic expression. It is an architecture of the specific in that it visually proclaims its credentials within the tight confines of a particular building type.

If a more mature environmental approach is to become integral with all forms of built expression, the models discussed above are not the way forward. Self-conscious and uncompromising, they mirror the environmental activism of the last generation, happy to remain in pious isolation from an imperfect majority who quite frankly deserve better. An awareness of the environment is slowly being accepted as a relevant criterion, integral to the planning of much human activity from the production of food to transportation.

Architectural expression has always depended as much on the objective, such as the structural behaviour of materials, as the aesthetic. Therefore, green architecture by emphasising its stylistic expression, shouting out for attention, will always be consigned to the fringe. For architecture to become a central pillar of a more environmentally sensitive community, it must become more objective. Few architects will ever publicise themselves as being environmentally oblivious. Ecological considerations, however, have yet to become an integral part of the objective realm of the design process. To succeed, it must be addressed in the same way that structure and the servicing of a building are universal issues that must be resolved. Whether such elements are overtly expressed remains the decision of the designer. In many respects, this is because of the paucity and immaturity of much information as to the environmental impact of constructional techniques and material use. It is an area characterised by overexaggerated claims by the ecological lobby, met with counter accusation and retrenchment by established industry – both sides assuming they have a monopoly on the truth. Until a consensus is attained, the ability of the architectural community to embrace and adopt a coherent environmental strategy, across all building typologies and architectural styles, will be elusive.

It would be naive to assume that the wholesale embrace of the ecological agenda will not affect architectural expression, although simultaneously it also does not signal a retreat to the turf roof and transparent hemisphere. 'Reduce, reuse, recyle', are, according to John Crane, three central tenets of sustainable design. To date, the emphasis has been to reduce energy consumption with scant regard for the questions of reuse, rebuilding or refurbishing. Simply through reusing an existing envelope, environmental impact is vastly reduced. To rehabilitate, or reuse, has always been the poor relative of virgin design, with some notable exceptions such as the interventions of Carlo Scarpa. It is often seen as merely conserving the past rather than working dynamically within an existing framework. Such an approach has always been attacked by conservationists. Reuse will lie between the slavish preservation of the past and the wholesale demolition of the existing

To allow buildings to grow and change in a more radical way than the enclosure of 'flexible space' may entail a core built from the very durable, surrounded by enclosures that are easy to demount, rebuild, recycle or reuse. Such expression are resonant of the work of Aalto in the later stages of his career. In projects such as Rovaniemi Library, there was a clearly defined hierarchy of spaces with rectilinear expression of more utilitarian

function contrasting with the primary spaces. Such clear physical demarcation allows a building to function more as a living organism, growing and contracting in a truly flexible way.

Rather than extract, manufacture and transport material, the reclamation of existing elements of brick, slate, timber and metal greatly alleviates environmental impact. Glyndebourne Opera House demonstrates the use of reclaimed materials to great effect; for instance the auditorium being faced with reclaimed pitch pine. The prevalence of timber and brick throughout the structure is characteristic of Hopkins' current work. The use of indigenous materials is a key to reducing the energy intensity of building, and at the same time engenders an architectural expression characteristic of its region. This is no exhortation to embrace the vernacular; as western society has lost many of the shackles that tied society closely together.

Architecture whose process of construction is characterised by techniques not subject to evolutionary change still carries the spirit of the vernacular. The student residences at Cirencester by David Lea have a feeling of timelessness and authenticity that is achieved by using local materials and constructional techniques, including a Cotswold stone roof and lime rendered walls. The building has a real environmental significance in that the materials used are locally sourced, resulting in a low embodied energy, and are expressed seamlessly without resorting to visually preaching its green credentials.

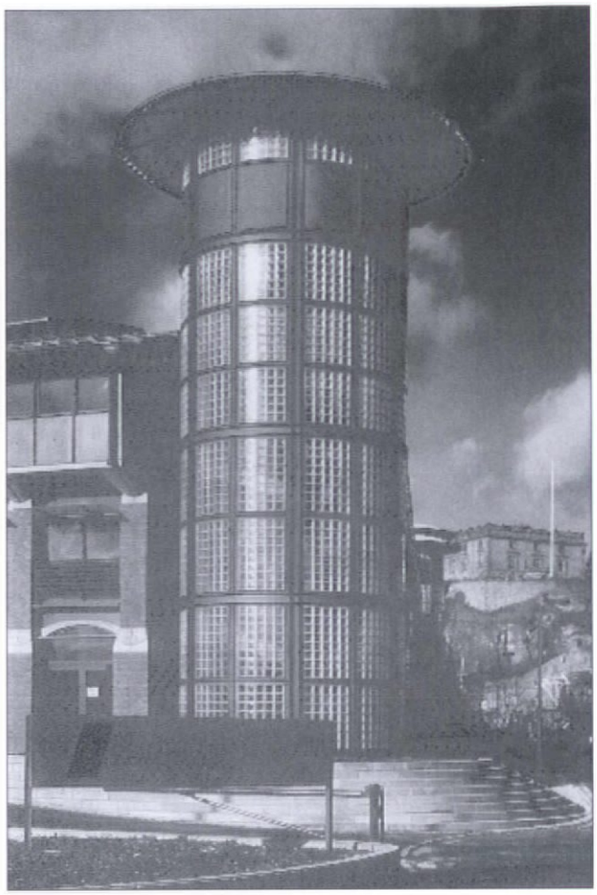
It is a misconception to expect that the vernacular, by its very nature, will interact impeccably with the climate. Presenting the igloo or the adobe house as perfect examples of bioclimatic design, ignores many building types in more temperate climes whose inhabitants have for centuries flourished with dreadful facility. The exploitation of site, microclimate and orientation are basic and well understood, and should be a contemporary response. The work of Ralph Erskine demonstrates that a response to climate can be dynamic; for instance in the case of the Borgafjäll Ski Hotel, where the building responds to the climate free from the compulsion to insert a conservatory. Crucially this approach also extends to the urban environment; schemes such as Byker illustrate how Erskine's designs carefully respond to the surrounding environment and microclimate.

Whilst the espousal of non-toxic materials and climatic design are important, the physical and cultural locality of the building are equally valid as design generators. Alphen-aan-den-Rijn, an initiative master-planned by Lucien Kroll, is of note both for the maturity of its environmental approach and the diversity of design within a small area. The latter was achieved by the commissioning of nine different architects and developers. Whilst the architecture could be described as being self-consciously green, what sets this development apart is the careful consideration given to issues of siting, orientation and waste management at an early stage. With the environmental agenda underwritten in such a scheme, the architecture is then able to be judged on its innate merits rather than any specific ecological response.

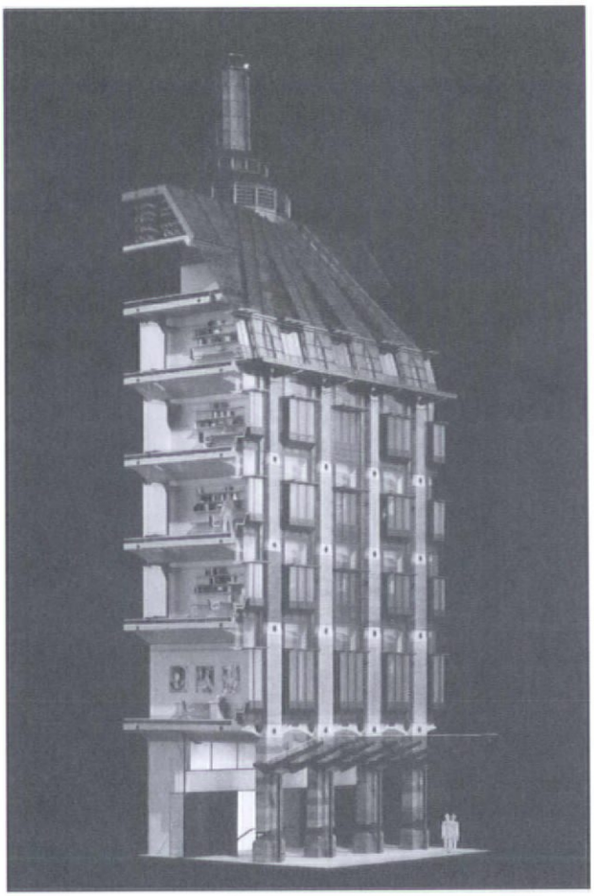
Peter Harper in his essay 'Tigers and Yoghurt Pots' argues that no longer can the northern hemisphere alone 'save the planet' by sturdy frugality. The progression of the developing world to industrialisation is where basic questions as to sustainability on this planet lie. The developed world has the necessary structures already in place to make dramatic environmental improvements. Those quite rightly lobbying for a more sustainable form of building must make distinctions between measures that can effect improvement along a wide front, not just for a committed minority. Harper refers to the metaphorical 'Sweden Syndrome', a fictional society, highly affluent, where everything down to the Yoghurt Pot is rendered sustainable in glorious isolation from the remainder of a very imperfect world. A fiddling with the finer points of autonomous construction in a European context whilst the developing world ecologically burns, addresses the needs of neither hemisphere.

Real progress to an environmentally conscious architecture is more likely to occur from a process of incremental improvement rather than revolution. Western society is seeming to adopt such a course and architecture, a supposedly progressive activity, should properly reflect this.

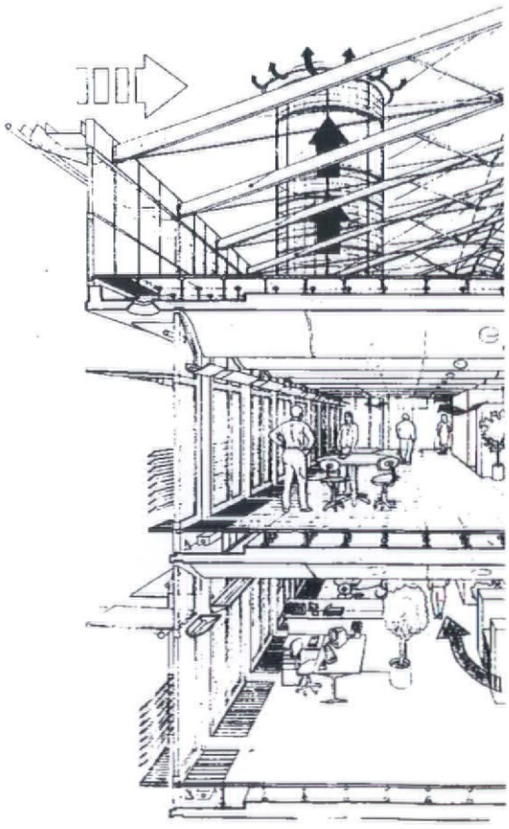
Edward Cullinan Architects, Westminster Lodge, Dorset, England, 1996



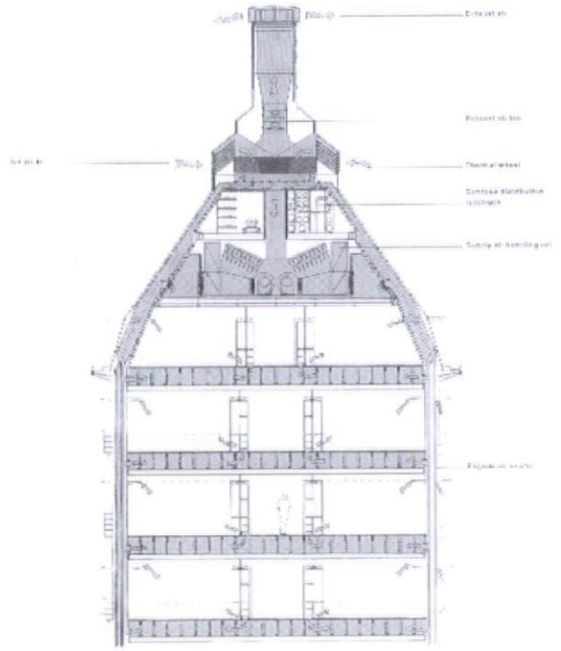
External facade, Inland Revenue Building, Nottingham



External facade, New Parliamentary Building, London



Ventilation concept, Inland Revenue Building, Nottingham



Internal airflow, illustrating heat recovery wheel, New Parliamentary Building, London

MICHAEL HOPKINS & PARTNERS

RESEARCH INTO SUSTAINABLE ARCHITECTURE

Context

The European Commission's Joule II programme provided a good opportunity for Michael Hopkins and Partners to develop, through two research projects, some of the technology needed to create sustainable architecture. Much of the effort concentrated on improving efficiency, reducing energy demands from the building and using renewable energy sources where possible. At the same time the practice wanted to maintain a broad vision and is conscious that it is possible to produce a very low energy design and yet not be truly sustainable for a number of reasons. Firstly, so much energy is invested in the original construction that the building only just manages to save enough energy to repay this initial debt before it falls apart. Secondly, the building's relationship with its surrounding infrastructure may not be sustainable, depending on its demands on transport, waste disposal and energy supplies, as well as its impact on the surrounding landscape. Finally, if the quality of life within the building is claustrophobic, stuffy and unpleasant, with poor daylight and little visual contact with the outside world, then no one will want to live in it and the proposal will be a failure. Inevitably an architectural practice's development is largely conditioned by the buildings demanded of it. Very few clients have an ideological commitment to sustainable buildings, and are therefore not usually disposed to make the necessary capital investment to realise reduced environmental impact in the long term.

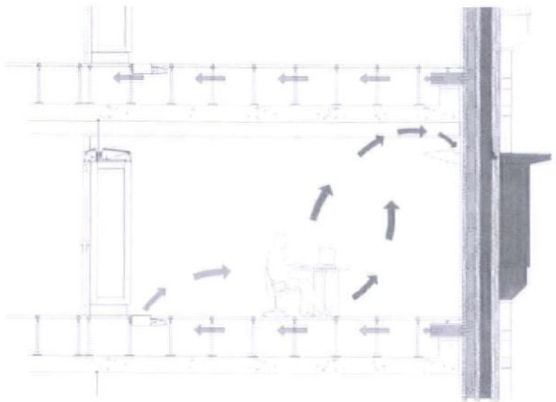
Public clients prove to be the only notable exception, as they envisage occupying their building for perhaps 120 years, as opposed to the building industry's standard design life of 60 years. For this reason it is unsurprising that the two principal low energy projects that are being constructed by the practice, the New Parliamentary Building and the Inland Revenue Centre, are both publicly funded buildings. The sustainable briefs that were set for both buildings may well be responding to the much greater awareness of these issues in continental Europe, evident in the European Union's environmental policies. Even so these concerns are still limited to the themes of natural ventilation and low energy targets rather than the wider ethics of sustainability.

In the end, most buildings that the practice is commissioned to design are still on urban sites with an infrastructure and surrounding environment that cannot be altered, with budgets that reflect a normal palette of materials and constructions, and a client with preconceived ideas as to the sort of comfort conditions that should be offered to the occupants. The practice's research therefore concentrated on what can be achieved in the near future with this type of building, utilising standard materials and techniques in a different but realistic way.

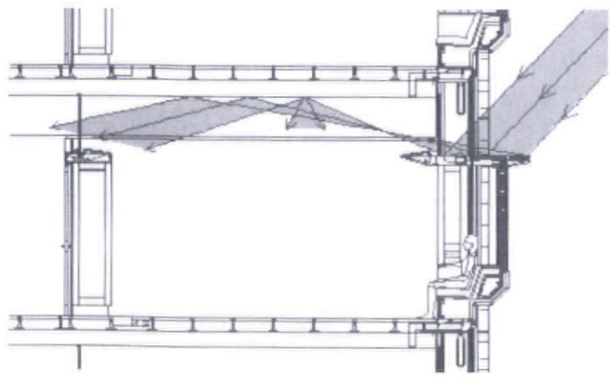
Design techniques

The traditional approach to low energy design is to filter the adverse affects of the outside environment as heavily as possible. This has often had a depressing effect on the interior, as the quest to neutralise the effects of the outside environment on internal temperatures also deprived the occupants of most of its potential benefits: heavy insulation, smaller windows, more and more layers of glass and conservatories, everything filtered through venetian blinds and ventilation limited to the minimum necessary in the winter. These buildings often resulted in a very negative architecture that was obsessed with environmental physics, but provided very little amenity. Many architects questioned what had happened to the modern movement's optimistic ideals of an architecture of daylight and fresh air, claiming that the 'baby had been thrown out with the bath water'.

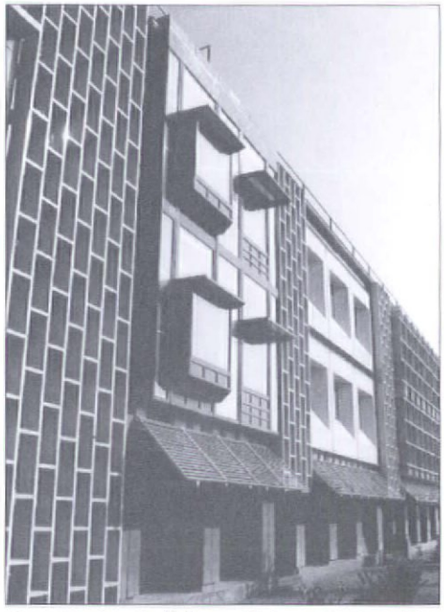
The practice's research looked at software engineering, rather than inventing more hardware to add to the building; focusing on how heat flows in and out of the building's fabric, and how air moves around the building naturally. Through this knowledge



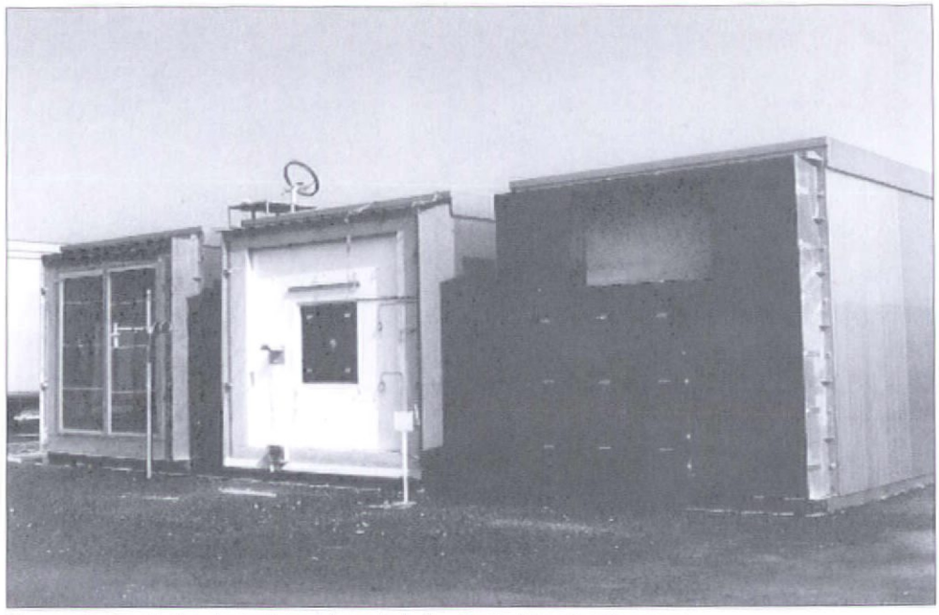
Ventilated floor voids determine convection heat transfer coefficients when air is introduced into the void between the structural slab and the raised floor



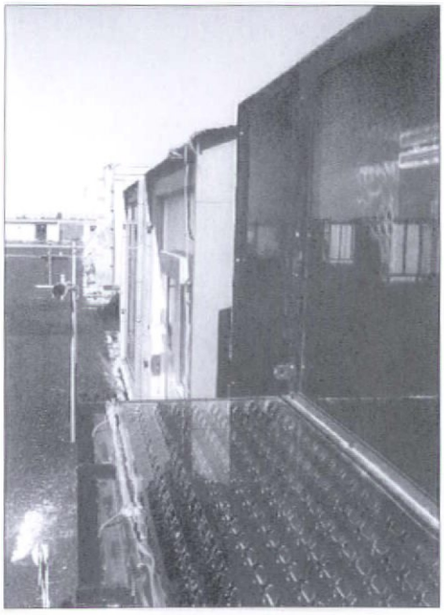
Daylight is reflected onto the exposed concrete soffit, increasing natural light



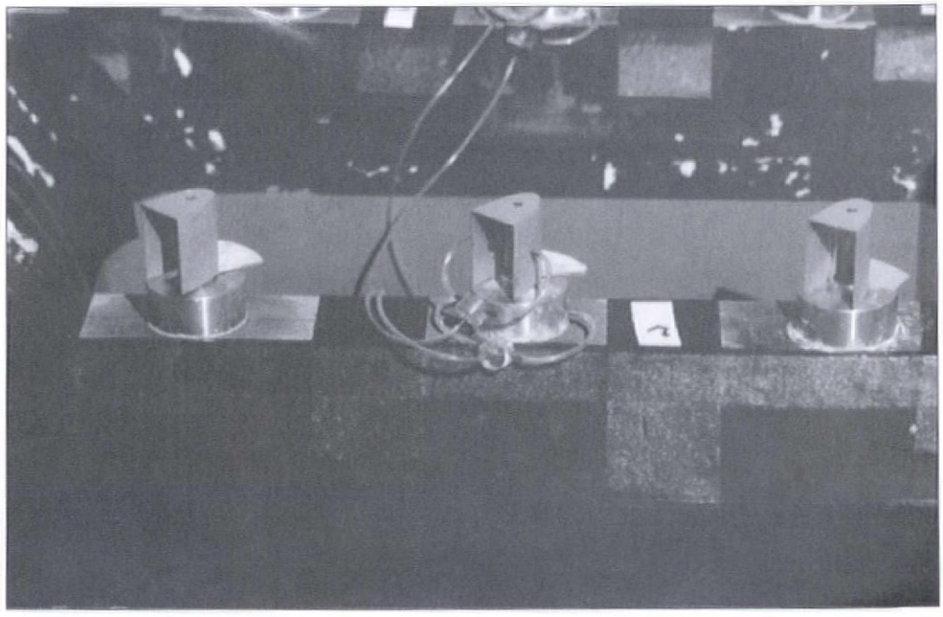
Conphoebus building with low energy office prototype installed



Passys test cell: the Joule II test facade being tested by Conpheobus



Details of light shelf design: including reflector within sealed glazing unit



Chimney cowls used for preliminary feasibility testing at CSTB wind tunnel in Nantes

architects can gain a greater freedom in designing sustainable buildings and free themselves from the ubiquitous insulated box. The researchers soon found out that adding a thermal sensibility to the design palette was more complex that the well-honed structural one that the practice already had. Similar concern was given to whether or not the practice could achieve a similar fluency in the architectural expression of these phenomena, in the same way that their buildings traced the flow of structural forces through the floors, beams, columns and walls.

Their approach was to integrate as many functions as possible into a single element of construction and to optimise its overall performance. This was a departure from the modern movement's orthodoxy of separating out individual building elements into mono-functional components; a steel frame for structure, with separate glazing for the enclosure, and bolt on air-conditioning systems for environmental control. Having won the structural freedom to open up elevations, it became evident that functional demands immediately filled them all up again with a clutter of single function elements that often only provided comparable environmental performance to traditional construction techniques. The addition of thermal insulation, acoustic insulation, solar shading and glare control devices had a tendency to compromise the clarity and transparency of the initial concept.

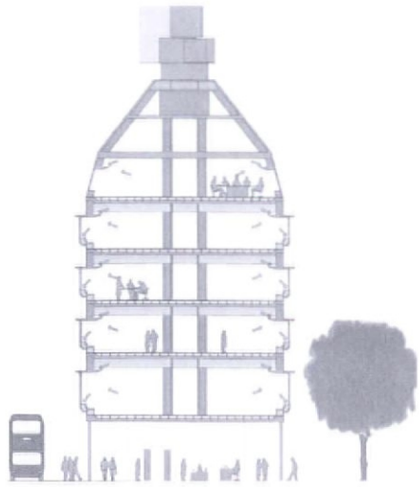
Design solutions

Adding more technical parameters into the design of each individual component makes the design more difficult, but can enable passive environmental features to be incorporated without additional cost. Whereas before a structural floor plate could be invisible, hidden by suspended ceilings and raised floors, an energy conscious building will be seeking to maximise areas of exposed thermal mass, providing large radiant surfaces that behave rather like a thermal flywheel. In this case the rooms actually need to be higher, allowing the air to stratify below the ceiling under its own buoyancy, creating a displacement ventilation system. This in turn allows low-grade ambient energy sources such as fresh air, ground water for cooling, and solar gains for heating.

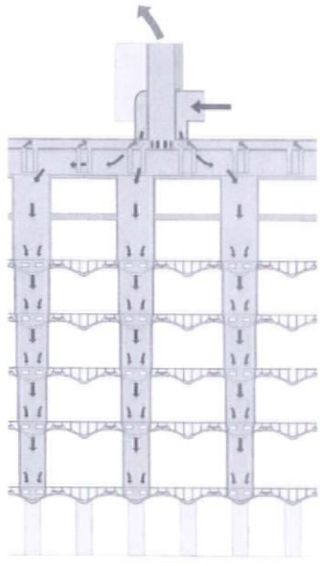
An energy conscious building should also exploit daylight, the best form of solar energy in our north European climate. Towards this end the facade should be inflected so that it scoops in high level zenith light whilst excluding direct sunlight and solar gain through built-in light reflectors.

The need to expose thermal mass suggests that the floor could be fairfaced reinforced concrete, the mix designed to maximise daylight reflection from the window wall, with the sun shade forming a light shelf. This method would obviously involve disposing of the suspended ceiling. The temperature of the room can be controlled by passing air through voids between the top of the slab and the raised floor, creating a sort of hypocaust. A simple structural floor has therefore become a radiator, a daylight reflector, a ceiling finish, a ventilation air duct and a thermal store. It costs more than its mono-functional predecessor, but less than the sum of all the above functions if they become separate bolt on components. It is also far more durable and, if carefully designed, will have a lower embodied energy content and fare better in a life cycle costing analysis.

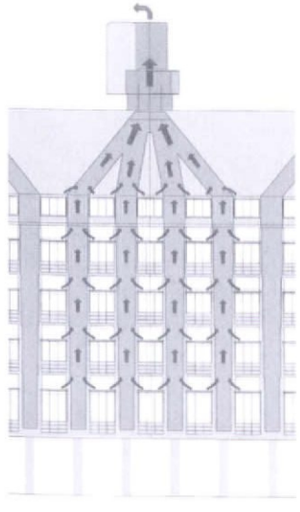
Likewise, the shading in the external wall can be used as a solar collector if dark blinds are installed in the cavity. The solar gains can be removed by linking the facade with the ventilation system, and recovered through a heat exchanger at roof level.



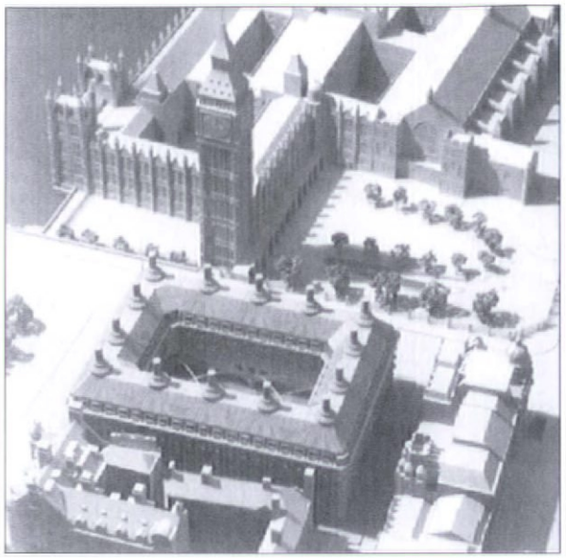
Low energy urban office model: cross section through vertical ducts



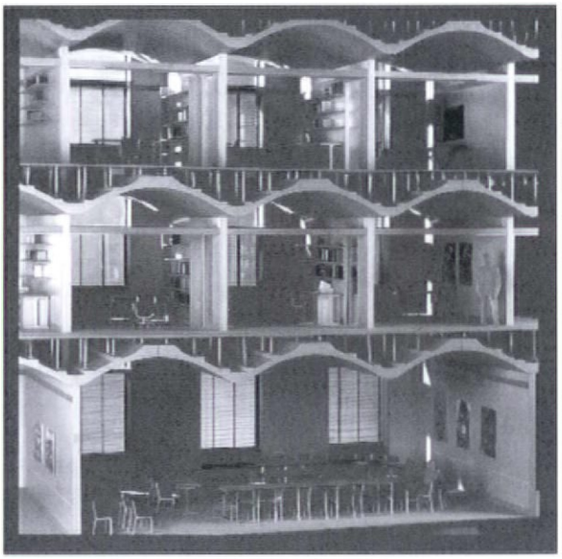
Low energy urban office model: longitudinal section through air supply ducts



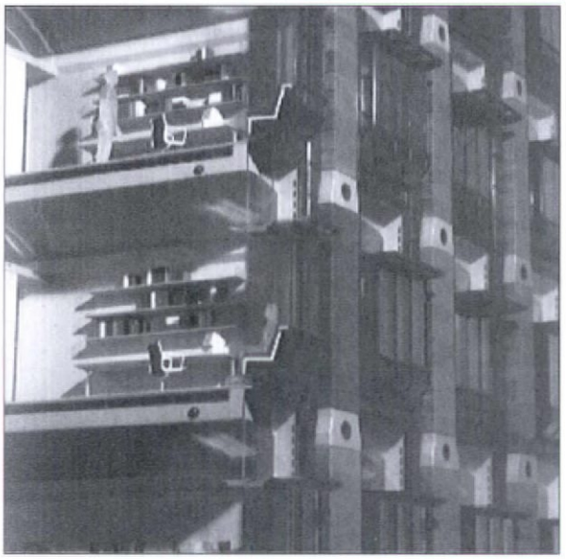
Low energy urban office model: longitudinal section through facade extract ducts



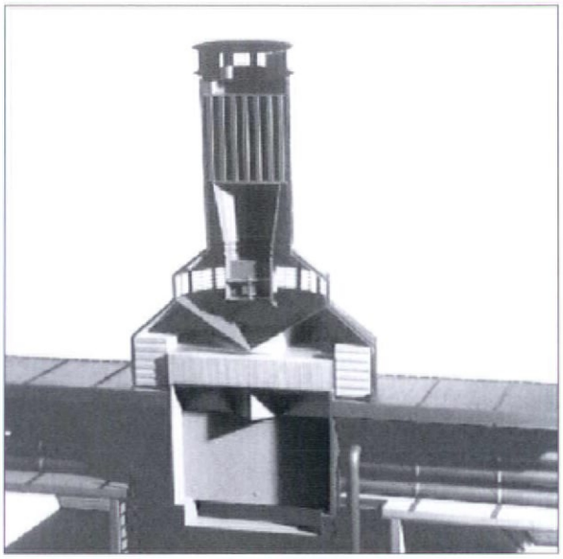
Aerial view of model, New Parliamentary Building



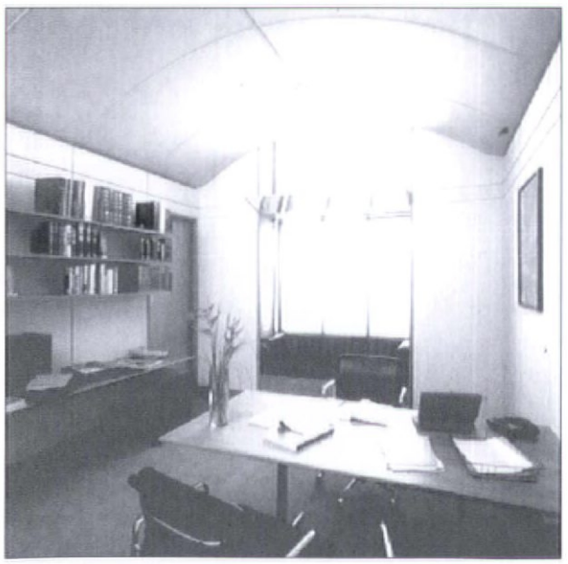
Section through New Parliamentary Building model showing thermally massive precast concrete floor plan



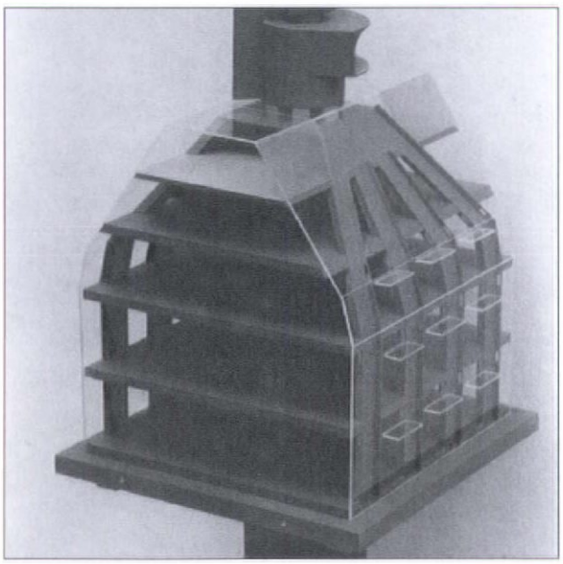
Model of external wall, New Parliamentary Building



Detail of New Parliamentary Building chimney showing heat exchangers



Full size mock-up of typical office for lighting tests, New Parliamentary Building



View of theoretical low energy urban office model

This is basically a realisation of Le Corbusier's idea of a *mur neutralisant*, 60 years after its invention, linked to the building's ventilation system, or *respiration exacte*. This system, however, avoids the energy penalty inherent in his original idea.

Research results

The Hopkins research project accepted that we still have to deal with the daily problems of high density urban blocks with poor sunlight, in polluted and noisy streets, often in historic areas where there is little choice of orientation to optimise solar access. The research model brought fresh air into the envelope, at roof level to avoid pollution, circulated it through the building, with a modest use of fans, and then exhausted it through chimneys. This 'breathing' motion is accommodated in a compact element which allows 85% heat recovery, 100% fresh air supply to the interior, eliminates recirculation problems, which leads to Sick Building Syndrome, with an almost negligible energy penalty. This solution is predicted to achieve an annual energy consumption of around 90kWh/m^2 on the New Parliamentary Building, and perhaps as low 65kWh/m^2 in an optimised design.

A second research project investigated ways of eliminating all the complex air handling plant to reduce further the embodied energy and maximise renewable power sources. A rotating chimney turret was designed to combine a wind catching aperture, for a positive pressure fresh air supply, with an exhaust air outlet, taking advantage of negative pressure formed by the inlet wake. The wind turret would reduce fan requirements dramatically and would provide ducted natural ventilation for much of the year. This was modelled in tandem with the buoyancy ventilation system, inherent in this flue arrangement, and utilises occupancy and solar gains on the facade, in conjunction with the thermally massive cool air supply ducts, to provide the motive force. This form of ventilation is particularly effective in ventilating the building at night, when it is necessary to pre-cool the structure, as the wind, unlike the sun, is often available both day and night, all the year round. Further studies investigated the use of photovoltaic cells, mounted on a sloping roof, to supply electrical energy to a slow moving fan when insufficient wind energy was available, whilst utilising the hot air generated to assist the solar flue ventilation system in the facade.

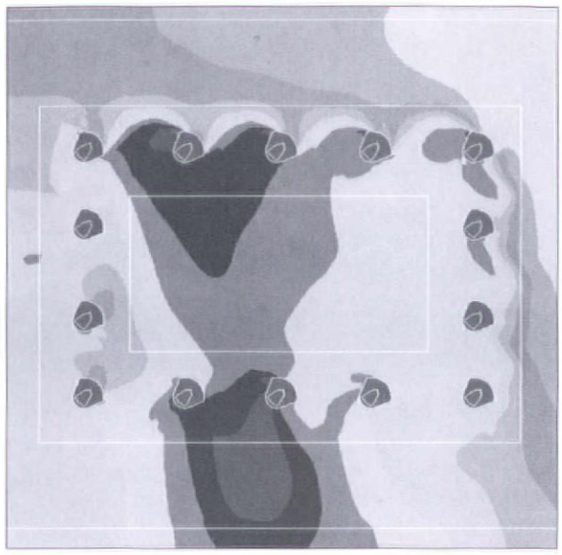
Using these techniques it should become possible to heat the building throughout the winter season for around 20kWh/m^2, without being unduly concerned by orientation or solar access.

Participants

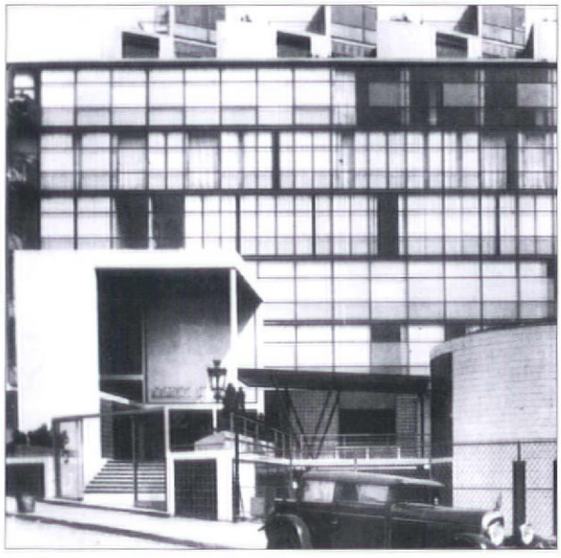
The research work included the preparation of computational fluid dynamics (CFD), testing scale models in a wind tunnel and under an artificial sky, testing full-scale prototypes of facade components, and monitoring an office building that was installed with the principal design elements.

The following organisations participated in the Michael Hopkins & Partners' Joule II research projects: Ove Arup & partners, London, UK (environmental engineers, CFD analysis); Conphoebus, Catania, Sicily (test laboratory and photovoltaic research); Bartenbach Licht Labor, Innsbruck, Austria (lighting consultant); CSTB, Nantes, France (aerodynamic engineers), and MBM Metallbau Möckmühl, Möckmühl, Germany (prototype development).

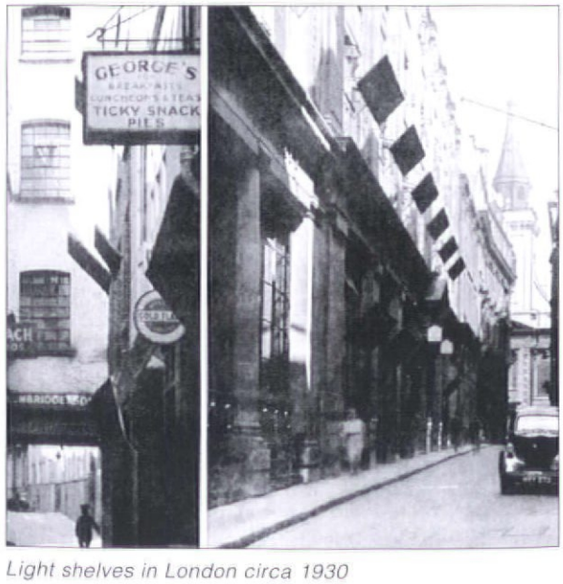
Bill Dunster and John Pringle



Pressure distribution across chimney stacks with flow at 45° to building axis – New Parliamentary Building



Le Corbusier, Cité de Refuge, Paris, France, 1933



Light shelves in London circa 1930

JAMES WINES

PASSAGES

The Fusion of Architecture and Landscape in the Recent Work of SITE

The relationship between architecture and landscape is still dominated by the formalist traditions of early modernist design: a situation where the edifice is seen as the star and vegetation as the understudy. In visual terms this usually means the building is conceived as an isolated sculptural artifact, while nature is represented by an indifferent girdle of trees. It is a hierarchy that seems predicated on the fear that the foliage might upstage the architecture. The results, unfortunately, are a 'discard' attitude towards the environment and a view that nature is a place where one drives on the weekend, but, upon return to the city, is never associated with buildings or the serious tasks of daily enterprise. This has negative implications for the urban aesthetic, but, more importantly, it is bad for basic health. The bottom line is simply that one tree means four people can breathe. Quality of life in any city is thus determined by the number of people related to the quantity of trees.

During the past decade, SITE has become increasingly convinced that architecture is urgently in need of a conceptual, philosophical and aesthetic reunion with the natural environment. This does not simply mean more city parks and conservation efforts – although these are obviously important – it also means an expanding awareness of ecology, interpreted from a social and artistic frame of reference. They propose that buildings today should connect in some physical and iconographic way to their larger context, which requires a response to psychological, cultural and topographical influences, as well as botanical.

Part of this conviction goes back to some of the ideas articulated through SITE's early work in the 1970s. At that time they felt that architecture should exchange its roots in modernist and constructivist design, abstract art and industrial age imagery, for a more open-ended visual language, consistent with the emerging age of information and ecology. The practice observed that people's reflex reactions to contemporary life had been shaped by a pervasive 'ambient sensibility' created by television, cinema, computer science and an awareness of the consequences of environmental destruction. They saw this consensus as a generator of subliminal references that had little in common with the industrial and technological sources that had shaped early modern design. As a result, SITE came to the conclusion that buildings and their adjoining spaces should no longer be conceived strictly from the standpoint of form, space and structure. Instead, the emphasis should be shifted to include narrative and environmental associations. In this way, they envisioned an architecture that dealt more directly with the mind, actually creating a dialogue between the two, and was responsive to earth-related issues. This shift of focus, from physical/hermetic to mental/environmental, seemed consistent with both the informational and ecological revolutions. It also opened up the building arts to a range of options, in terms of message and content, that had been closed off for the majority of the century.

Currently, most post-structuralist philosophy in architecture is turning away from references to deconstruction and chaos theory, in favour of 'integrated systems' that could be considered more in concert with the so-called information highway and ecology movement. One recent direction, referred to as 'folding', has been notable for its 'pliancy, continuous and heterogeneous systems, fluid transformations, and smooth mixtures of disparate elements'. While much of this dialogue seems to suggest a renewed sympathy for the organic architecture of Frank Lloyd Wright, the actual manifestations in built and model form tend to treat the surrounding environment – especially landscape – as an alien territory, generally populated by random grids of lollipop trees that bear little or no reference to the centrepiece architectural event. Folding is generally characterised by formal exercises in the use of warped planar surfaces to alter conventional relationships between exterior and interior. Whatever its claims for pliancy and fluidity, the folded building still remains a familiar hermetic object that can be readily photographed apart from its context without a loss of meaning.

While some of the propositions of folding appear to be in accord with the new eco-sensibility, there is no real 'earth awareness' or intent to fuse structure with context implied in its objectives. Instead, like deconstructivism, folding seems to be one more extension of 20th-century orthodox formalism, and the representative examples are very much a part of the traditions of early constructivism and the notion that a building must always be some form of abstract sculpture: in this case comparable to a kind of architectural origami.

One interesting linguistic contribution of folding is an expansion of the meaning of 'information' to 'in-Formation', which implies a fusion of both the transmission of data and the developmental process of shaping ideas. This thought leads directly to the main focus here, the interpretation of architecture as a system of 'passages'. It is a concept that links buildings, landscape and elements of social, contextual and environmental communication. Edifices designed on strictly formal terms and then plunked down to await some kind of peripheral vegetation tend to remain static and insular. Buildings conceived as integrations of structure and landscape are mutable, metamorphic and evolutionary, constantly conveying new levels of information.

SITE's current views on the integration of architecture and landscape architecture came, in part, from an observation about television. The TV set in one's living room is seldom regarded as anything more than a generic artifact for receiving and disseminating electronically-generated images. Usually a TV viewer does not even notice the physical receptacle as an example of good or bad design, or as an important object of furniture: although it can obviously be both. Instead, the importance of the ubiquitous box is its capacity to process information. Applying the same principles to building, the practice developed the idea that it might be productive – as a way of breaking free from the strictly formalist interpretation of architecture – to shift the

aesthetic focus from shelter to the capacity to absorb and transmit messages. This suggests that walls, instead of being seen mainly as barriers, enclosures or compositional elements, can serve as information-filtering partitions, or points of passage, that fuse and dissolve traditional inside/outside relationships and incorporate narrative commentaries. There is nothing new about the idea of walls delivering messages – the majority of historic churches and civic buildings in Europe were based on this objective – but, its radical appeal today derives from an opposition to conventional architectural geometry and the rich potential to establish landscape and environmental awareness as leading forces of change in response to the new age of ecology.

The interpretation of passages is infinitely variable and should not be considered as any kind of design formula. Basically, the concept proposes that the wall and floor planes in a building should be seen as fluid, contextually responsive membranes, converting the measure of aesthetic quality from evaluations of formal design to how well a structure reflects and engages various aspects of landscape, regional identity, topography and cultural references. In orthodox modernist and constructivist architecture, walls are usually treated as functional or sculptural elements that have an aesthetic significance derived from abstract art and are contained by the clearly defined perimeters of the plan. Walls as passages can appear to defy the plan, and range, in form and purpose, from indeterminate ribbons of transition in space to monitors of social and environmental change.

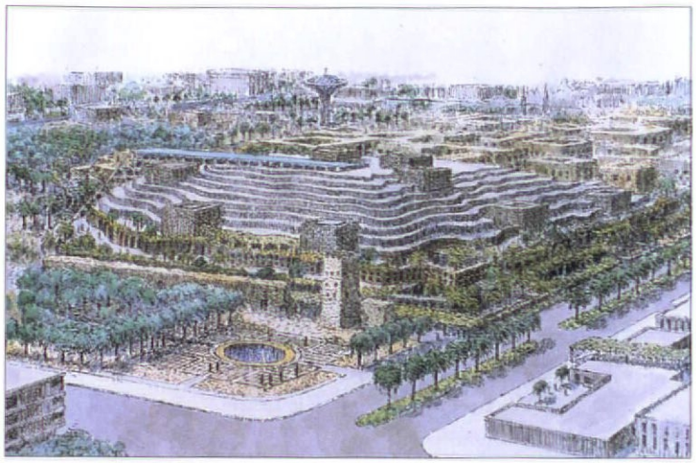
In terms of architectural construction, the concept of passages proposes that plant life and earth elements should be as much a part of the physical substance of shelter as conventional building materials. From an aesthetic standpoint, the objective is to look at the fusion of structure and landscape as a kind of interactive biographical dialogue, that, when translated into visual imagery, describes their mutual origins in nature. This entire direction in design suggests the development of new paradigms in the building arts that are based on ecological models. However, there are also many obstacles to this objective. Since our society has no collectively shared cosmology or religious associations with nature – of the kind that were prevalent when the Celtic monuments of Wiltshire, or rock cut temples of Ajanta, India, were built – the designers of today's environment cannot rely on a consensus iconography for communication. At the same time, the earth and sun are still universal symbols, and the global awareness of ecology has become a motivating psychological force in the development of a post-industrial version of Jung's collective unconscious. In this context, landscape becomes the world's most potent source of symbolism.

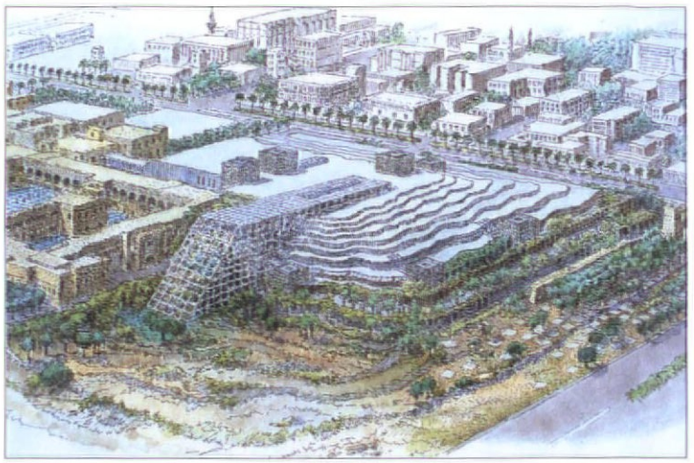
Whereas the term folding seems to suggest a process of methodical, geometry driven, formal strategies, the notion of passages is intended to describe a mutational, organic and informal set of connections between building and landscape. For example, this concept might take the form of a series of lateral, informational walls that can be distributed over a land parcel in both an orderly and random way, allowing roof structures and the surrounding context to casually bridge and/or penetrate the spaces between the partitions. This approach creates great flexibility in the orientation of sheltered services, as the covered areas can be distributed arbitrarily. Taken to its potential artistic extreme, it can completely break down the established definition of where architecture begins and landscape ends.

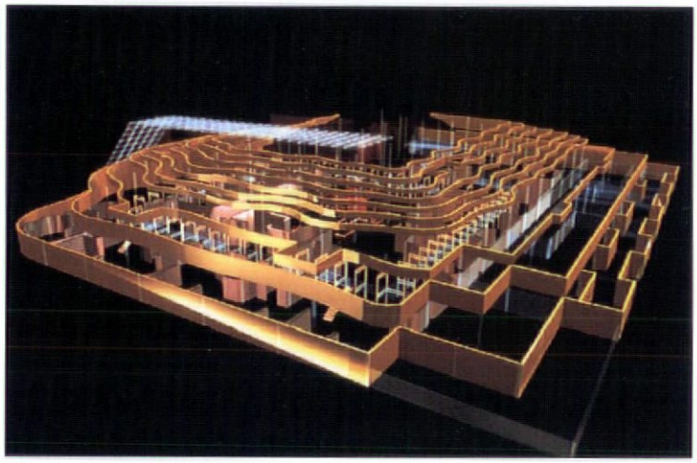
One major problem is trying to apply the theory of passages to a standard formula for high-rise architecture. When the cost of real estate is the determining factor in aesthetic decisions, the idea of an office tower as the product of such nature-oriented design features as 'fluidity, indeterminacy, and chance' is hard to sell. On the other hand, there is the possibility of interpreting large civic structures as heavily vegetated microcosms of their regions, a derivation of the Japanese concept of 'borrowed scenery', or tableaux of other places, becoming the contemporary equivalent of the Hanging Gardens of Babylon.

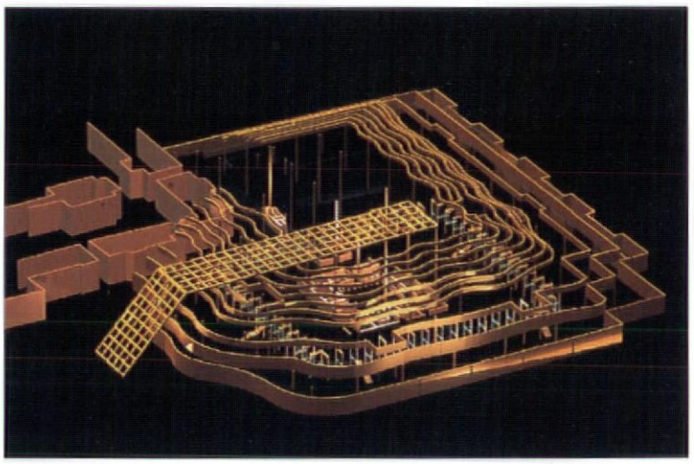
The theory of passages is, like the qualities of change and discovery implied by the word itself, endeavouring to chart a cartographical route through new and sometimes conflicting territories. While there is plenty of lip service given to integrated systems, the reality, depicted on a vast majority of architects' and landscape architects' drawing boards, reflects the same scenario of two cautious protagonists publicly professing a sympathy for collaboration, but, behind the scenes, jockeying for a position of aesthetic supremacy. Hopefully, passages can be viewed as a means of reversing this anti-ecological and unproductive process.

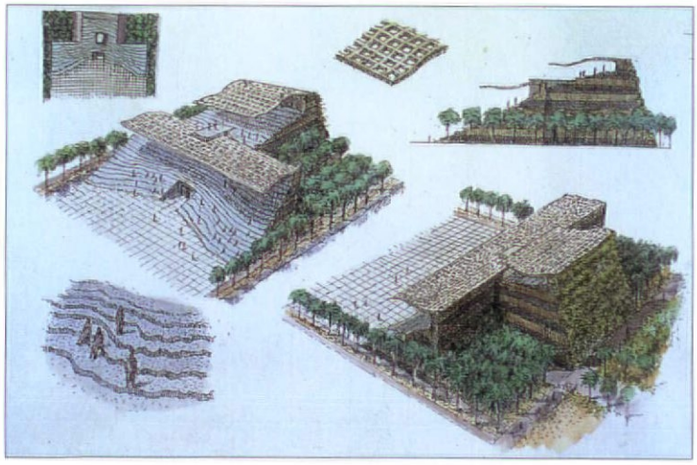
Much of the ecologically motivated work today, acclaimed as green or contextual, is nothing more than a catalogue of environmental technology and land conservation systems tacked onto otherwise conventional buildings and landscapes. This mission of sustainable design is essential, the intentions are admirable, yet the results are boring. It is SITE's conviction that environmentally conscious fusions of architecture and landscape architecture should demonstrate their commitment through highly visible aesthetic choices. This opinion is supported historically by all of those regionally integrated ancient cities of the Middle East, Africa and Asia, where shelter in harmony with the earth has maintained its beauty and symbolic presence over the centuries by converting sustainability into high art. In our present age of ecology, this example has never been more relevant. Clearly, the interactive dialogue between buildings and landscape is an art, as well as an ecological imperative.

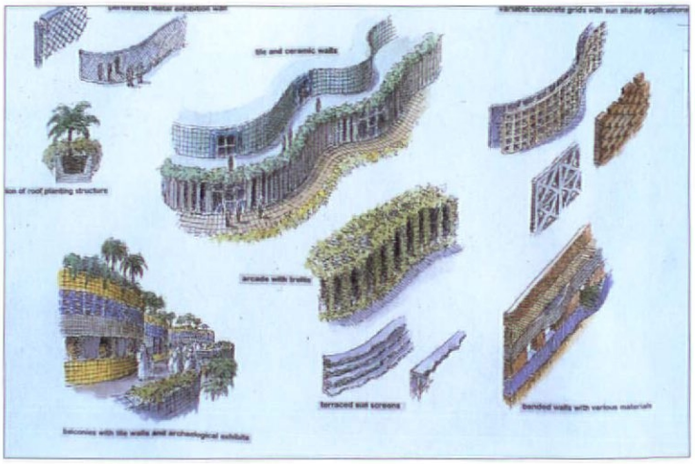


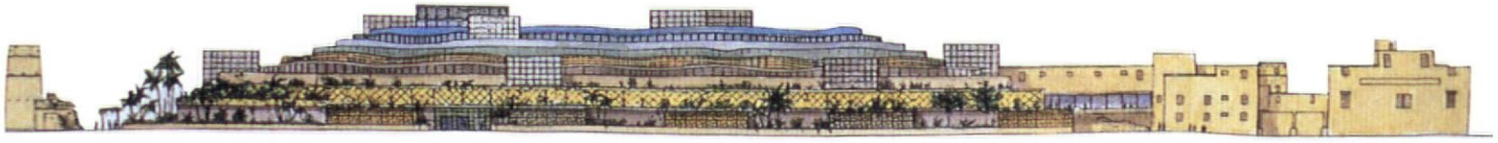









tile and ceramic walls
arcade with bricks
terraced soil screens



SITE

THE SAUDI ARABIAN NATIONAL MUSEUM AND DARAT AL MALIK ABD AL-AZIZ

Riyadh, Saudi Arabia

The Saudi Arabian National Museum is a celebration of Abd Al-Aziz, the founder of modern Arabia, based on the symbolic significance of his achievements as they relate to the land and people of 'The Kingdom'. The main building is a fusion of architecture and landscape, conceived as a microcosm of Arabia, that will house exhibitions on history, culture, science, archaeology, technology, ecology and arts and crafts.

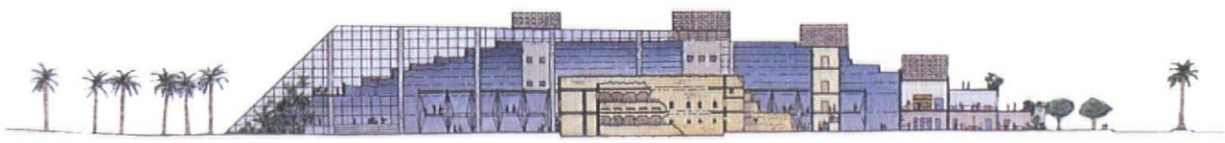
The architectural brief consists of the museum, a multimedia centre, the restoration of the surrounding historic mud brick city and the Palace of Abd Al-Aziz, the renovation of a mosque and the adaptive reuse of several existing structures as offices and a Department of Antiquities. The scheme also includes landscaping, several parks, a master-plan for the surrounding city and a 50-year proposal for the development of a cultural corridor in Riyadh.

The landscape architecture illustrates vegetation and terrain from various Arabian environs through a series of gardens, plazas and arcades. In the northeast corner of the site a section of the wadi area is utilised as an earth shelter, to cover the parking facilities and commercial centre.

The main museum building is designed as a series of multi-layered, undulating tiers that recall the terraced landscape of the Azir region, the tradition of ziggurat structures in ancient Mesopotamia and the striations of the glacier-carved walls surrounding desert wadies. The facades of these levels are constructed from wooden screens, masonry grills, tile panels and vegetated trellises, and are designed shade the building. The building envelope functions as a giant shell – 30 metres at its highest point – spanning over the exhibition areas, allowing great flexibility in the use of the interiors and making it possible to totally enclose a section of the ruins. These elements are used as screens for film projection and as a dramatic enclosure for special events, integrating them into the fabric of the museum. In addition, the building includes offices, storage areas, restoration labs and a study centre, as well as an upper level observation walkway that gives visitors the opportunity to look down on the exhibition space from above.

The contours of the roof are oriented to provide shade and include a series of service towers. These structures are enveloped in masonry versions of *mesh-arabia* screens to decrease their visual weight and to ensure controlled interior temperatures during hot weather.

OPPOSITE, FROM ABOVE: Aerial views; computer-generated projections illustrating relationship between interior and exterior; explanatory sketches, multimedia theatre and amphitheatre; details of wall typologies; elevation; ABOVE: Existing ruins; BELOW: Section



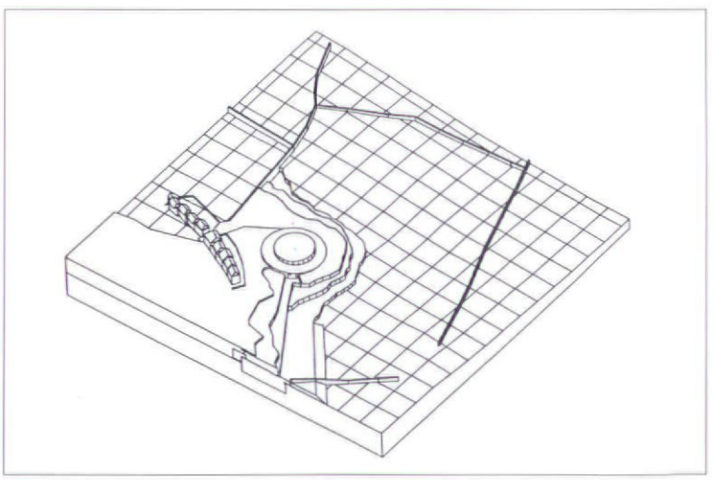
TRAWSFYNYDD INTERNATIONAL ENERGY COMMUNICATIONS CENTRE

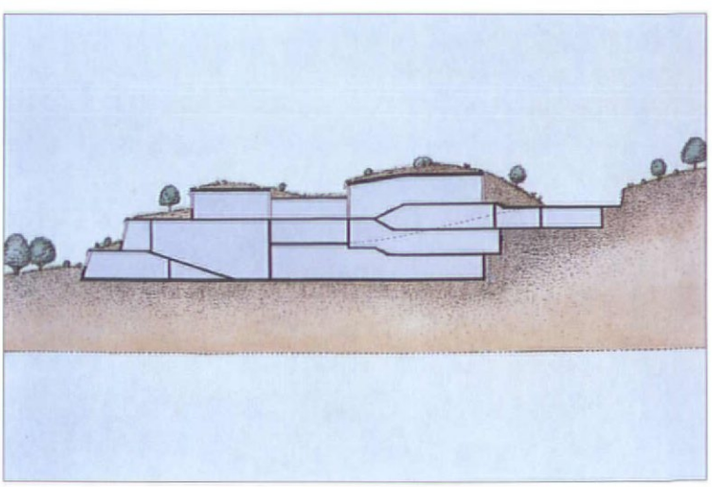
Trawsfynydd, Wales

The Trawsfynydd International Energy Communications Centre (TIECC) is designed for a magnificent hillside site just below the town of Trawsfynydd, overlooking the nearby valley, lake and nuclear power station. The scheme is intended to be a reminder of the end of the nuclear age and the need for massive research into new energy resources. In response to the rich history of North Wales, the configuration of the centre is based on a combination of a Celtic cross and the typical layered mounds of a Neolithic monument.

The building is integrated with the environment by cutting the structure into the hillside and using the landscape to cover the roof. Similarly, existing slate and stone walls are fused with the glass partitions of the architecture.

The centre contains facilities for education, research and exhibitions on all aspects of new energy resources, and serves as a global centre for updated information on the decommissioning process. It is also equipped with many design features related to environmental technology and sustainability, which are intended to establish the TIECC as a functioning and continuously evolving example of energy conservation. Since the structure and landscape form a coherent whole, it is anticipated that the building will gradually become increasingly invisible within its natural context.





FROM ABOVE: Aerial view; site axonometric; section through site

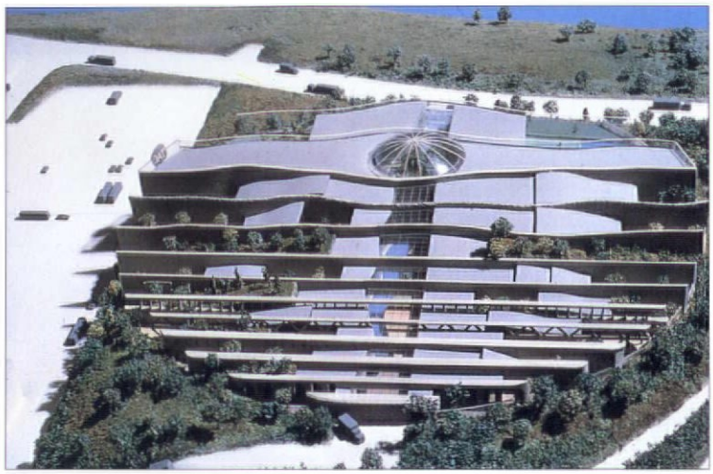
TENNESSEE AQUATORIUM

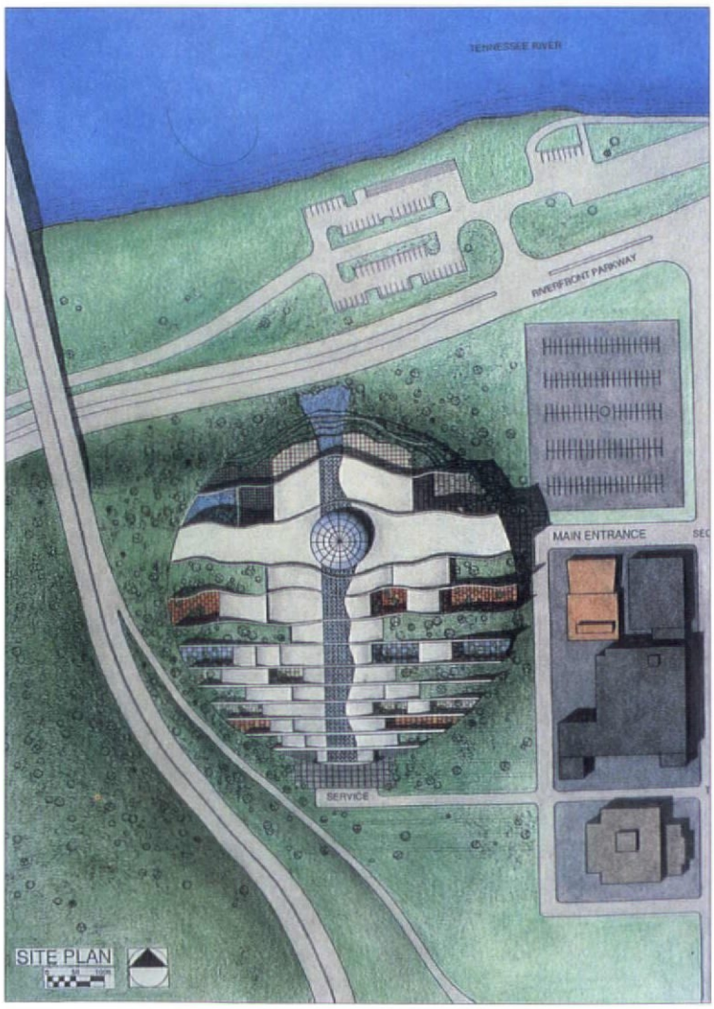
Chattanooga, Tennessee

The Tennessee Aquatorium is located on top of Kirkman Hill, adjacent to the Tennessee Fresh Water Aquarium and Ross's Landing: completed by SITE in 1992. The centre is dedicated to the history, science, culture, and preservation of water, and is intended to inspire a profound appreciation of humanity's relationship to the earth's most precious resource. The new centre is based on the circular configuration of the site and is intended to completely integrate with the existing landscape. The circular plan also reflects the earliest origins of cosmology, when shelter and ceremonial monuments were constructed as reflections of people's debt to the sun, moon and earth.

The centre is composed of a series of lateral information walls – or 'passages' – that carry the exhibitions outside and merge with the hillside topography and vegetation. These animated walls divide the museum into culture, science, habitat, technology and agriculture, and use video, virtual reality and interactive displays, as well as fountains, gardens and natural phenomena, to explain the power and uses of water.

In addition to these narrative environments, the aquatorium provides several grand spaces for special shows and conferences. The centre also contains an IMAX cinema, study centre, library, administrative offices, and a restaurant that serves food produced by aquaculture. Finally there is a health centre, specialising in water therapies, where visitors, who have experienced all aspects of water and civilisation, can be immersed in it as a reminder of its value on the most basic level.





Site plan

RICHARD ROGERS PARTNERSHIP

DAIMLER BENZ OFFICES

Berlin, Germany

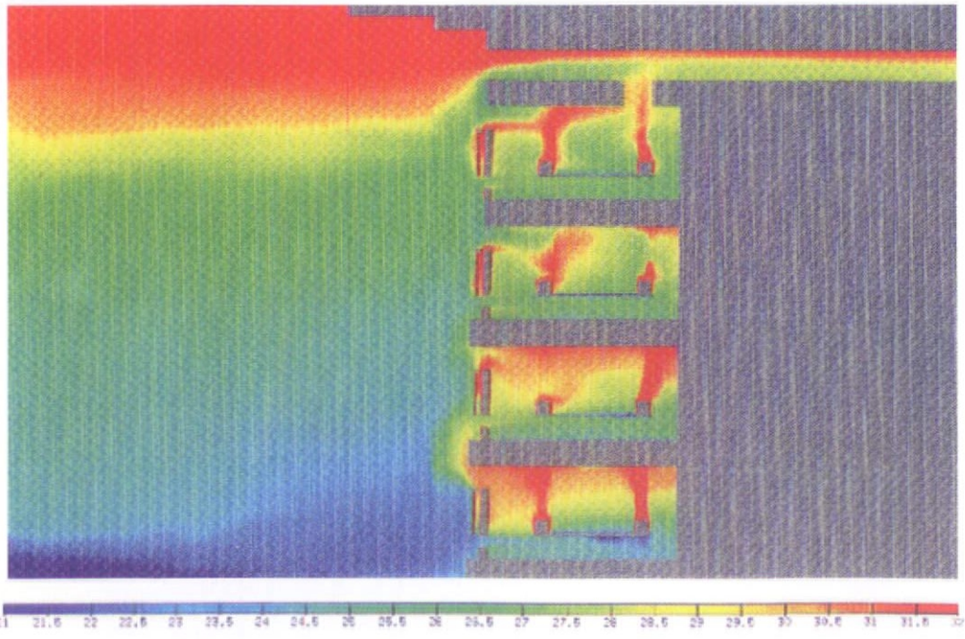
The key environmental objective of these three buildings, located on Berlin's Potzdamerplatz and complying with the urban development specifications formulated by Renzo Piano's master-plan, is to demonstrate the integration of low energy design and architecture in a dense urban environment. Towards this end each unit aims to optimise the use of passive solar energy, natural ventilation and daylight to create a comfortable and energy efficient working environment.

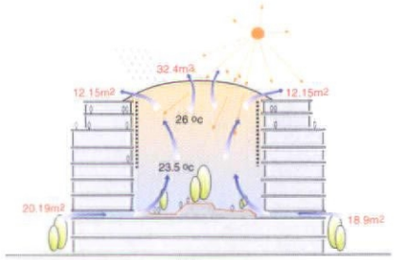
The open southeast facade is the focal point of each building. The width of this opening increases towards the top, facilitating daylight penetration into the interior. This stepping back also creates south facing green terraces for the occupants. The rotunda, addressing the corner of the building, further increases daylighting to the atrium: a tempered 'external' environment intended to encourage social interaction.

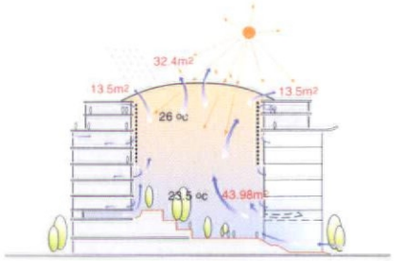
The design of the building envelope focuses on the control of solar gain, to satisfy the client's thermal comfort criteria, with individual components designed to optimise the effective use of natural ventilation and daylight. Depending on its specific orientation, external obstruction and view out the glazing varies from opaque to transparent in order to provide suitable solar shading. The expansive fenestration, forming the middle section of each bay, maximises the building's visual link with its surroundings.

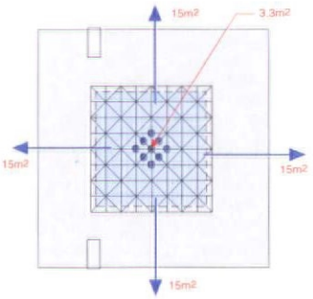
All offices have openable windows and partially exposed ceiling slabs to optimise natural ventilation and free nocturnal cooling. Natural ventilation in the atrium is achieved by a stack effect controlled by strategically located air inlets and outlets, and shading devices. The traditional atrium is developed even further by introducing an air plenum, between the retail level and the offices above, which regulates air movement, resulting in 'near-external' air quality.

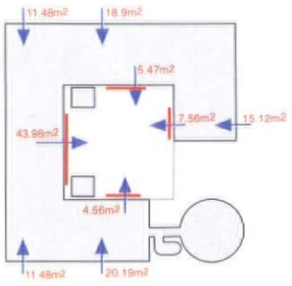
Initial analysis indicates that these environmental features produce a building whose annual energy consumption is significantly less than a typical office building in Berlin: artificial lighting cut by approximately 35%, heating and cooling 30%, and carbon dioxide emissions by 35%. However, it should be noted that despite these reductions the embodied energy of the construction is relatively high compared with a traditional masonry office.



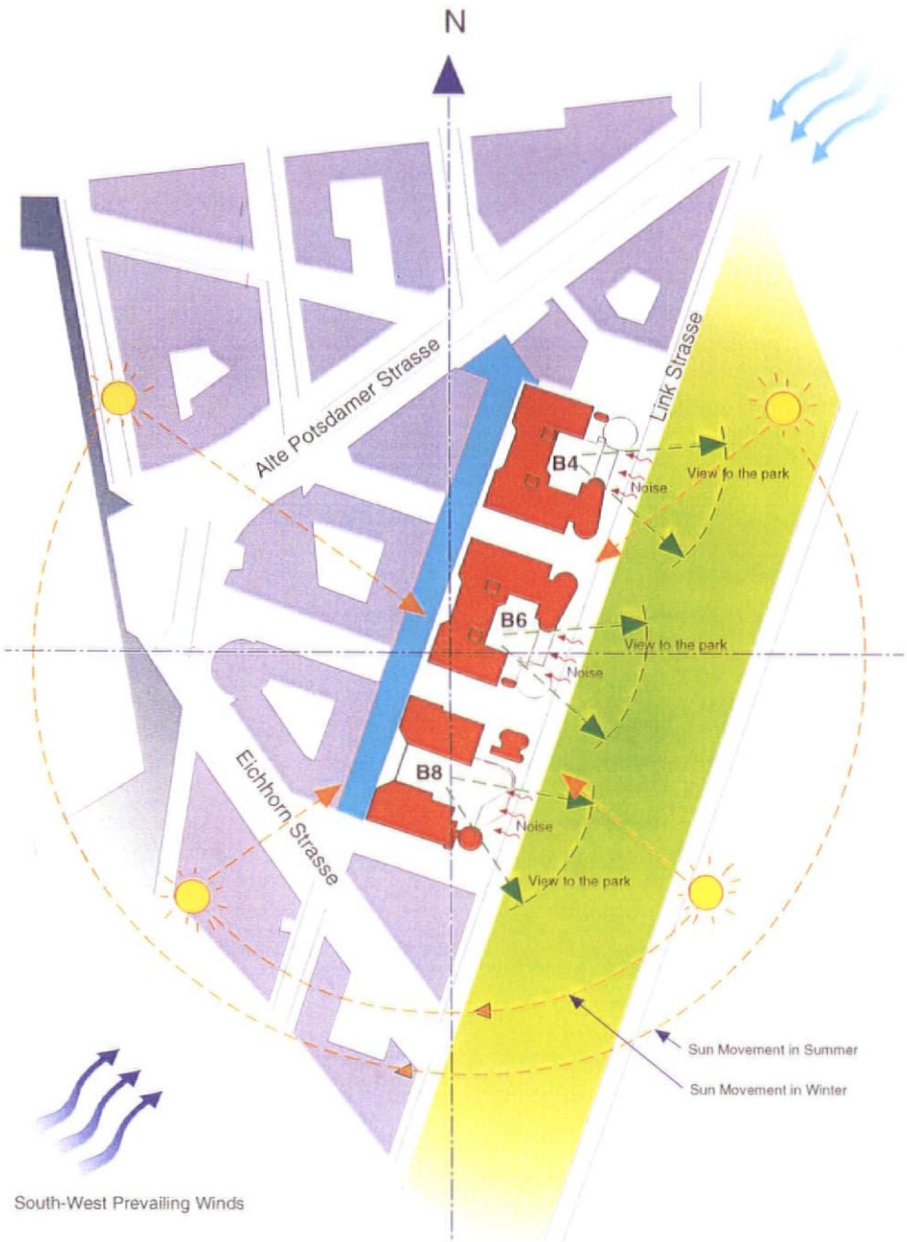


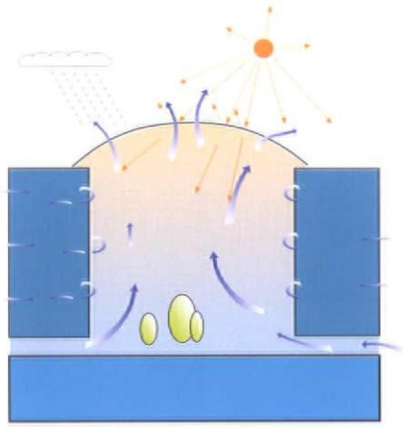


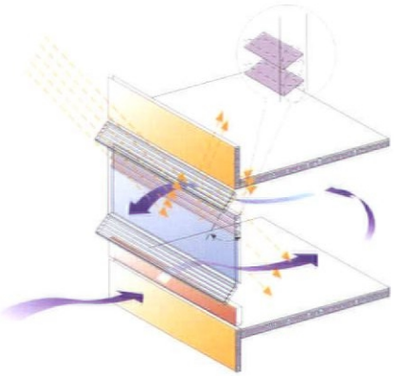


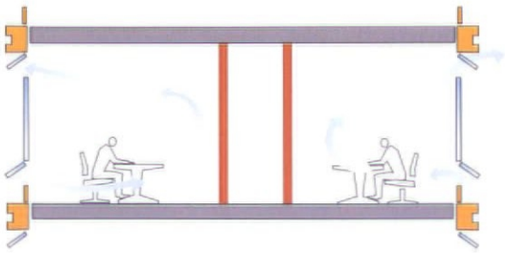


LEFT: Section showing temperature profile in the upper half of the atrium. There is vertical shading to the atrium-facing offices. Note that the hot air pocket is limited to the upper part of the roof only; ABOVE: Final strategy of natural ventilation in the atrium, with plenum, roof vents and external vertical shading to offices. Total air inlets equal to 60 square metres. Outlets equal to 60 square metres located at the perimeter of the dome roof, with additional outlet of 3 square metres at the apex









ABOVE: Diagrammatic site plan showing the opened block to optimise ventilation, daylight and sunlight; RIGHT, FROM ABOVE: Atrium as a thermal buffer; high performance 'kit-of-parts' facade; opening up of the courtyard; use of thermal mass

NICHOLAS GRIMSHAW & PARTNERS

THE EDEN PROJECT

St Austell, England

Without plants there would be no life on earth. Plants provide all the air that we breathe, most of the food that we eat, the clothes we wear, the fuel we burn, the shelter we need, many of the medicines we use and even the paper upon which this is written. They are the living backcloth for the diversity of environments which so enhance the quality of our lives. Civilisation is inextricably linked to our ability to harness the world of plants to our needs. If this fragile relationship is to continue and develop, it must be sustainable. At last we are beginning to recognise that this relationship cannot be one of exploitation only, and that man's future role must be as the steward of natural ecosystems and sustainable crop production. The Eden Project will make a contribution towards this future through education, research and responsible, sustainable, commercial development in world-wide partnership.

The project will be a showcase for global biodiversity, and human dependence upon plants. It will be centred on an example of world-class architecture constructed, on 30 hectares of reclaimed derelict land in the south west peninsula of the United Kingdom. At its heart lies a 14-hectare, 70-metre-deep, south facing clay pit in and around which will be constructed 8 hectares of linked, climate-controlled, transparent capsules (biomes), set in a designed landscape. For the first time, using advanced technologies, scientists, architects and engineers will create structures large enough to allow the exhibition and study of plants on a hitherto unachievable scale.

Uniquely, this living collection will enable the exploration of the existing, and potential, relationship between the world of plants and peoples of diverse cultures. Such studies could provide practical solutions to many of the issues surrounding global sustainability.

The scheme will be an international visitor attraction, the profits from which will fund research and implementation programmes in line with *Agenda 21* – The United Nations Programme of Action.

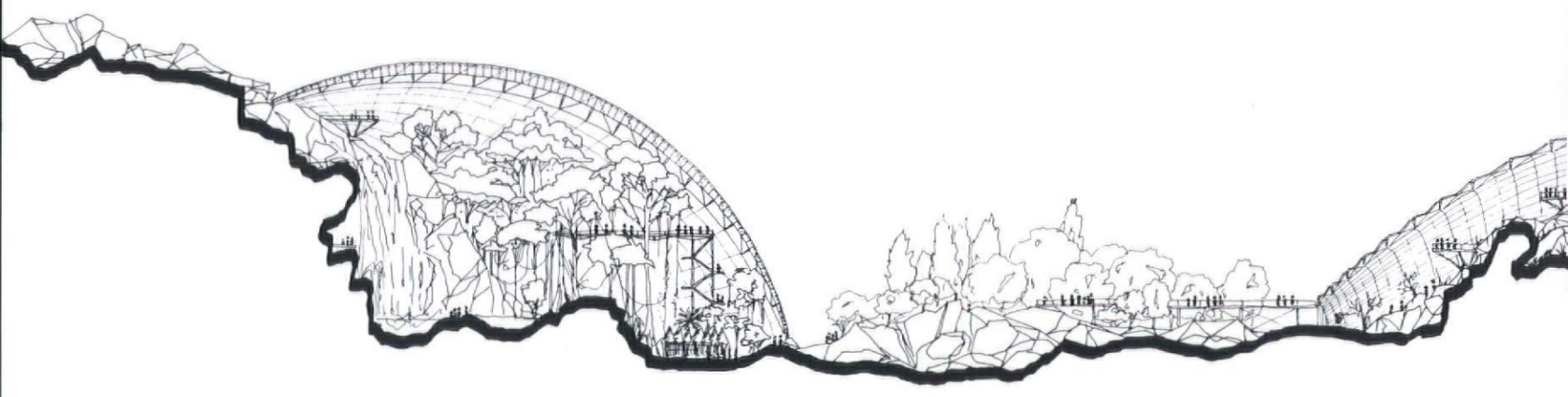
The experience of visitors is based on two key principles. Firstly, the conditions must be perfect for the plants, the horticulture outstanding and the rationale behind the assembly of the living collections coherent. The calibre of the agricultural, ethno-botanical, horticultural and landscape design team reflects this ambition. Secondly, the visual impact must be stunning to ensure that Eden will be a world-class destination.

The giant biomes, the largest of which will cover 4 hectares, will encapsulate four key climatological regions. However, as the project develops over the years, more will follow. The first four regions are: the wet tropics, or rainforest; the dry tropics, or semi-desert; the subtropics, and the Mediterranean. These have been chosen because they are host not only to great biodiversity, but also to the widest range of plants used by man.

The Eden Project will make an important contribution to the conservation of threatened plant species and primitive crop plants. This work will be undertaken in collaboration with botanists around the world whose field work is already associated with the introduction of potentially valuable crop plants. The main thrust of the project will, however, remain the demonstration to the public of the inextricable links between people and plants.

This will be the first exhibition house to accommodate the height of a rainforest canopy. At 60 metres, even the largest tropical hardwoods would be able to grow to maturity. It is the intention that a series of aerial walkways will enable visitors to explore the canopy.

The master-plan needs to fulfil the following divergent criteria: to optimise solar orientation in order to achieve maximum horticultural benefit for each biome; to work in harmony with the natural beauty of Bodelva pit; to accommodate substantial future growth, and to create a complete architectural statement for the opening of the project. The adopted approach combines all of these



criteria in one cohesive organic solution, notwithstanding the radically different scale of each biome – the rainforest being 36,000 square metres, the desert 4,500 square metres. The architectural solution weaves the controlled environments of the biomes into an amorphous form which grows from the rock face.

The Eden Project represents a new point of arrival in the long tradition of horticultural glasshouses. With its Gothic – in the broadest sense – origins, it lends itself to organic development. Plant-like, it can expand and contract, cling and grow. The simple concerns of spanning and transparently enclosing an area of existing steep and rugged landscape, responding to the terrain as found, here results in a form peculiarly suited to its purpose. It is the world's largest single greenhouse, approximately one kilometre from end to end; its tensioned trusses spanning 120 metres at its widest point, with a height of 60 metres. But its effect is as much to do with where it is as what it is. Topography, vegetation, architecture and engineering are interdependent.

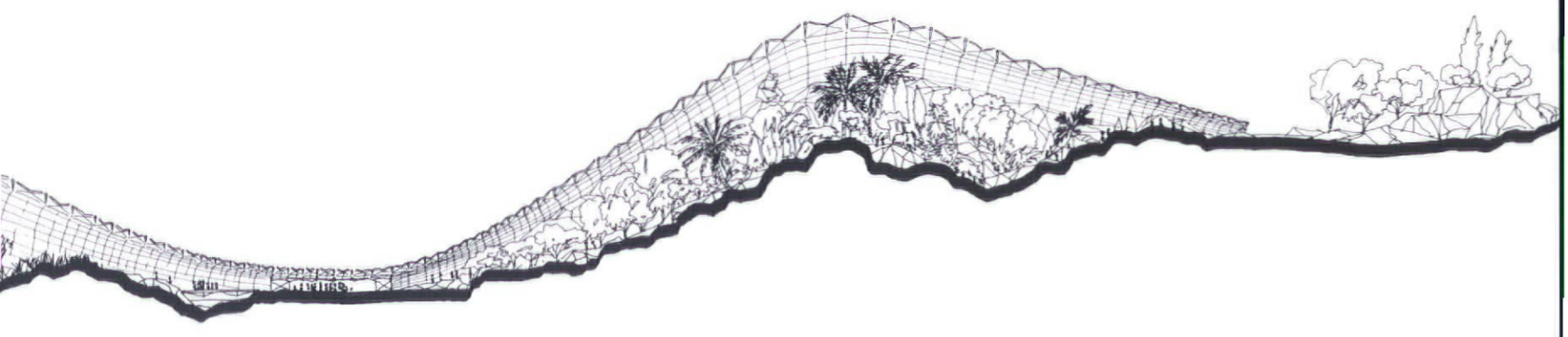
Functionally speaking, the Eden Project consists of a series of big climatic greenhouses, linked by smaller greenhouses containing ancillary spaces, staff accommodation, restaurants and so on. A separate visitors' centre at the point of arrival, expressed in the different structural idiom of the leaf-form, acts as an introduction as well as observation dome.

Natural forms, we now know, are the best engineered of all. In responding to this, the architecture of the Eden Project eschews meaningless sensationalism in favour of a calmly considered response to the unique site: its aspect, its contours, its contents. The experience of going here will undoubtedly be dramatic, not as a result of grand gestures, but because of what the architecture reveals and clarifies. It will grow, shelter and nurture, but – for all its virtuosity – it will not seek to impose.

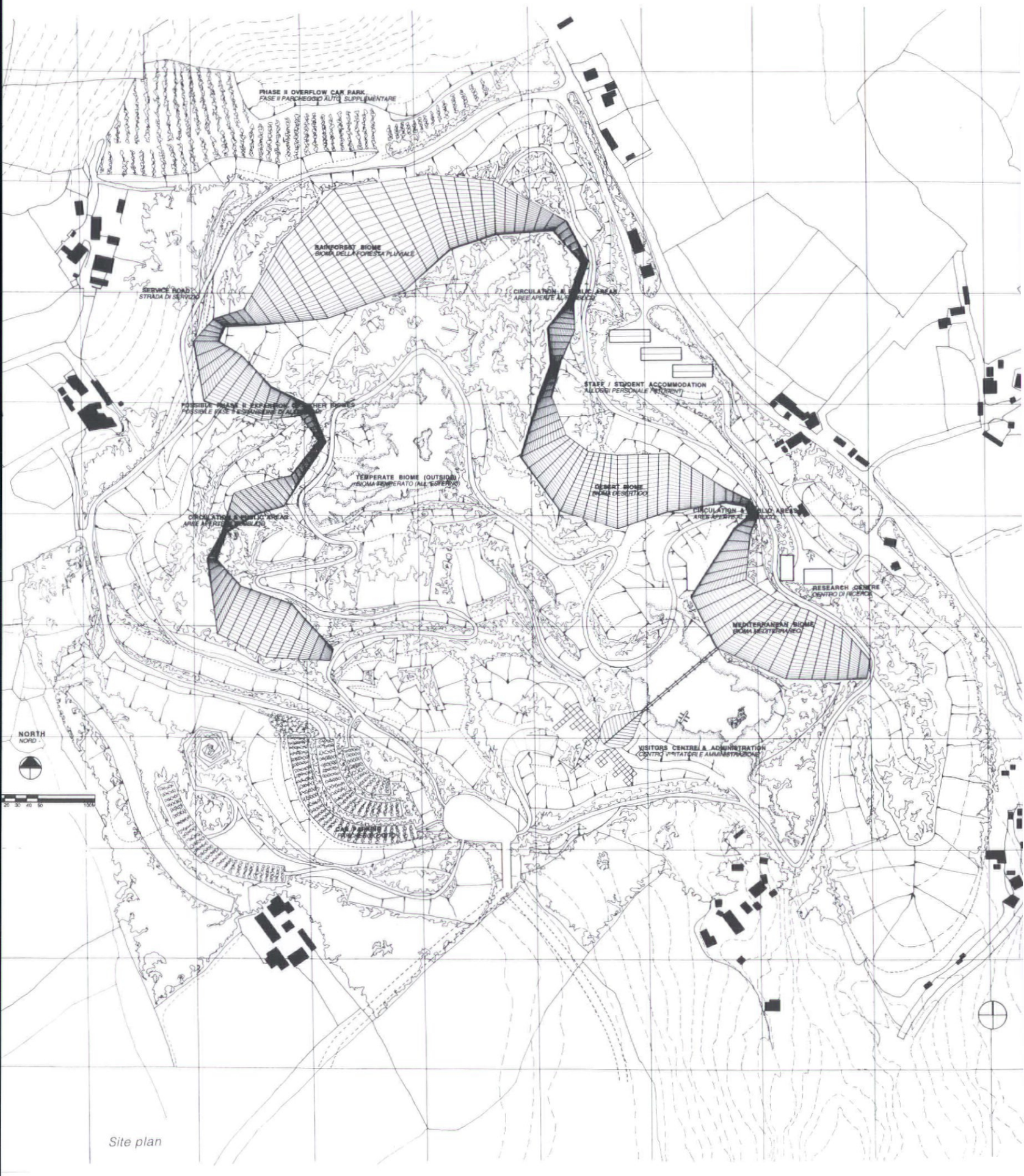
A clear differentiation has been made between the interior and exterior by structuring the building as an exoskeleton, with a soft, clear membrane suspended beneath the lightweight taut steel structure. Three reasons informed this decision. Firstly, the form and structure of the building must be fully expressed externally within its parkland setting. Secondly, the visitor should be almost unaware of the large span structures when inside the biomes, instead being immersed in each environment. Thirdly, to ensure the longevity of the biomes by minimising maintenance, remembering that the internal environments are so much harsher than the external.

The forms of the biomes are variable. Their width ranging from 15 metres to 120 metres, with the pitch of each arch shifting from 30 degree slopes to a level plane. A double bowstring structure has been selected, which, although light, could adapt to these constantly changing criteria. The diameter of the central compressive boom's tubular sections will diminish both along its length, and from one arch to the next. A bowstring tie-rod assists the span under live load, with a second above preventing wind uplift.

Separating the forces creates a dynamic yet adaptable structure, which clearly expresses its function. This structural legibility is an exciting and appropriate solution for such an ambitious botanical project. The envelope is formed from ETFE Foil – a transparent film – formed into a three layer pneumatic pillow, a form of construction with a proven performance and maintenance record. These pillows are inflated under low pressure by small electric motors, and continuously topped up with sensors which allow an active loading response to variable conditions such as wind and snow loads. It is intended to power the whole system with photovoltaic cells, in order that the biomes themselves function, live and breathe using their own form of photosynthesis.



Longitudinal section through site


PHASE II OVERFLOW CAR PARK
FASE II PARCHEGGIO AUTO SUPPLEMENTARE
RAINFOREST BIOME
BIOMA DELLA FORESTA PLUVIALE
SERVICE ROAD
STRADA DI SERVIZIO
CIRCULATION & PUBLIC AREAS
AREE APERTE AL PUBBLICO
STAFF / STUDENT ACCOMMODATION
ALLOGGI PERSONALE (RESIDENT)
POSSIBLE PHASE II EXPANSION OF OTHER BIOMES
TEMPERATE BIOME (OUTSIDE)
BIOMA TEMPERATO (ALL'ESTERNO)
DESERT BIOME
BIOMA DESERTICO
CIRCULATION & PUBLIC AREAS
AREE APERTE AL PUBBLICO
RESEARCH CENTRE
CENTRO DI RICERCA
MEDITERRANEAN BIOME
BIOMA MEDITERRANEO
VISITORS CENTRE & ADMINISTRATION
CENTRO VISITATORI E AMMINISTRAZIONE
NORTH
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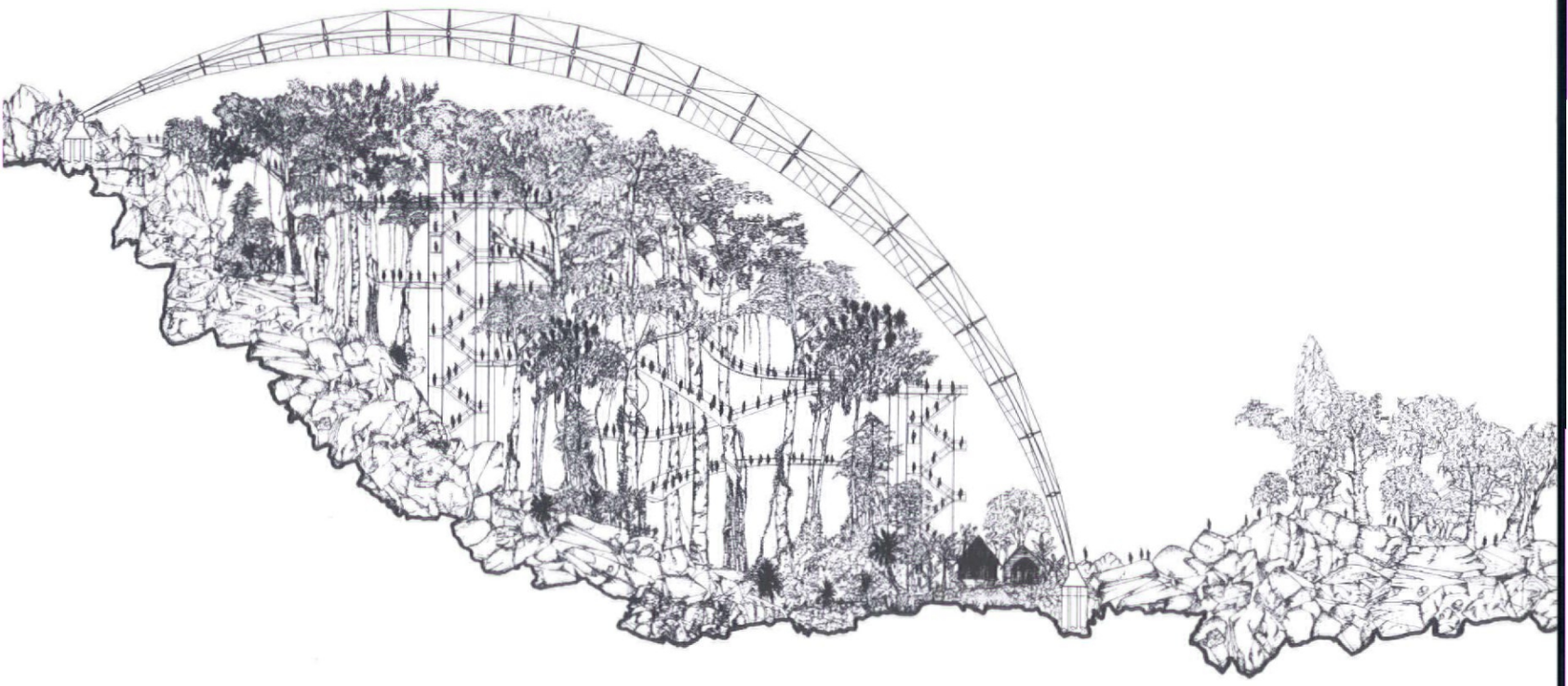
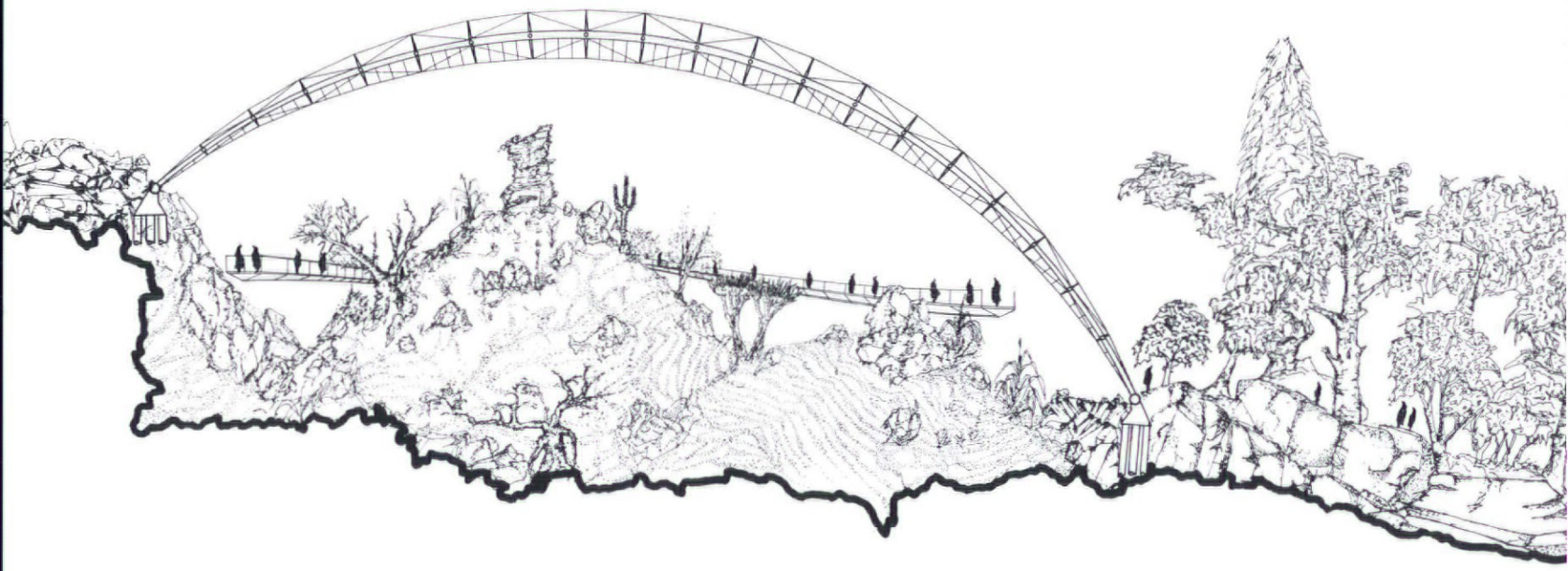
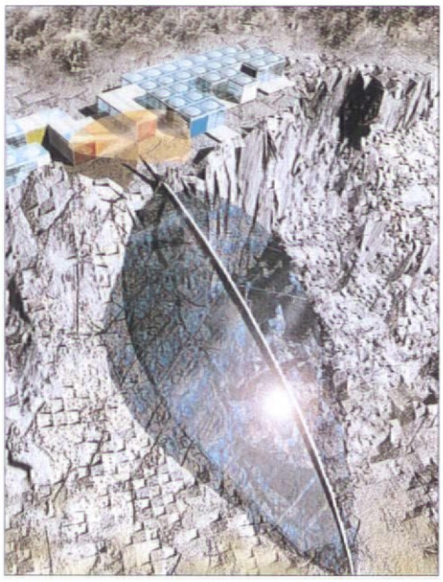
Site plan

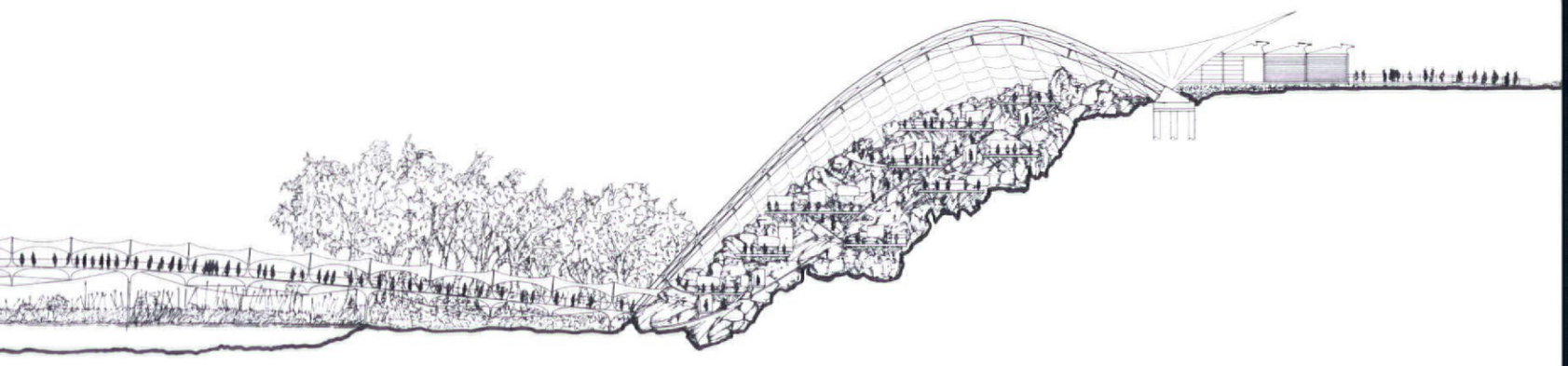


Section through rainforest biome



Section through desert biome





'The Leaf' Visitors' Centre; BELOW: Section

EMILIO AMBASZ & ASSOCIATES

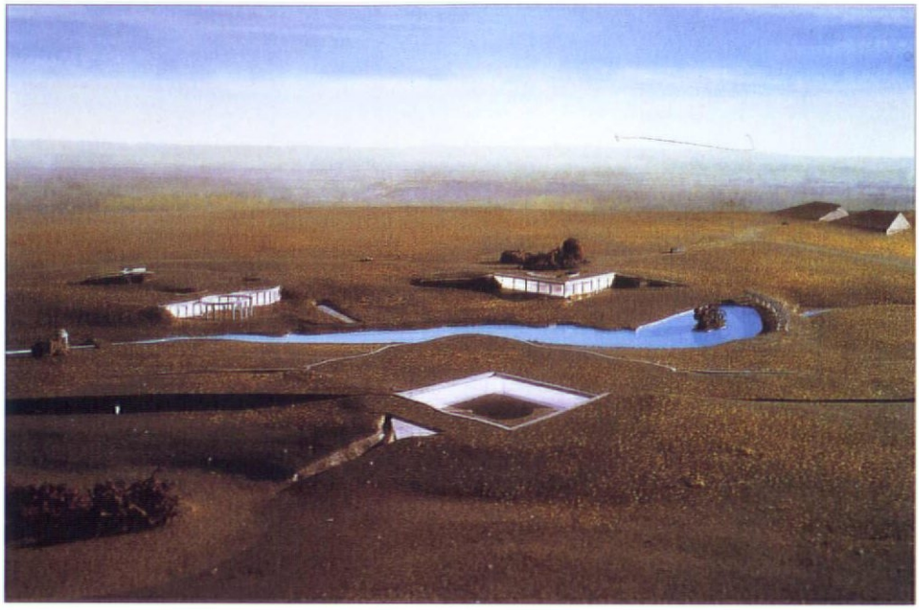
SCHLUMBERGER RESEARCH LABORATORIES

Austin, Texas

The brief for this computer research facility outside Austin required a laboratory that could adapt readily to changes in research group size, and which would promote communication. The architects have provided a solution that meets the client's needs while taking advantage of the building's location.

The site warranted a design that harmonised with the landscape and so the project was divided into a series of individual buildings, with earth berms built up against them to help integrate them into the topography, reduce energy costs, and provide the client with the campus atmosphere requested. The laboratories and recreational facilities are arranged casually around a man-made lake, in the manner of an English landscape garden. The buildings, as a result of the earth berms, blend into their surroundings, and provide a pleasant environment for employees, which takes full advantage of the pleasant vistas. Furthermore, the scheme's fragmentation encourages workers to go out and experience the landscape, rather than observing it from their offices.

The innovative laboratory consists of a large, undifferentiated space in which the researchers' enclosed offices – 2.74 x 2.74 metres mobile units – are placed. Each individual has complete control over the lighting, acoustics and temperature of their unit, and also enjoys an unusual degree privacy. The units may be moved quickly and easily by a fork-lift truck to a new location, accommodating any group size and configuration. The proximity of these units, and the common space that results from their arrangement, fosters communication within the research group. These laboratories successfully combine the benefits of an open-plan office with those of a traditional office.



NICHII OBIHIRO DEPARTMENT STORE

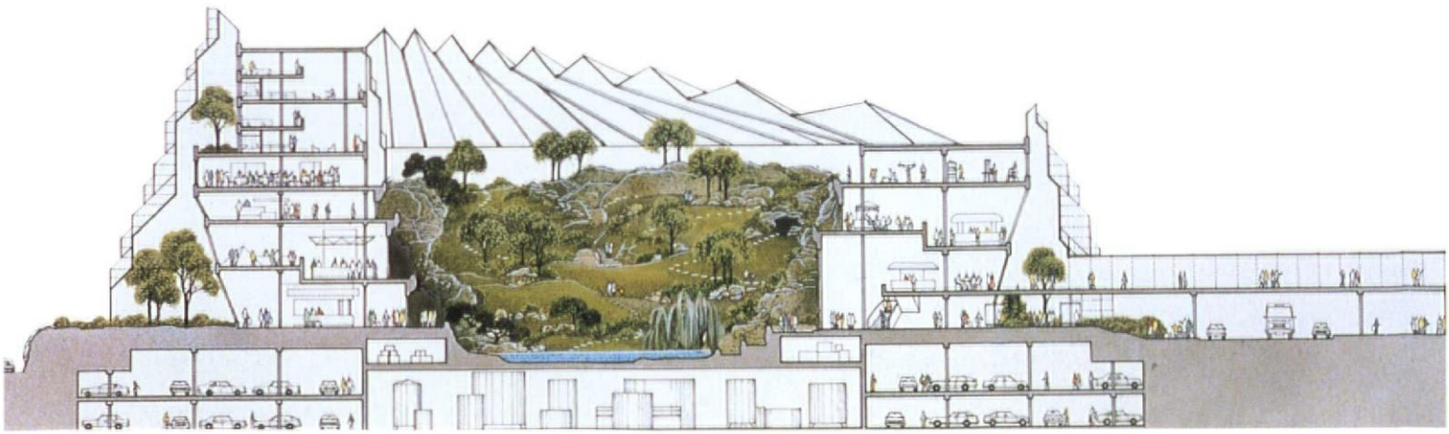
Obihiro, Japan

This department store will be built in Obihiro, the second largest city on Hokkaido, Japan's northernmost island. Climatically similar to Siberia, Hokkaido's ever present image is that of a winter in which the snow seems somehow to fall horizontally. The Mycal Group, owner of the Nichii Department Store, is an enlightened corporation, committed to the notion that customers should be treated as old friends, and that it is their responsibility, as merchants, to provide a pleasant, welcoming environment. This department store, therefore, will offer the citizens of Obihiro a grand winter garden, where they can gather under a glass skylight to look at plants, listen to cascades, and stroll along walkways in the courtyard around which the building is organised.

The store will be dedicated not only to retail sales, but also to various other services, ranging from health clubs and restaurants, to mountain climbing lessons. This unusual variety of services results from the Japanese policy that forbids department stores from competing directly with smaller shops, and allows them to expand only if they provide facilities other than retail. The store will also house micro-factories for baking, bottling, knitting and garment assembly, and will contain hotels, banquet halls and even wedding chapels. In this way, the complex will also address the city's lack of space for large social gatherings.

Since the store covers approximately 2.5 acres, a rather large footprint for a Japanese building, the client wanted the building to present the friendliest possible face to the community. Therefore, the store will appear as if it is 'covered' with greenery. In fact, the building will have an outer layer of glass, but the space between it and the insulated walls of the interior will be filled with plants. Visitors driving around the building will see it as a naturally green promontory, rising from an earthen podium that conceals extensive underground parking facilities. The building's faceted glass walls rise to a peak, their irregular shape dictated by sun and shade angles, local zoning and height limitations, and the presence of a microwave-beam, carrying telephone communications, 33 metres above the store. When the public enter the building, they will discover that this promontory also has a green heart that pulsates with spring, even in the middle of winter.

Above: First floor plan; BELOW: Section



MEMORIAL MUSEUM

Ramat Hanadiv, Israel

Drawing upon the Eastern tradition of shaded gardens, the new visitors' centre creates an encompassing sense of peace and serenity, while leading visitors to the gateway of the existing European-style gardens.

After symbolically driving through a cleansing, circular, shallow reflecting pool at the entry to the grounds, visitors soon arrive at the centre's entrance gates; a symmetrical pair of earth berms, carrying solar panels which supply the energy requirements for the museum. Two identical columns, each bearing a live olive tree upon its capital, receive the visitors to the gardens. A grid of similar columns supports an open ivy covered trellis, providing continual shade to the expansive parking area.

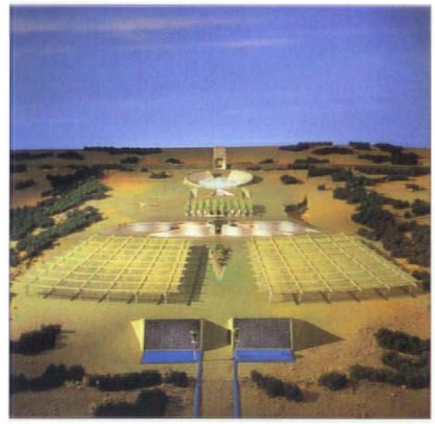
Arriving at the first, circular entry court, visitors walk quietly past a single leafy and shading tree, which represents Israel's historic commitment to agriculture. Passing through this entry court, evocative of the original garden, visitors emerge into an inviting ambulatory surrounding a rectangular, shaded courtyard and reflecting pool. The water may be drained from its enclosure to create a large open gathering space for dining tables or special functions. An array of columns, once again bearing olive trees, appears to grow from the very waters of the pool, subtly arching to a high point at the centre, shielding the visitors with a dome-like canopy reminiscent of the curvature of the sky.

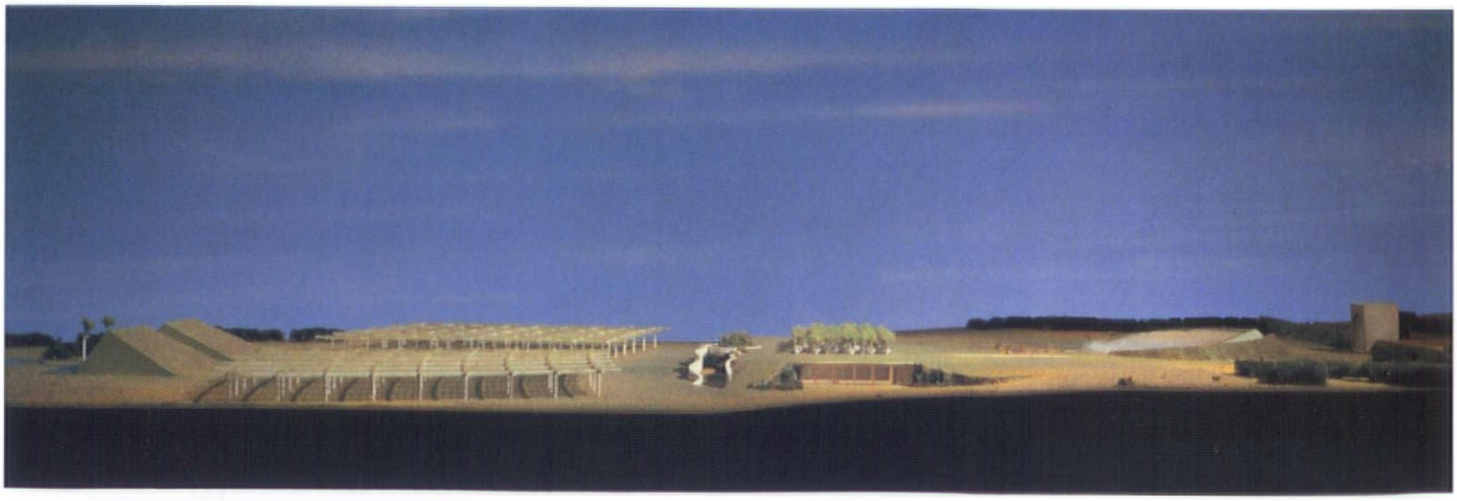
The central courtyard creates a cool, shaded area of respite, while providing access to each of the museum's functions. It was important to address not only the need to gently guide the new visitor around the exhibits, but also to stimulate the regular visitor who may have a much more specific agenda. In this design, both needs are reconciled.

Guests may proceed directly to the gardens via two gently inclining ramps, which also provide disabled access, or descend through the Auditorium.

From the central courtyard, one may proceed directly into the open garden which leads to the final gateway. Here, a circular planted berm creates an outdoor amphitheatre, protected by moveable stretched cloth canopies, where the visitor may relax or watch performances. The amphitheatre also frames the view of the final gateway. Looking ahead, however, the view to the gardens is gently veiled by the gate's tall green hedges, reminding us that what is to come cannot be wholly foreseen.

Beyond the gates, visitors cross an arched bridge above a pool of water. Just as the shallow, circular reflecting pool cleansed the path of each visitor, this final pool purifies them before they enter the Memorial Gardens.





JOHN MILLER + PARTNERS

ELIZABETH FRY BUILDING

East Anglia, England

Even though the university encouraged the architects to pursue an energy efficient solution, there was no additional budget available. It was therefore necessary to specify materials which were low cost, readily available and able to perform multiple functions.

Externally, there is a one-storey plinth of reconstructed stone-faced blockwork, with bands and coping courses of blue engineering brick, above which a self-finished cement render was extensively utilised in order to avoid the need for decoration. The internal cavity wall is constructed from locally sourced block work, whose density significantly contributes to the thermal mass of the building. The main structure consists of hollow-core precast floor slabs, which distribute ventilation, provide the main source of internal thermal capacity, and reflect and distribute artificial light.

The windows are triple glazed, with aluminium clad wooden frames. The inner sealed unit is filled with argon, and finished using a low-emissivity coating. With the exception of the north elevation, integral venetian blinds for solar control have been placed between the inner unit and the outer pane. All the windows are openable, providing natural ventilation as required. The aluminium cladding reduces maintenance costs, while the timber ensures good insulation.

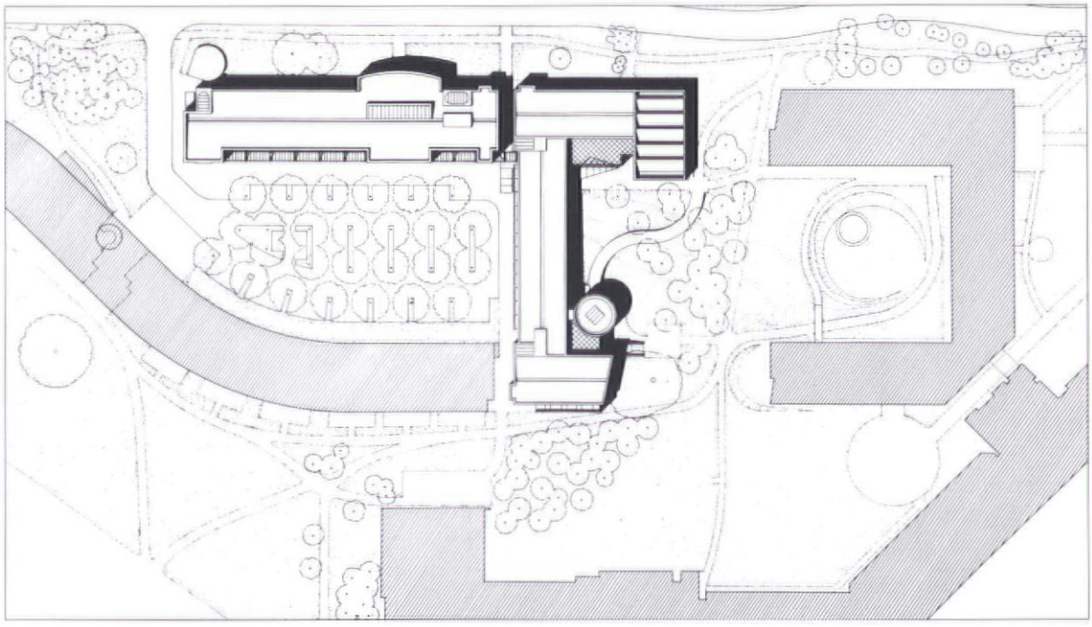
The building maximises passive solar energy and ambient conditions to achieve comfort without air conditioning. This also avoids the use of damaging CFCs and HCFCs. Similarly, the insulation chosen, Rockwool and EPS, were produced using environmentally friendly processes. Where possible, applied finishes are eliminated, and, when unavoidable, water-based paints and adhesives are used. The target was to construct a building that produced less carbon dioxide per square metre than the BRE low energy office, and it is pleasing to note that this has been achieved.

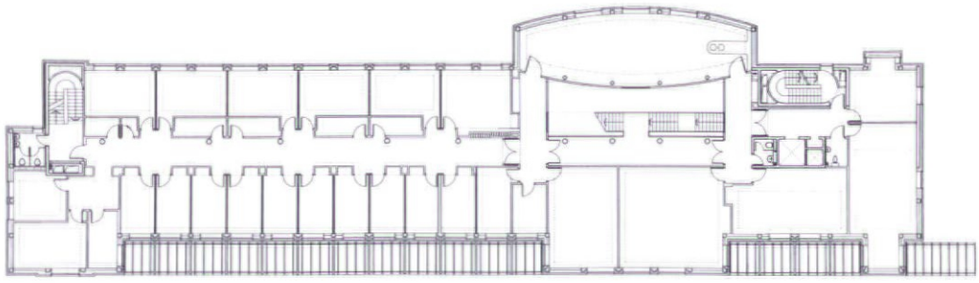
The main ventilation system uses 100% fresh air, which is warmed using heat exchangers. All rooms are naturally lit as daylight has been exploited throughout. Artificial light is provided for use outside of normal working hours.

The need to achieve comfort while minimising energy consumption, led to the use of a very well-insulated and draught-free building envelope, with a high thermal capacity. The offices and other rooms are mechanically ventilated in winter, with heat recovered from the exhaust air. If this does not provide a satisfactory environment, the users can always open a window. The principal improvement in energy performance is the elimination of mechanical cooling.

In order to achieve an energy efficient solution at a reasonable cost the building is heated by warming the ventilation air, which is distributed via the floor slab. The insulation levels are high for the UK, but they are considered standard in Scandinavia and North America. Great care was taken to avoid major thermal bridging, as this can completely negate an architect's efforts to insulate a building. Structure and insulation must be highly integrated, or a building is likely to save less energy and cost more. It is symbolic of the building's energy efficiency that it can be entirely heated by two domestic, wall-mounted boilers.

South elevation and part section





FROM ABOVE: Site plan; first floor plan

EDWARD CULLINAN ARCHITECTS

WESTMINSTER LODGE

Dorset, England

When considering building design from a green perspective, the issues of renewable resources and sustainable development, as well as energy conservation, become significant. This is what makes the work of the Parnham Trust so important. John Makepeace, the furniture maker and director of the trust, has written that:

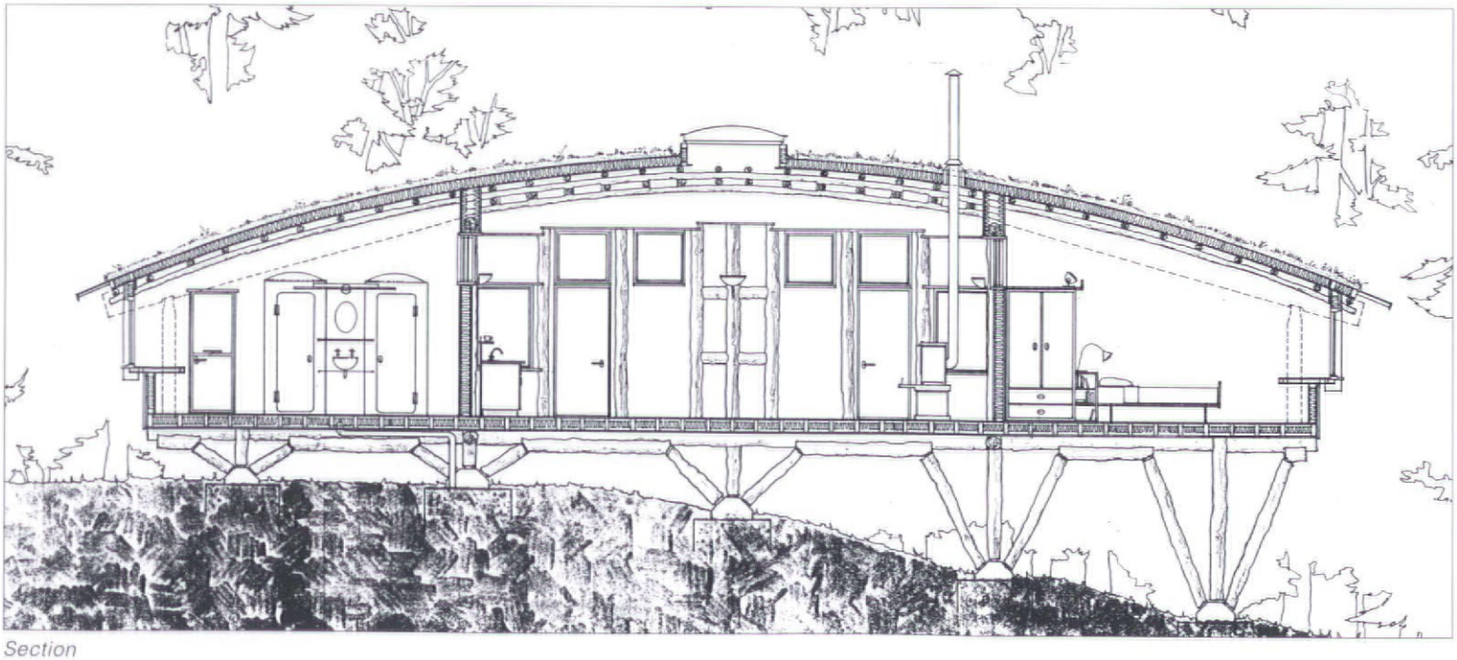
> Britain imports 90% of its timber at an annual cost of £9 billion. Yet thinnings, which represent half the annual crop of British timber, are disregarded as a structural material. By using this resource, we can improve the quality and productivity of UK woodlands and reduce imports. Timber is as strong as steel on a weight to strength ratio, but it has not received the scientific research for it to compete with new materials made from finite resources. Now that energy, sustainability and employment are pressing issues, trees and timber offer new economic, social and environmental possibilities.

Westminster Lodge, supported by a generous donation from the Duke of Westminster, demonstrates a new ecological approach to housing, as it is constructed from thinnings which are a by-product of good silvicultural practice.

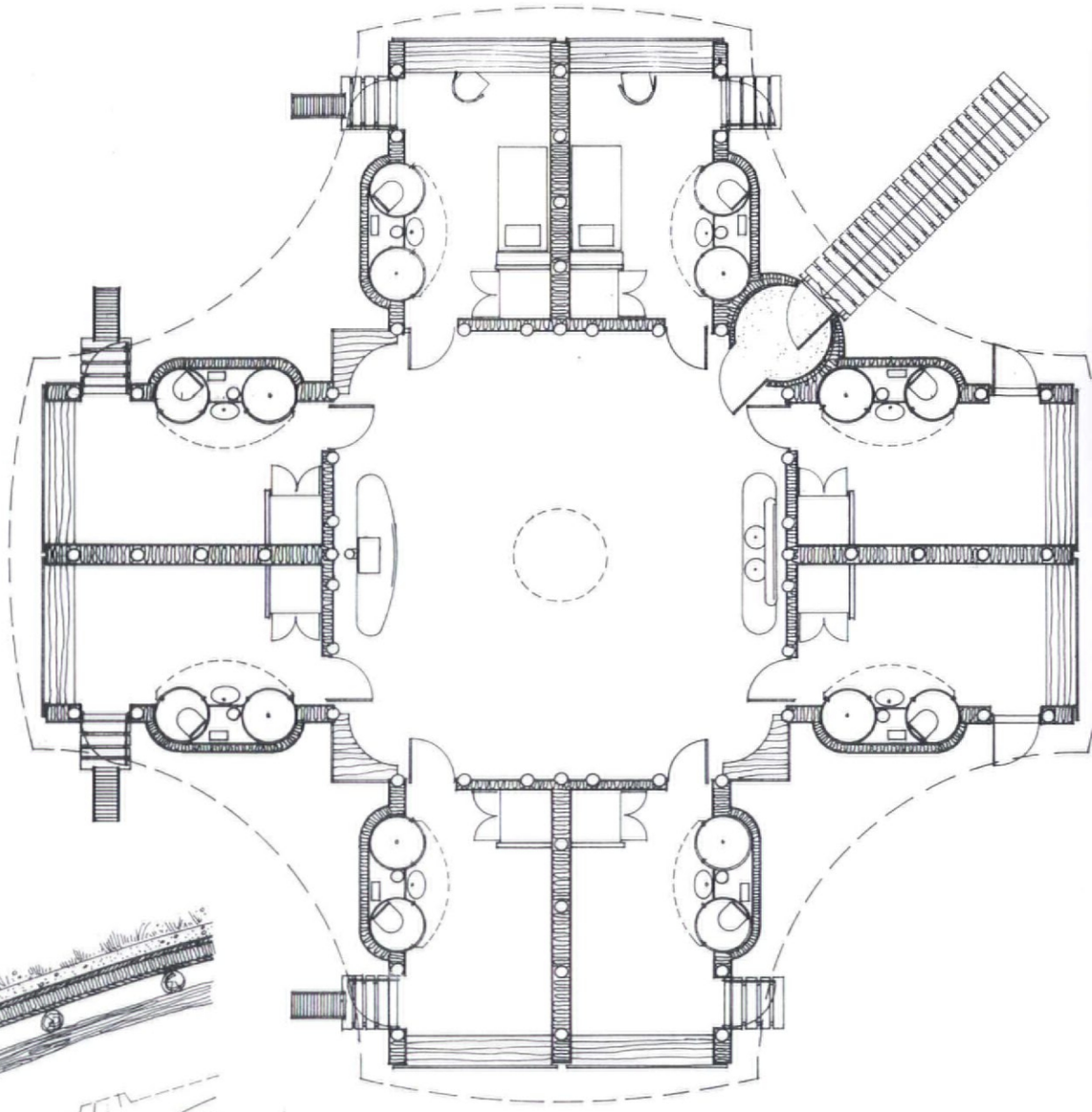
In this building, the first of five residential lodges for courses at Hooke Park – for students wishing to integrate ecological design, manufacturing or construction into business – the architects set out to achieve the following objectives. Firstly, the building was a vehicle for vital research into the properties of roundwood in building construction. This was a collaborative research programme by the engineers Buro Happold and scientists at the University of Bath, working with the construction team at Hooke Park, and was funded by the Department of the Environment and Industry. Secondly, the lodge was designed to meet the demands of future housing markets in sensitive landscapes, and provide the basis for an ecological village which will exploit the best structural properties of timber and be a showcase for the improved use of wood.

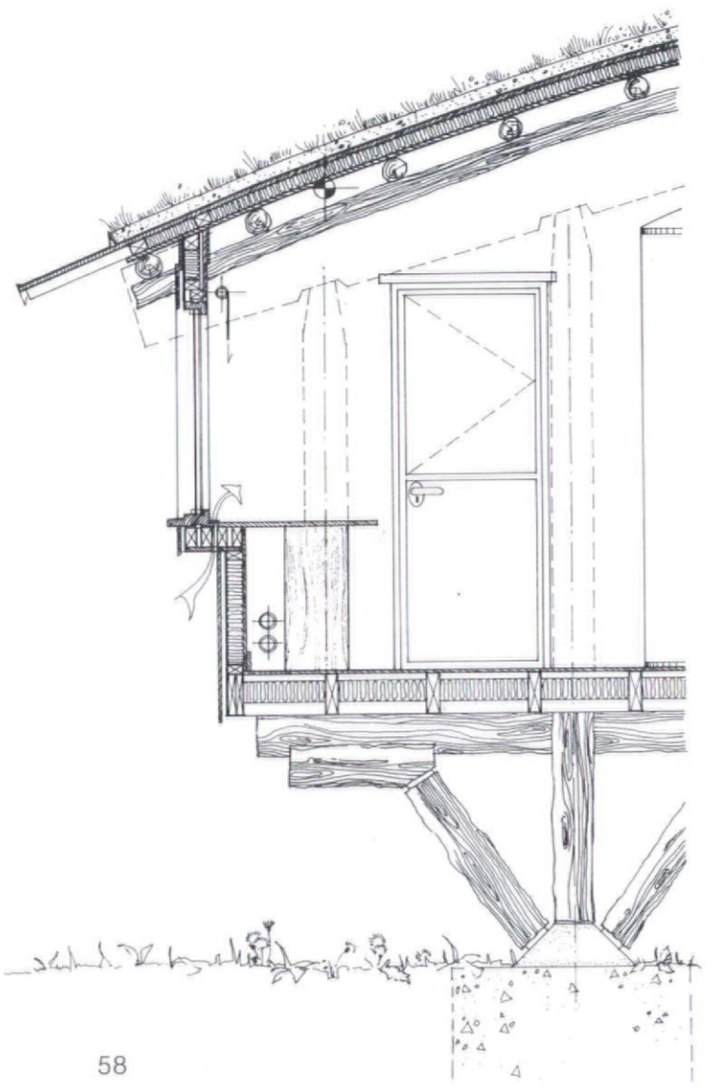
Underlying the construction of the lodge is the concept of using locally resourced roundwood thinnings. This is very much a continuation of experiments made in the two previously constructed buildings at Hooke: a large workshop and a prototype house. These structures used thinnings in suspension and in clear span arches to form individual spaces. In the lodge, there is divided, or cellular space, where the divisions are necessary to the total construction.

Soundproof, roundwood framed walls separate four pairs of rooms and a central space, all raised on a platform above the forest floor. The result is a ring of comfortable and secure feeling rooms gathered around a large living, kitchen and seminar room. The roof over the central area is supported by thinnings, bent over the dividing walls and engineered into a double lattice. All the accommodation is placed beneath a great grass topped, curving canopy of a roof, which appears to float through the tall trees of the forest.

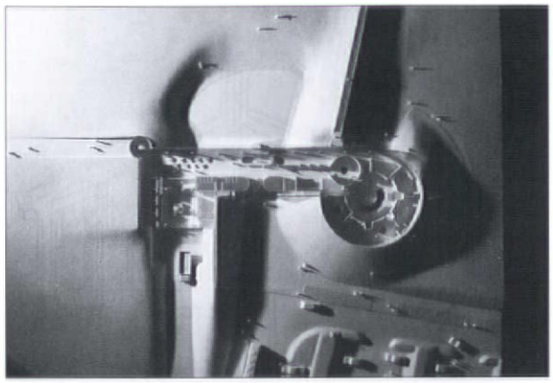


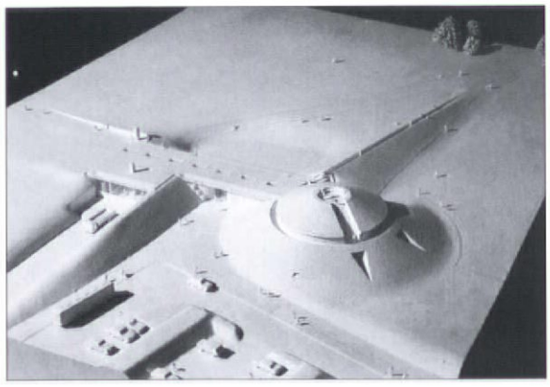
Section

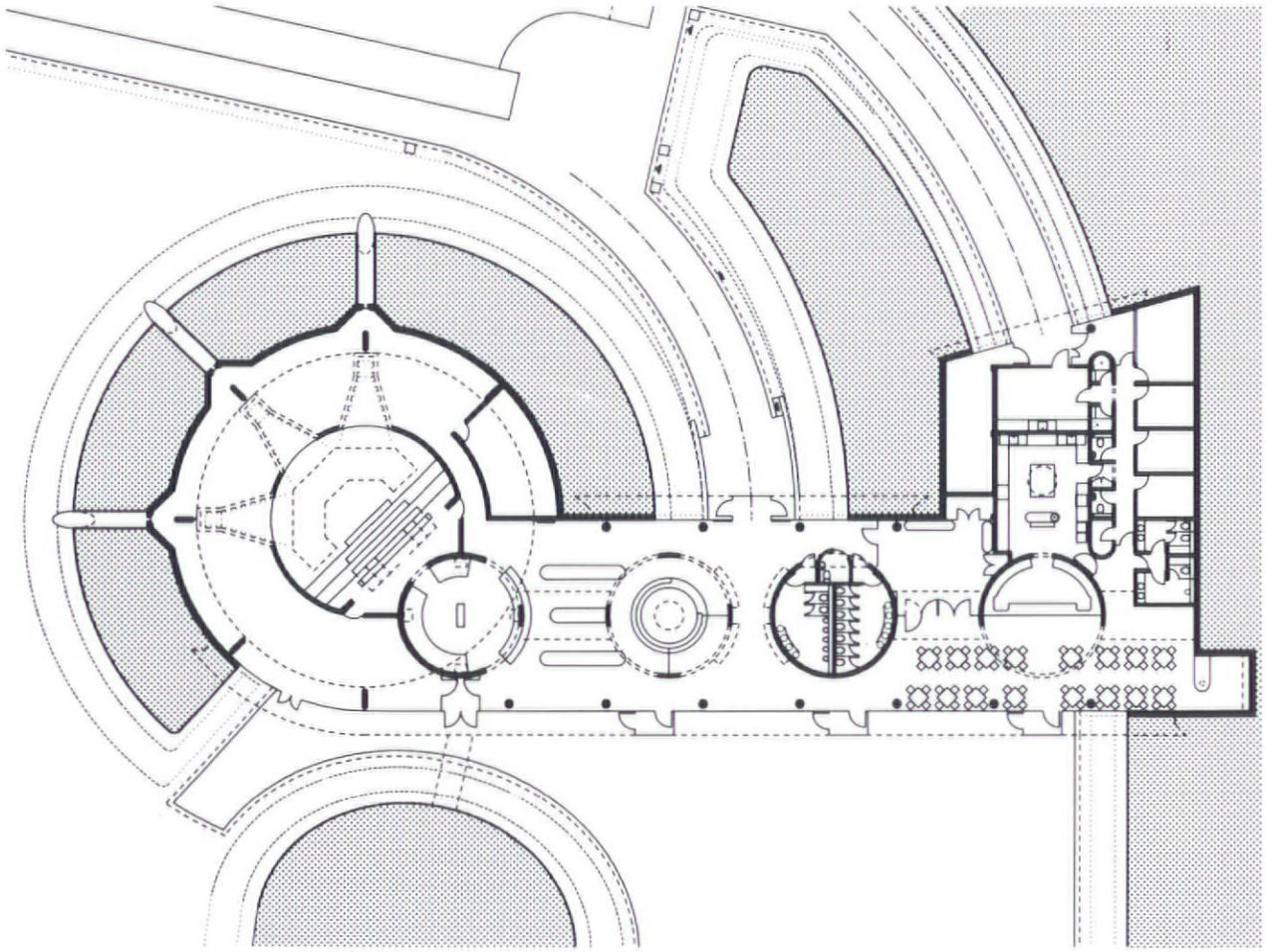


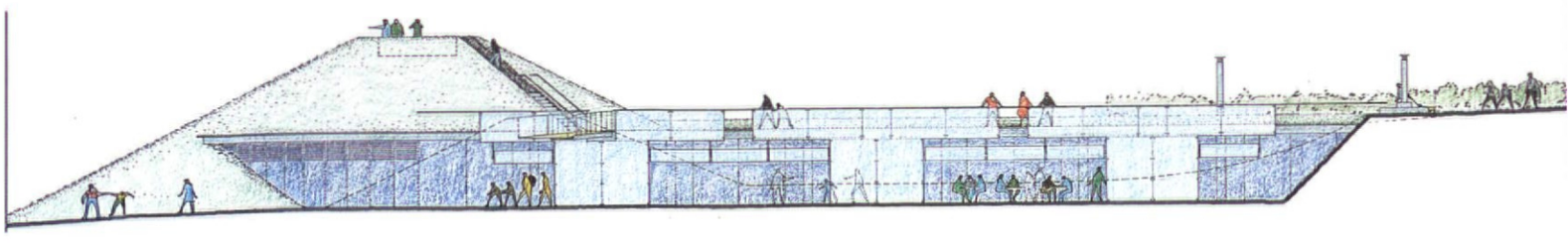


FROM ABOVE: Plan; constructional section









ARCHAEOLINK CENTRE

Oyne, Scotland

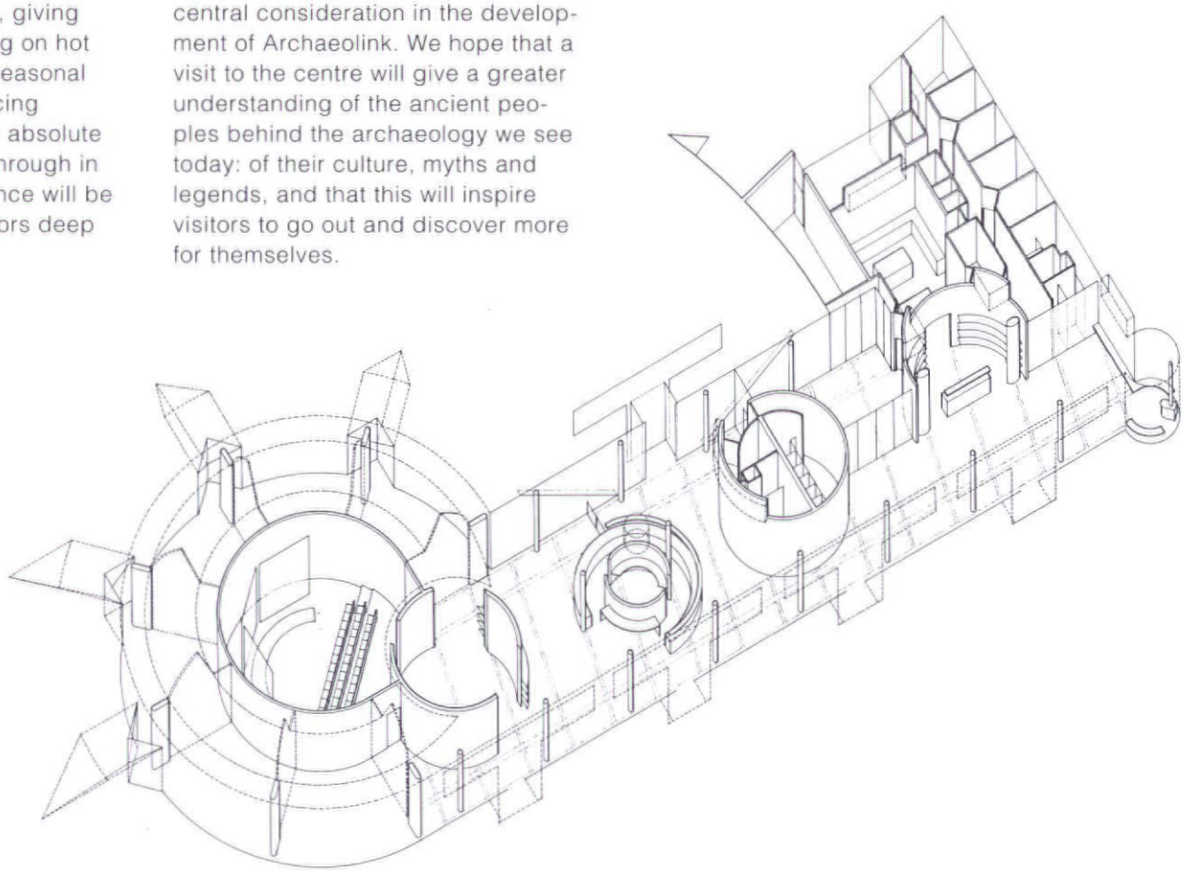
The Archaeolink building is unique in many ways. Constructed with reinforced *in situ* concrete frame, walls and roof, it has been designed to sit in the contours of the sloping fields, with the land roofing over and folding around it. The dome which houses the cinema will be grassed over, and, viewed from the outside, will blend into the surrounding hills.

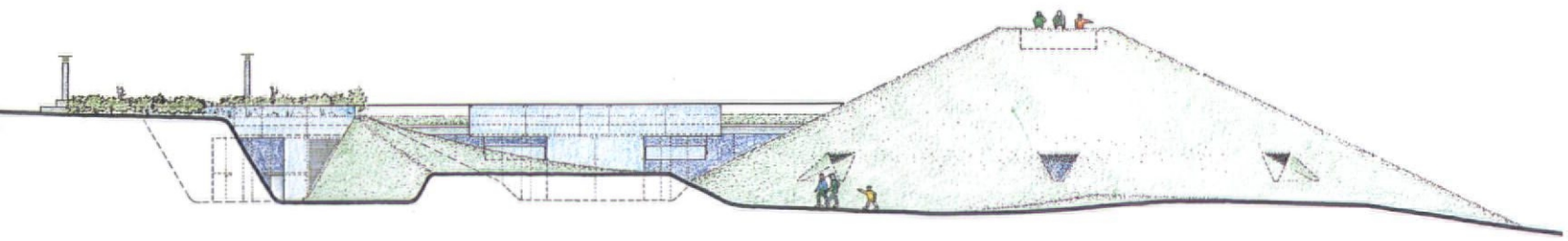
In fact, 80% of the building fabric will be underground using the latest earth sheltering principles to create a giant heat store beneath the building, giving heat in cold weather and cooling on hot days. The design will balance seasonal variations in temperature, reducing heating and cooling costs to an absolute minimum. As a potential breakthrough in low energy design its performance will be measured by temperature sensors deep in the ground.

The external walls are all of glass, with a long glazed hall, which houses the shop and restaurant, opening onto a sunken courtyard. The design is intended to provide a window on Aberdeenshire's ancient past, maximising views to the prehistoric hill forts of Dunnideer and Berryhill, as well as Mither Tap beyond. Project director Karen Smith said:

> This link between the centre as an information point and the actual sites outside our walls, has been a central consideration in the development of Archaeolink. We hope that a visit to the centre will give a greater understanding of the ancient peoples behind the archaeology we see today: of their culture, myths and legends, and that this will inspire visitors to go out and discover more for themselves.

OPPOSITE, FROM ABOVE: Plan; west elevation; BELOW: Axonometric; east elevation





CD PARTNERSHIP

ADDISON WESLEY LONGMAN HEADQUARTERS

Harlow, England

Completed in December 1995, the new headquarters for the Addison Wesley Longman publishing group successfully demonstrates the benefits of a close client/design team collaboration in seeking a genuinely user-led approach to the design of the modern workplace. This naturally ventilated building displays coherence and clarity in form, structure and circulation, and, when assessed under the BREEAM environmental design scheme in 1993, it achieved 20 out of 21 credits, a rating unequalled at the time.

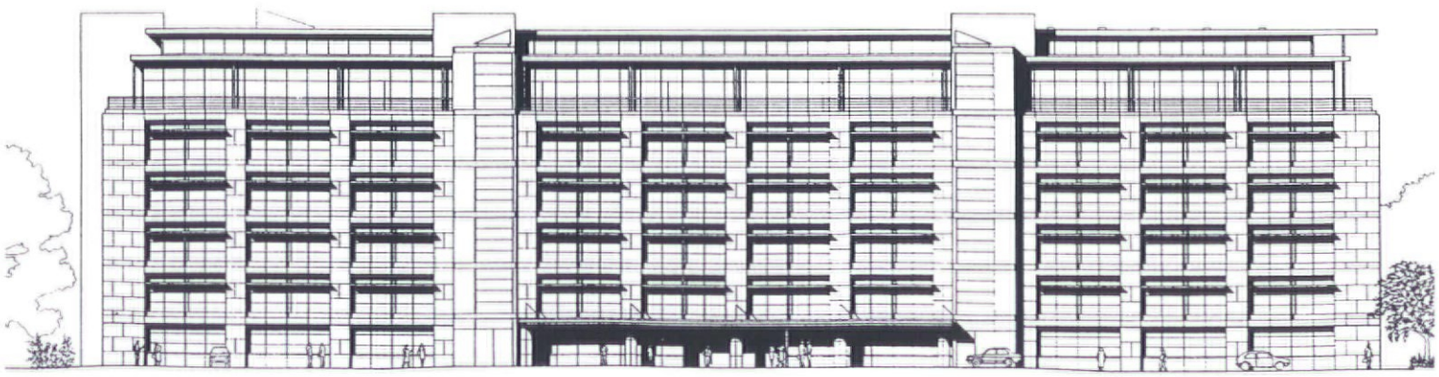
The development of the client's brief was a highly interactive process. A broad cross section of staff was involved in meeting with the design team to discuss corporate facilities, site services, information technology and the quality of the working environment. The result was a very clear demand for individual control, value for money, quality without ostentation, internationalism and environmental awareness. A poll of all staff produced one demand in particular: the ability to open windows.

The building has an area of 16,000 square metres, and is located along the eastern edge of the site. This orientation positions the two shorter elevations next to the noisier site boundaries: to the north is a railway line, to the south a main road. It also creates a strong relationship with, and views to, the adjacent park, which the building protects against further development.

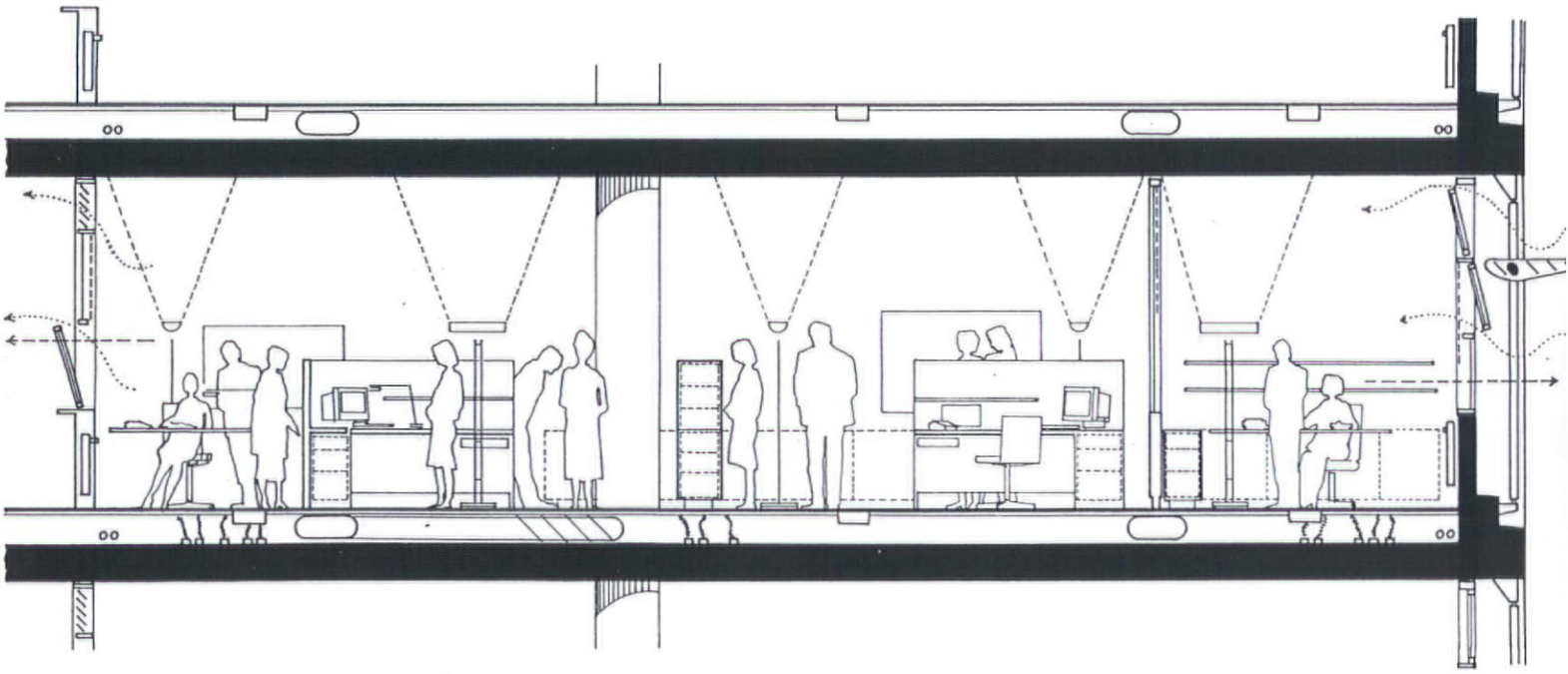
Constructed from *in situ* concrete the headquarters is constructed in two blocks, each 90 metres long and 13.5 metres wide, on either side of three atria, 12 metres wide and separated by the main service cores.

The west block has six floors and the east five. The offices are located on floors one to four, while the ground floor houses the shared facilities. The fifth floor accommodates the main staff restaurant, with roof gardens to the east utilising the stepped section and providing views over the surrounding parks.

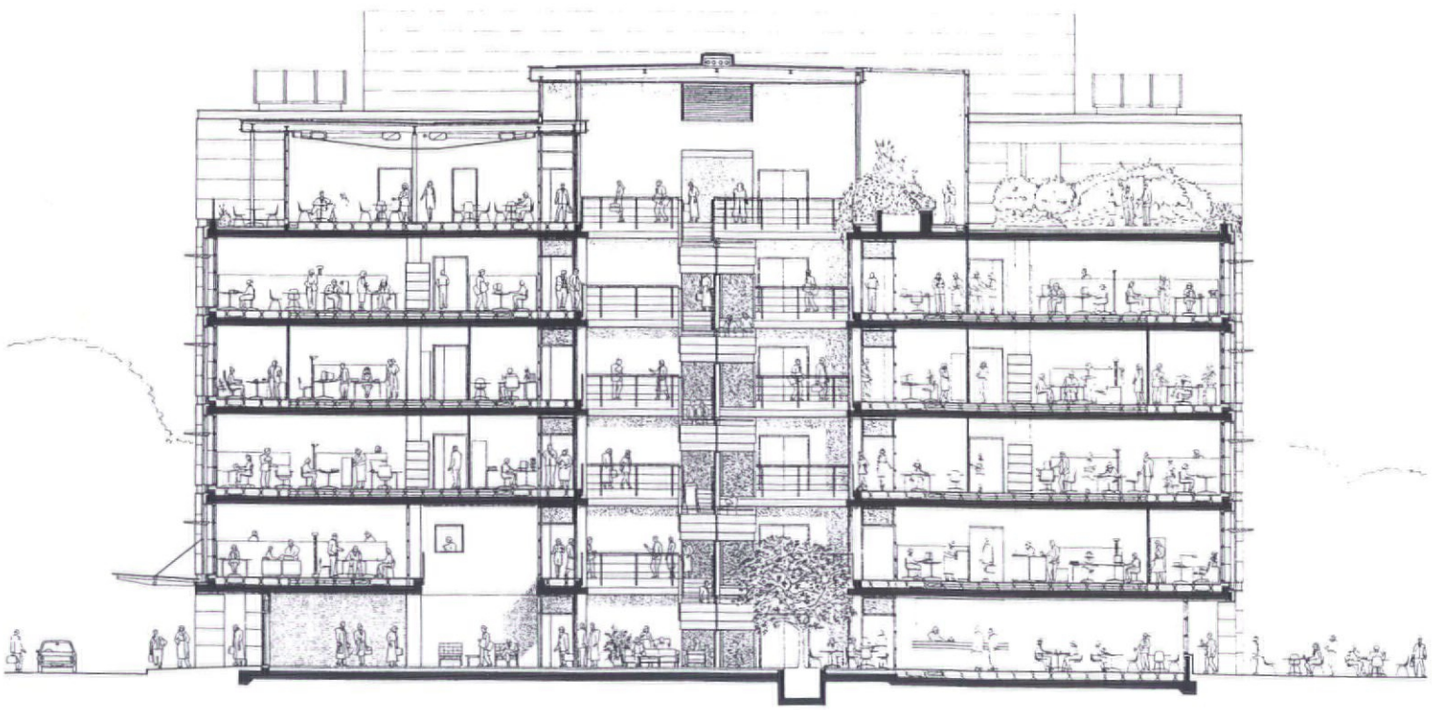
Internally the concrete structure is left exposed using its thermal mass to assist cooling. The floor to ceiling height of 3.1 metres is generous, and enables heat to rise above the working plane. American oak screens, with windows and louvres for ventilation, separate the offices from the atria. All services are fed from a raised floor leaving the concrete soffit clear. Purpose-built uplighters reflect light to reduce glare, while the ceiling is painted white to maximise efficiency. As the luminaires are moveable they can be positioned as required. Radiators, with individual thermostatic control, heat the interior. Large areas of openable window maximise natural light, with external solar shades and internal blinds to control of solar gain and glare. Externally the building is clad in Cornish granite and Jura limestone, both materials which age gracefully.



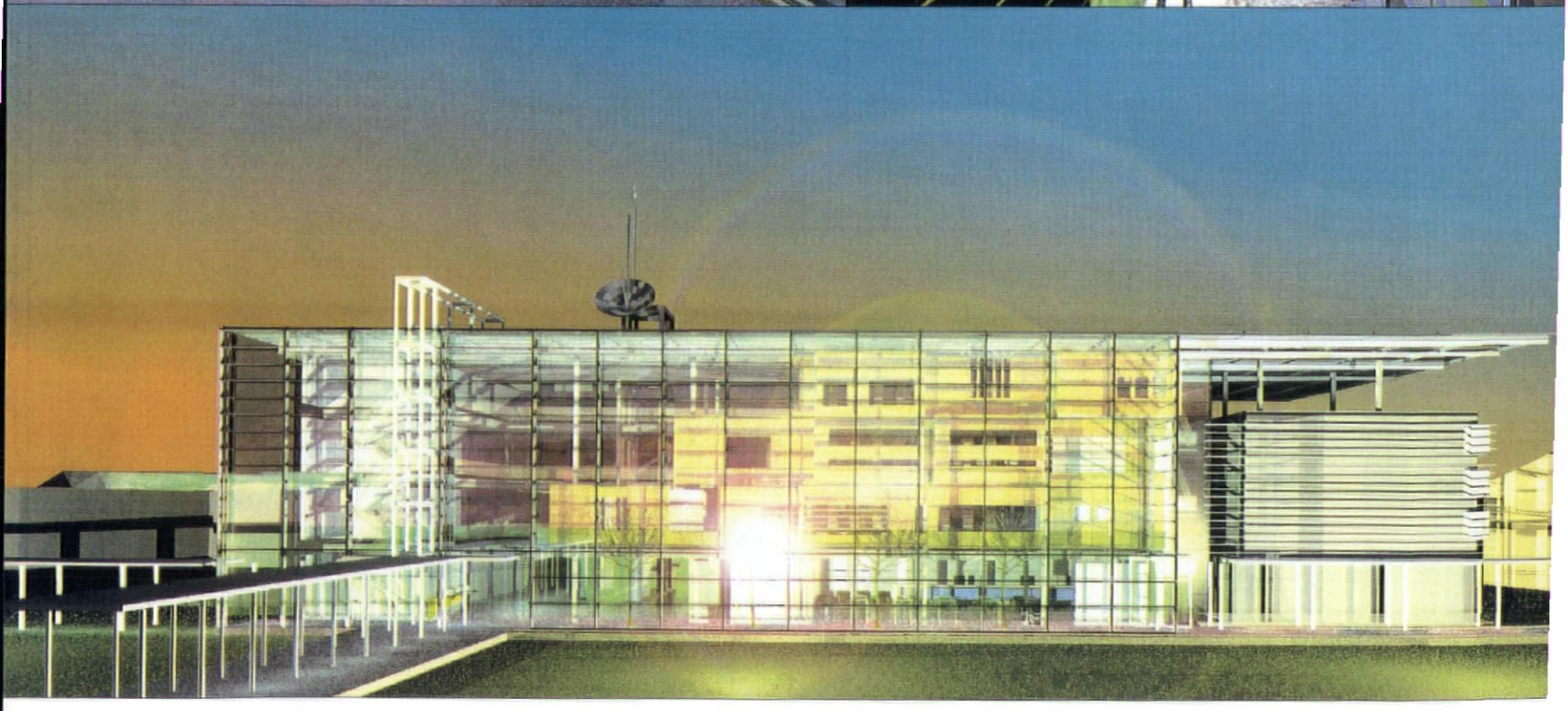
Elevation



Typical office floor section



Section through central atrium



ECD ARCHITECTS

SELLIC: THE LIBRARY OF THE 21ST CENTURY

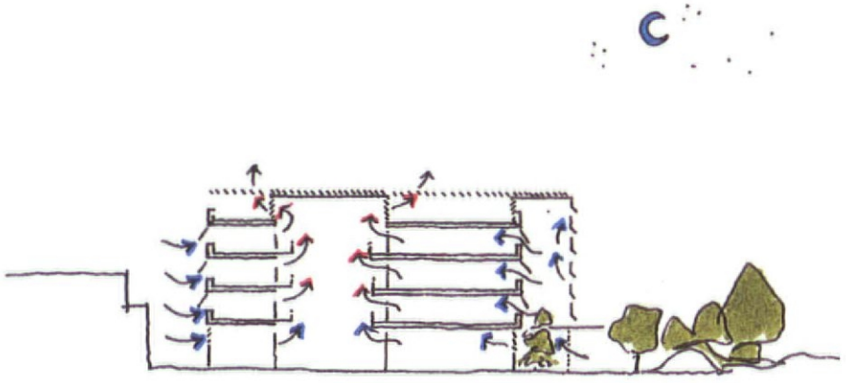
Edinburgh, Scotland

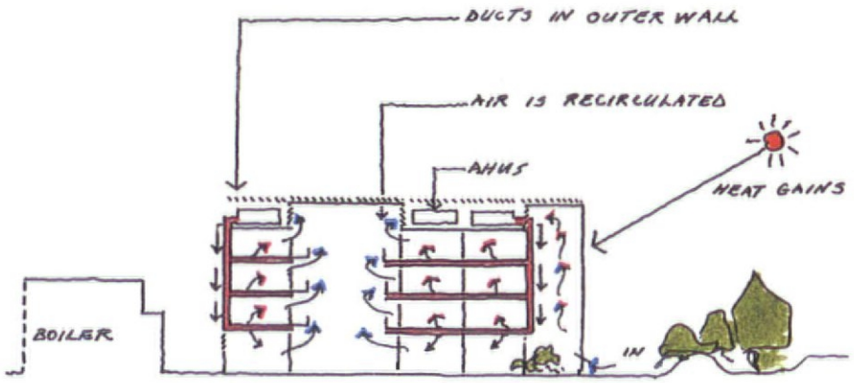
This project, currently on show in the British Pavilion at the Venice Biennale, attempts to redefine the traditional typology of the library, based on recent developments in information technology. The electronic revolution has transformed most aspects of our lives, and particularly the way in which we receive information. These events have now progressed so far that the traditional form of the library as a book repository is in question. More and more, these institutions become virtual rather than physical spaces: one more location on an ever increasing global network. In this project the architects have represented this transition by producing a transparent hub at the centre of Edinburgh University.

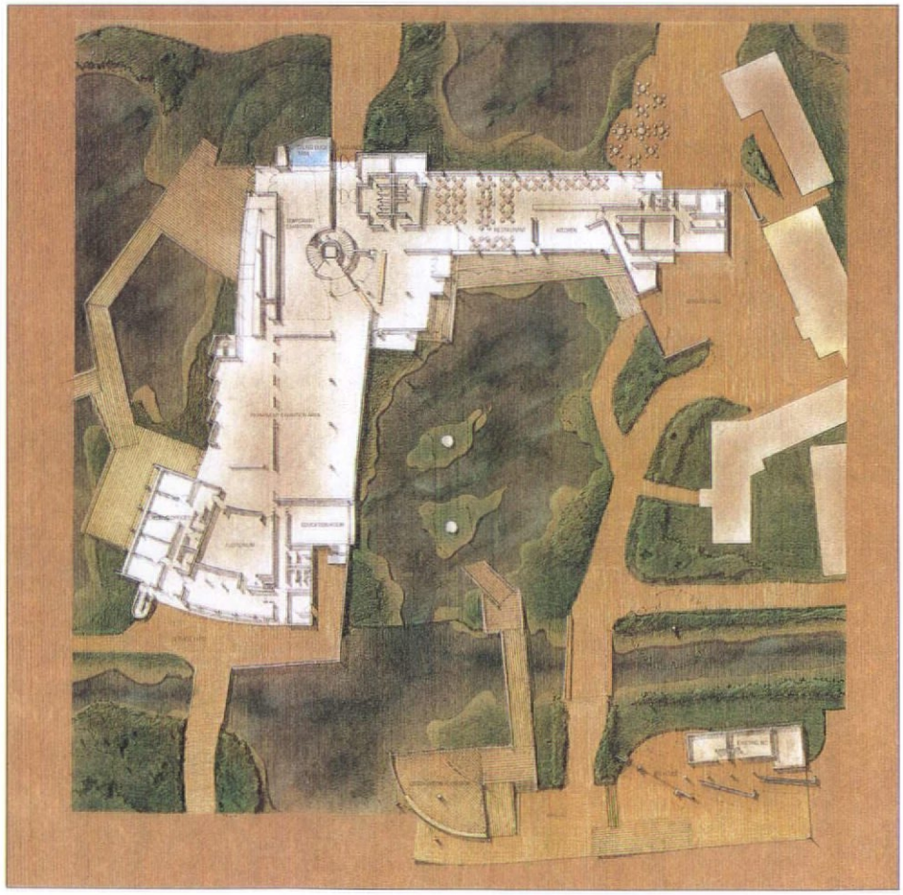
The building organises itself around a central atrium which contains the vertical circulation, and orientates the users upon entry. To the south a winter garden encloses an existing pathway, creating an environmental buffer zone.

The library is designed to respond intelligently to external and internal environmental criteria, adjusting its 'breathing' as conditions alter from day to night, summer to winter. The outer skin is modulated by automatic controls which open and close the membrane in tune with environmental fluctuations, while the atrium acts as a transitional 'lung' that naturally transfers warm stale air up to the services concealed in the roof void. The inner skin, made of timber panelling, is softer in nature and can be operated manually, allowing users to open the windows. In the summer the southern elevation can be completely opened, dissolving the barrier between the interior and the winter garden.

OPPOSITE, FROM ABOVE, L TO R: Interior of the library; the winter garden; southern facade of the library facing the internal campus garden (all images computer-generated); BELOW: Analytical sketch diagram summer night cooling; analytical sketch diagram winter heat reclaim







WILDFOWL AND WETLANDS CENTRE

Slimbridge, England

At the Wildfowl and Wetlands Centre, Slimbridge, sustainability became an immediate issue due to the remote location of the site and the client's sensibilities. Ideally, in this situation a building should attempt to be entirely self-sufficient, and not require any external inputs of energy, or create any outputs which are harmful to the immediate environment.

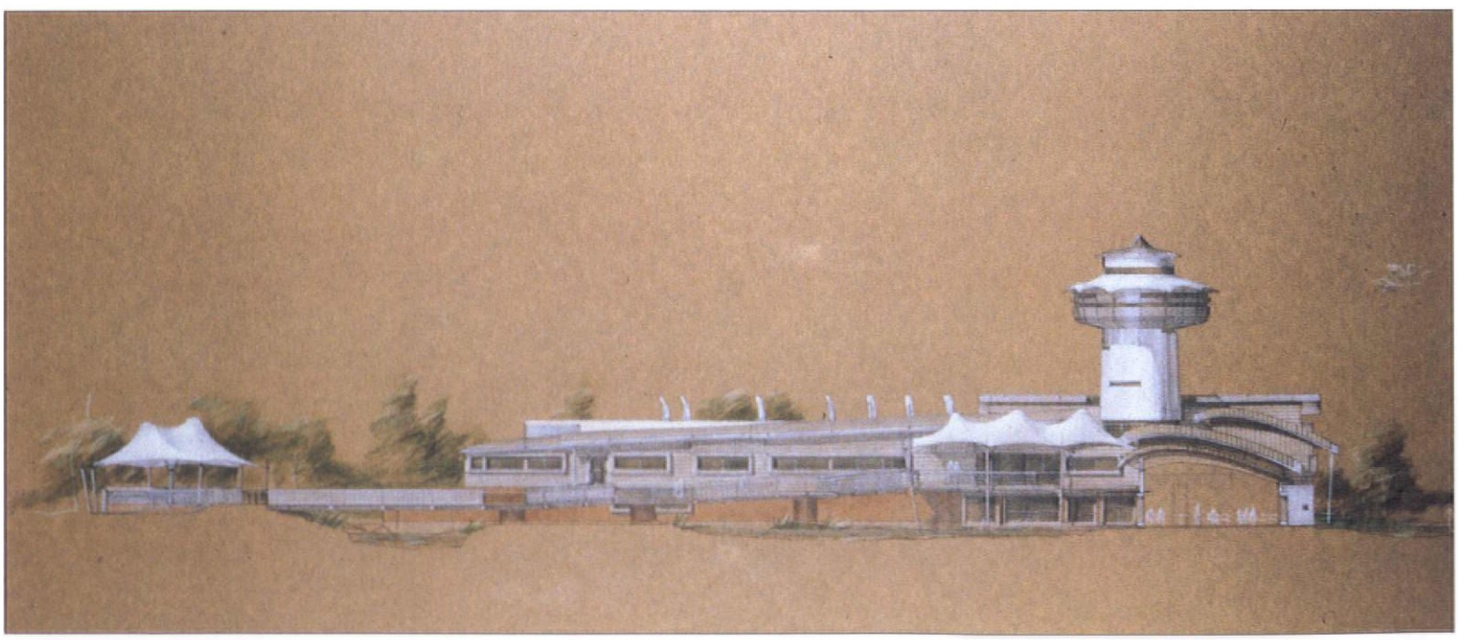
The complex is set in the totally non-urban context of the Severn Estuary, in the west coast of England. The project area covers some 4.5 acres of man-made wetlands, which is located in 80 acres of an international bird sanctuary. The centre is to be the headquarters of a national conservation organisation.

The building will be integrated into an existing group of *ad hoc* structures, creating an internal courtyard and emphasising the splendid views. The simplest ecological gesture that an architect can make is to use materials and forms that are appropriate to both the ecological environment and the landscape in which the building sits. At Slimbridge, the architects decided that all the materials used would be as natural as possible, and locally resourced. With the exception of the fabric canopies this is more or less true. The gently curving, timber shingled roofs are intended to reduce the scale of the building when seen against the skyline. A few years after the building is finished the cedar will go a beautiful silvery grey, and shimmer in the low estuarine light.

Similarly, it is essential, regardless of its type, that the building is naturally ventilated, as mechanical systems can account for up to 50% of a building's total energy consumption. This is not easy when the scheme contains exhibition spaces which can get very hot due to the amount of visitors and the high levels of illumination. A deep plan will exasperate the situation even more. As this is the scenario at Slimbridge, the scheme will use rotating wind-sensitive cowls which naturally extract heat at night. The air intakes will be at low level, utilising the lakes' evaporative cooling effect. Fortunately, the exhibitions are neither humidity, nor pollutant, sensitive and no filtration or moisture controls were necessary. All the other spaces are kept as narrow as possible so that cross-ventilation occurs easily.

The buildings are designed with a reed bed sewage system to minimise load on the local drainage services, and to avoid reliance on chemically based purifiers. This will be placed at the main entrance, illustrating the architects' confidence in the ability of the system to be odour free.

OPPOSITE, FROM ABOVE: Site plan; ground floor plan; BELOW: Section through restaurant



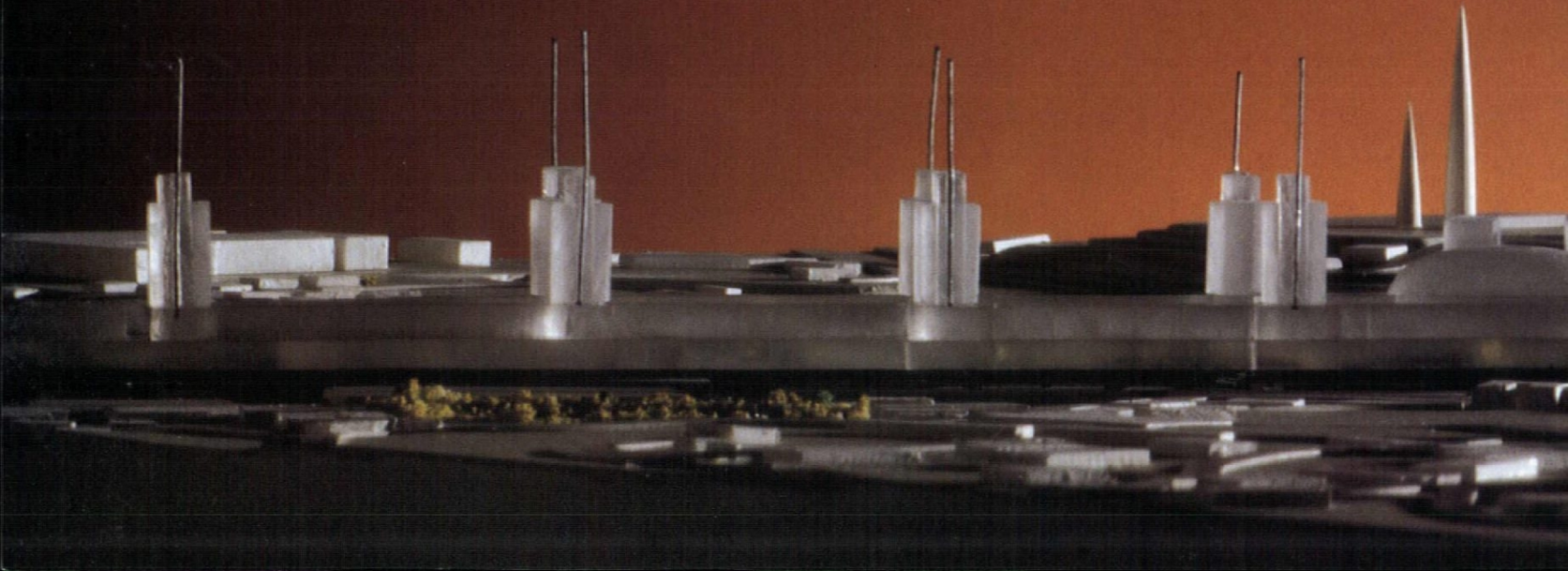
TR HAMZAH & YEANG

SOVEREIGN TOWER

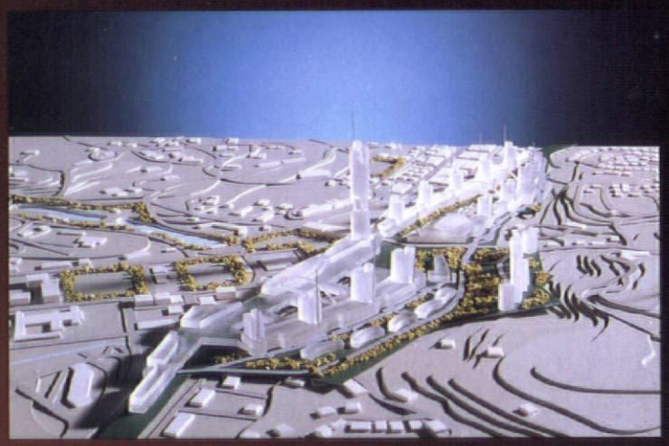
Malaysia

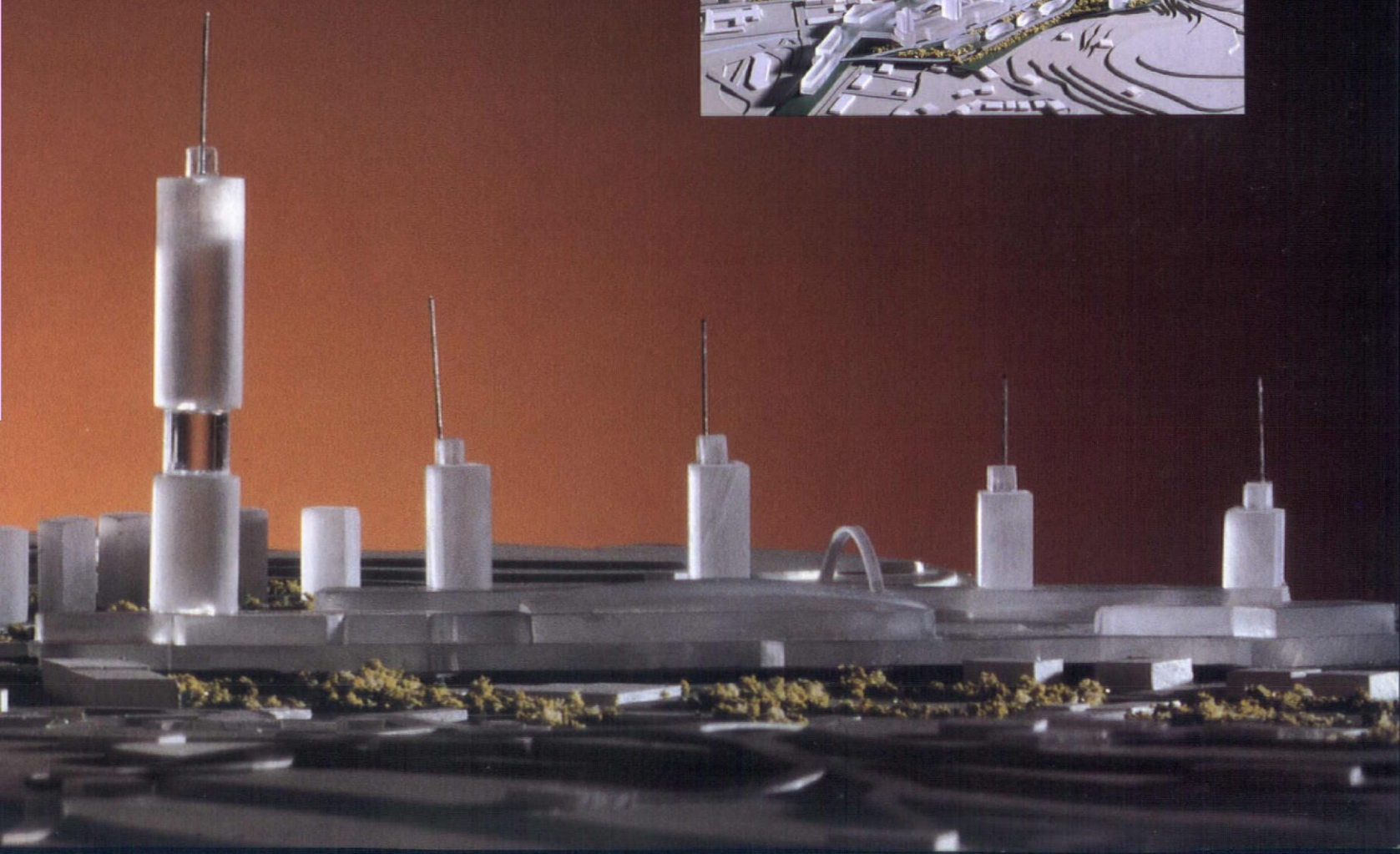
The 80-storey Sovereign Tower is a mixed-use development which will be constructed on 40 acres of disused industrial land in Malaysia. Despite using a standard steel and reinforced concrete structure – with columns positioned around the edge of the precast floors to maximise the building's economic viability – the architects have managed to expose the occupants to the environment, rather than sealing them off from it as is the norm with this genre.

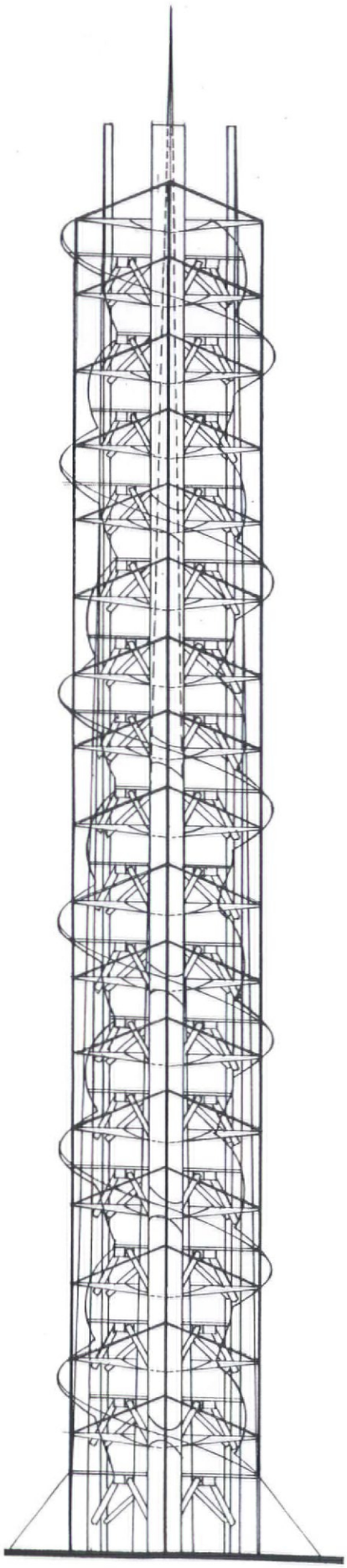
To achieve this the tower's massive volume has been broken up by locating four-storey 'skycourts' at two-storey intervals. These zones provide aerial gardens for the inhabitants, encouraging social interaction and eroding the barriers between the building's interior and exterior. Similarly, all of the lift lobbies, staircases and toilets are ventilated with fresh rather than recycled air. The designers have expressed their commitment to the natural environment externally by introducing tiered planters onto the facade.

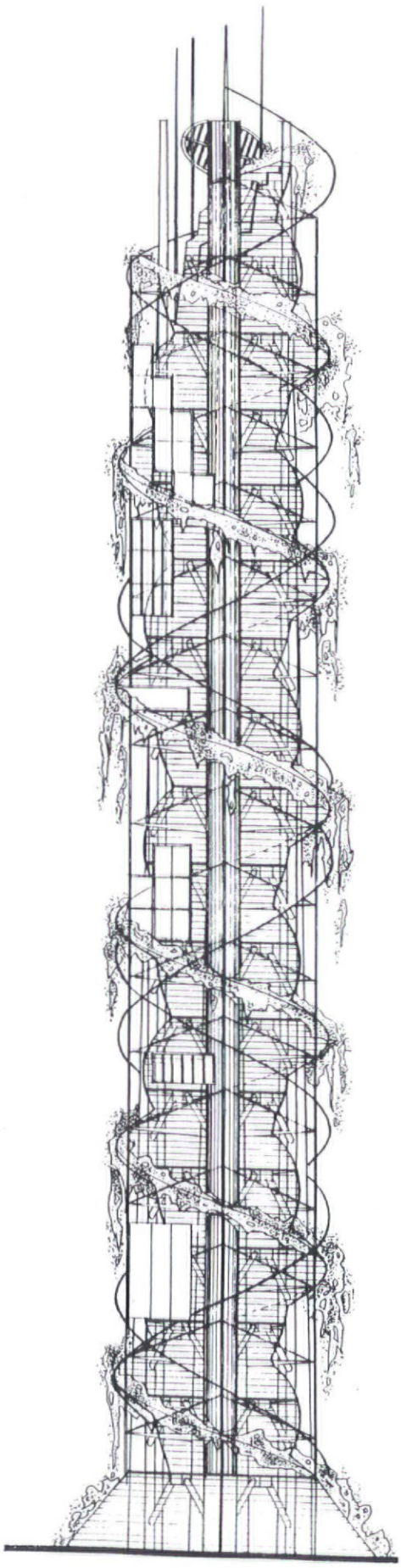


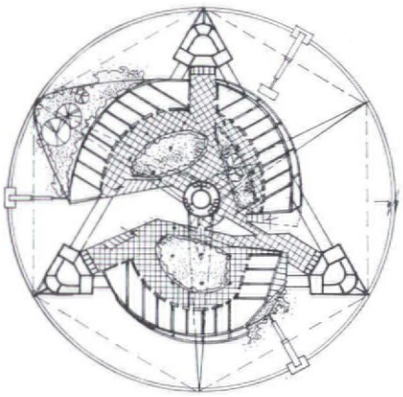
Site elevation

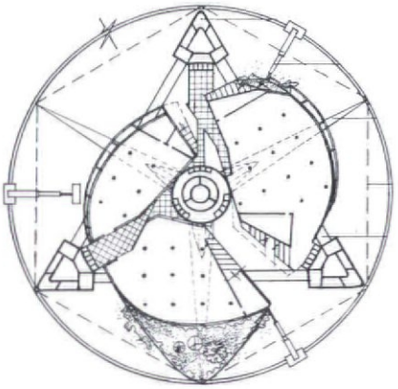


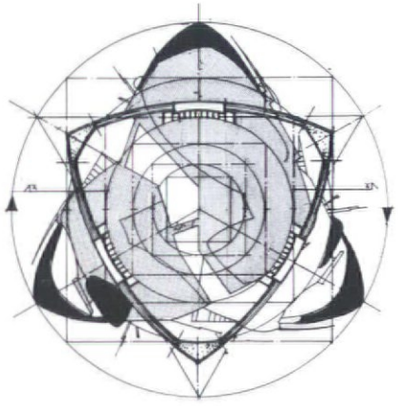


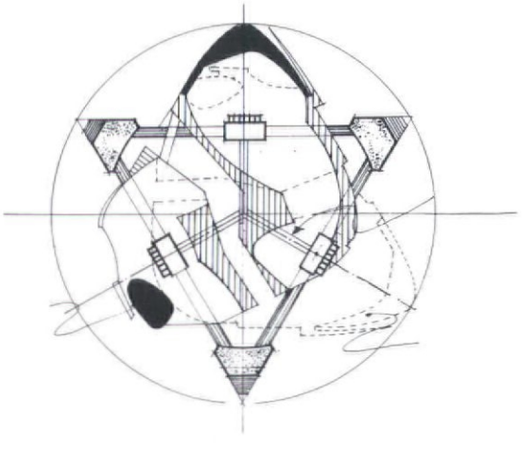












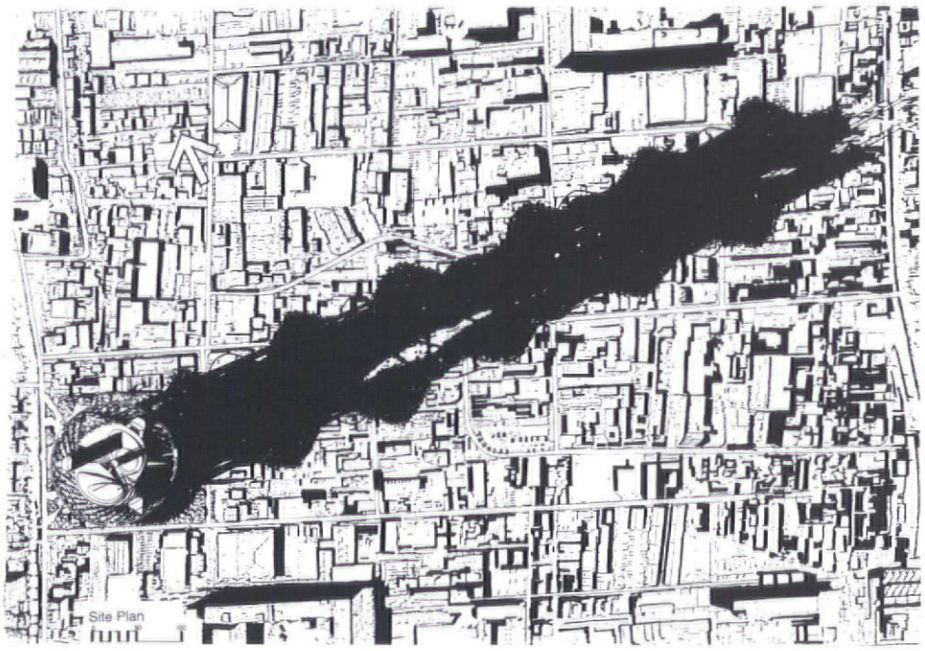
TOKYO-NARA TOWER

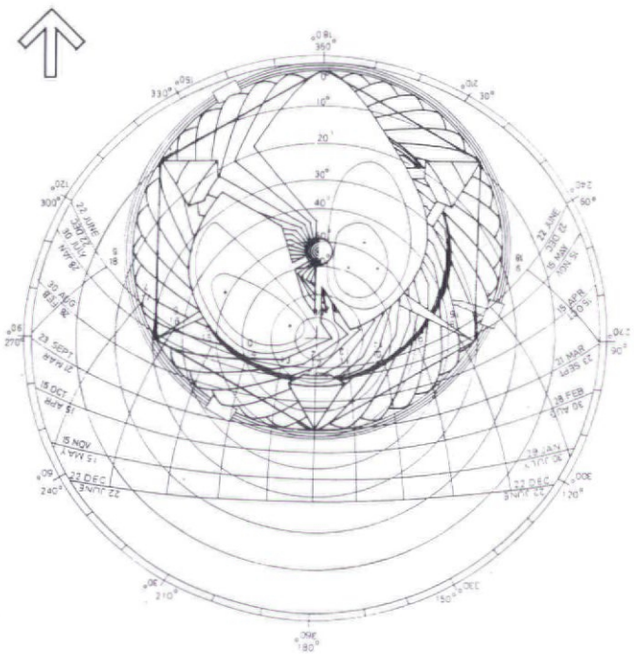
Japan

The Tokyo-Nara Tower, located between Tokyo and Nara, realises many of the theoretical ideas expounded by this firm, and represents a significant stage in its ongoing research into the potential of environmentally friendly skyscrapers.

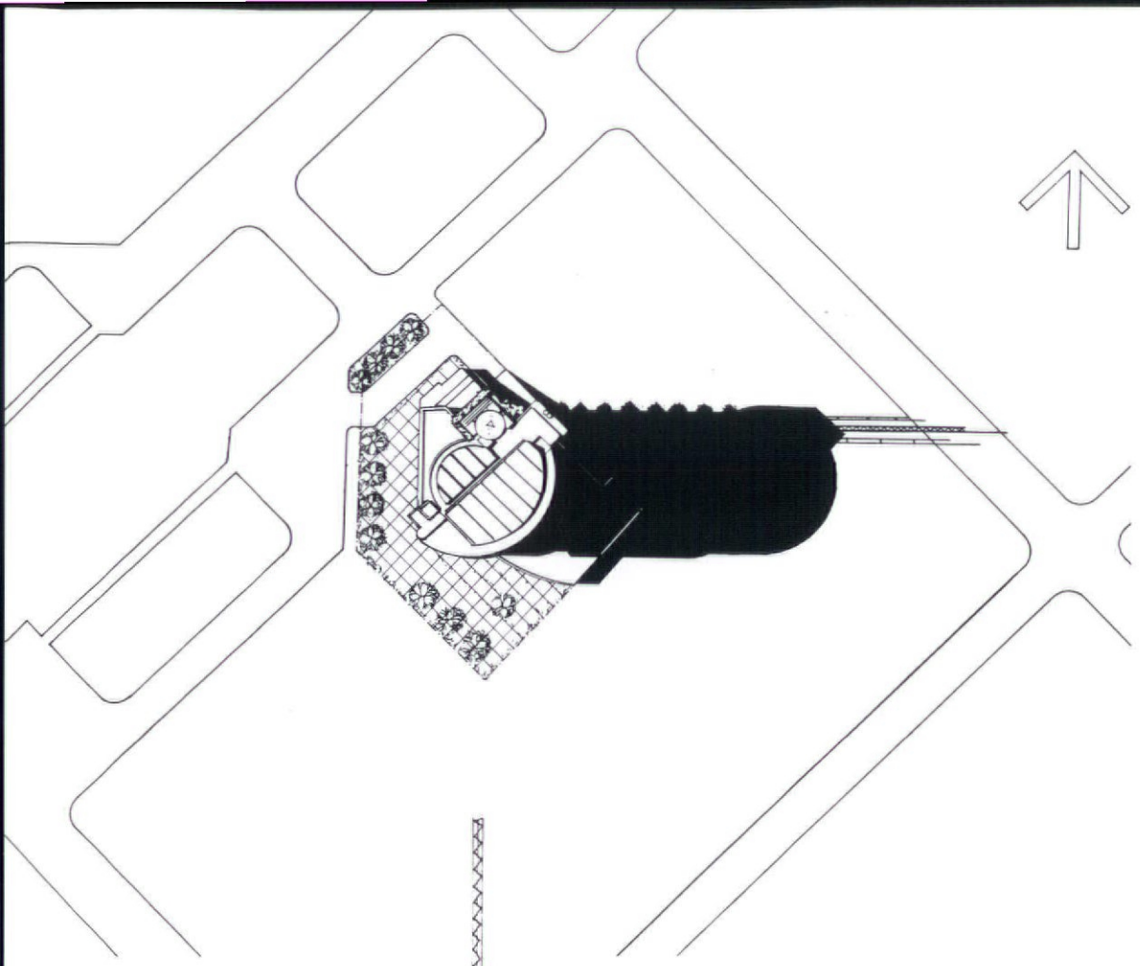
Most visually apparent is the vertical landscaping, which spirals around the central core of the building. Although the positioning of these floors is designed to shade the preceding level from the sun – as well as articulating the internal morphology of the centralised atrium – the vegetation they support actually performs a far more important environmental role. Quite apart from its aesthetic appearance this foliage cools and controls air movements within the built structure, acting as the tower's lungs breathing life into the floors above and below, and ensures that the biosystems are acting symbiotically with their mechanical counterparts. The glazing, in conjunction with a variety of perforated metal sheets, tiered sunshades and the building's orientation, is designed to control solar gain.

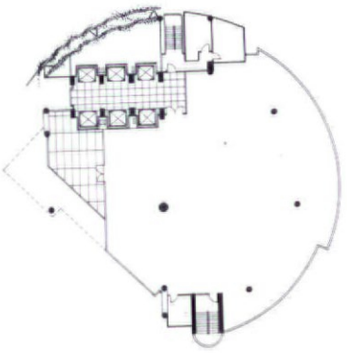
These sky gardens also furnish the inhabitants with numerous recreational parks. Similarly, the various atrium spaces within the building – bridged by walkways and flanked by stairwells – provide an internal focus for the occupants social interaction. Perhaps these internal and external communal spaces are intended to compensate for the fact that even though the tower is open to the environment, it is insulated from the city.

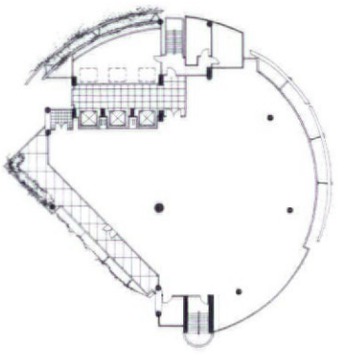


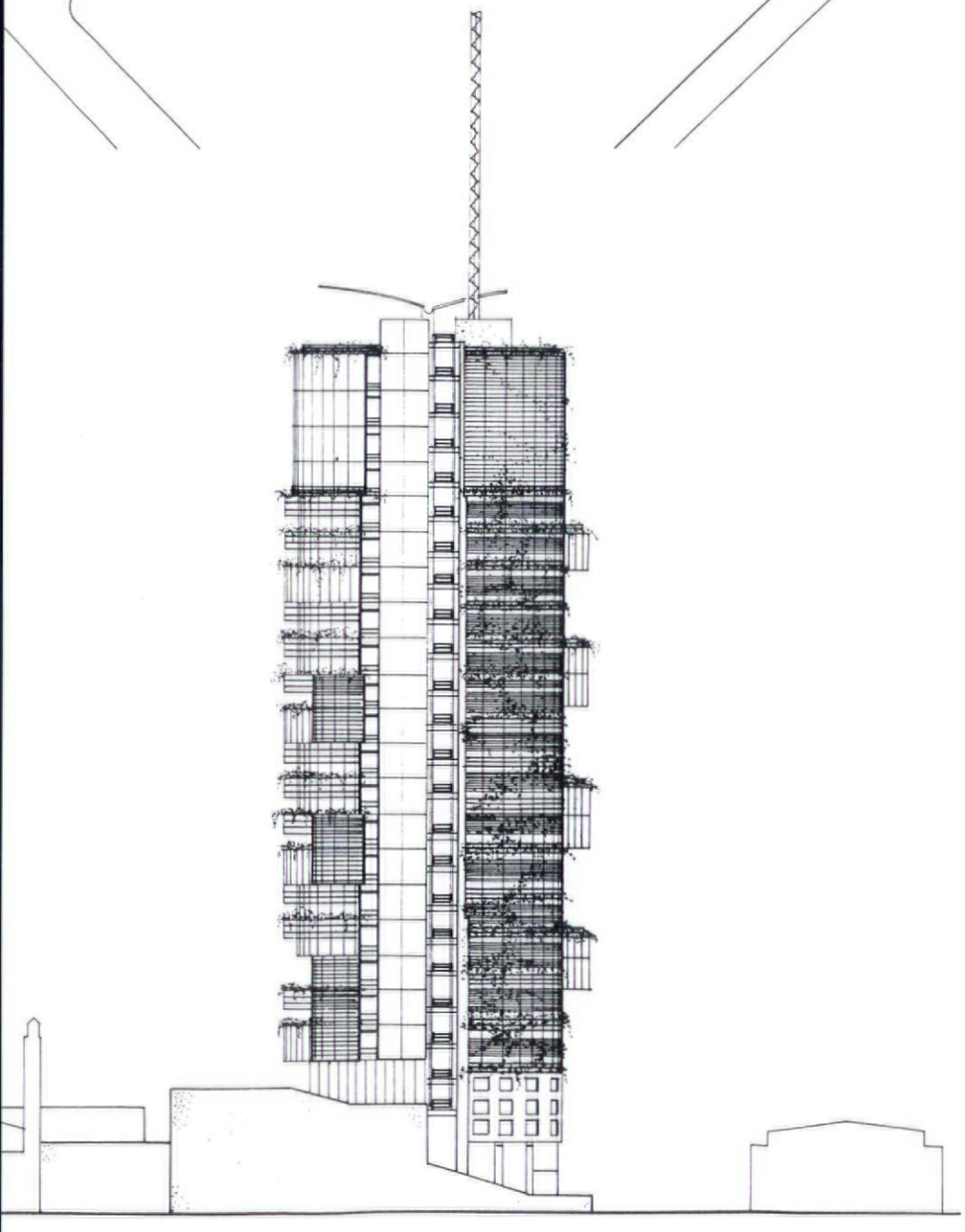


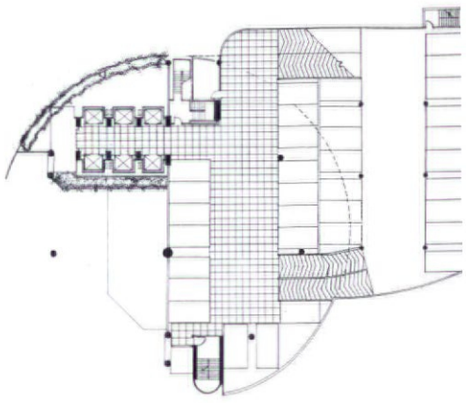
OPPOSITE, L TO R: Section; elevation; floor plans (FROM ABOVE: Hotel floor; office floor; geometric rotation of floor plates; typical floor plan); FROM ABOVE: Rendered site plan; sunpath diagram

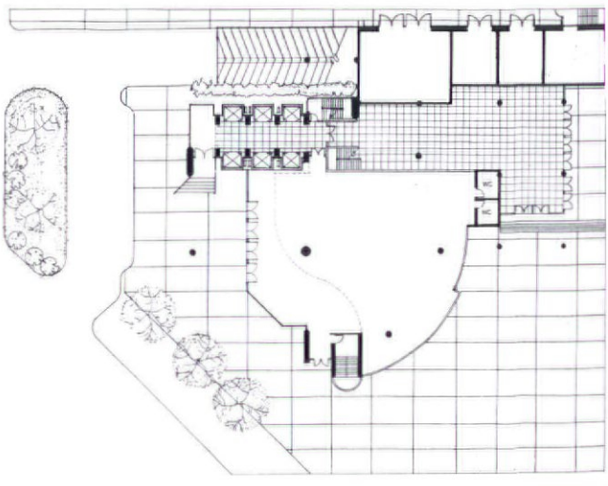










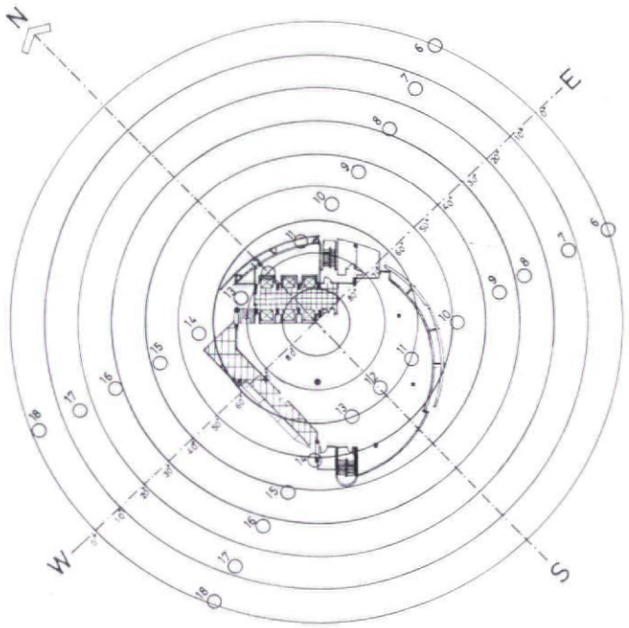


HO CHI MINH CITY TOWER

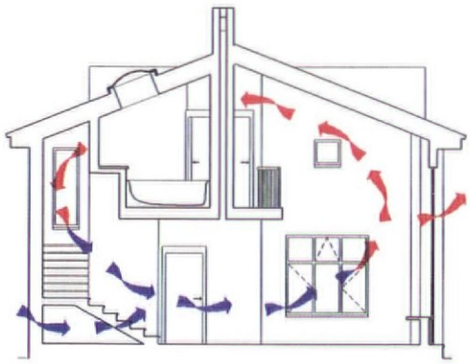
Ho Chi Minh City, Vietnam

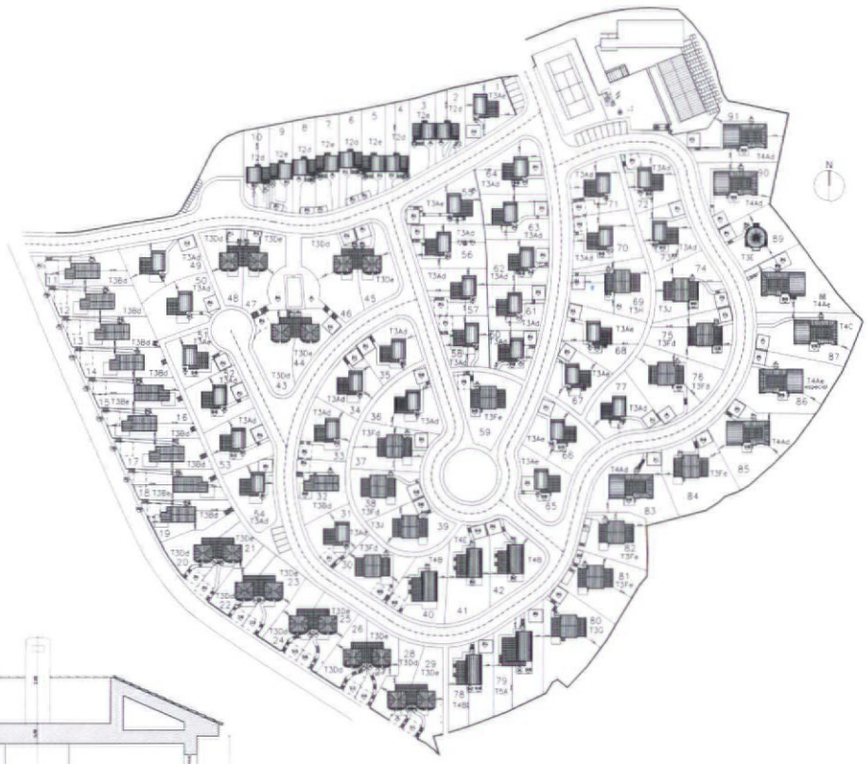
In this scheme the architects have created a relationship between the tower and its context by reflecting the city's ambience in their design. High above the ground the tower's ecological features – the open skycourts, trellised-lined lift shafts and planted penthouse tower – are articulated to emulate the Gallic tree-lined boulevards below. This bond is strengthened even more by locating the building in the corner of its site, creating a small plaza which is linked into the existing pedestrian infrastructure.

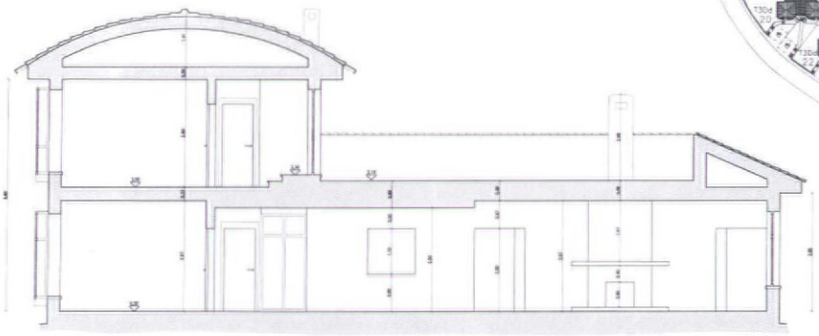
As with the practice's other bioclimatic skyscrapers, great lengths have been taken to ensure that this tower works with the environment rather than against it. Typically, the ancillary public spaces are naturally ventilated, but there are many features which are unique to this tower. These include bridges off the lift lobbies which provide external access to the sky courts, and a double layered environmentally-interactive building envelope.

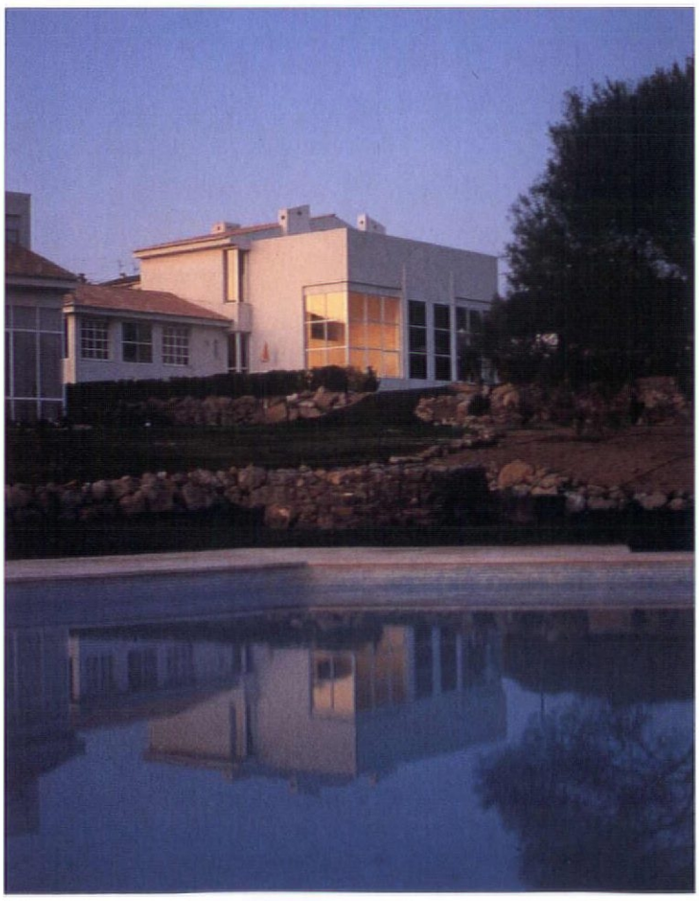


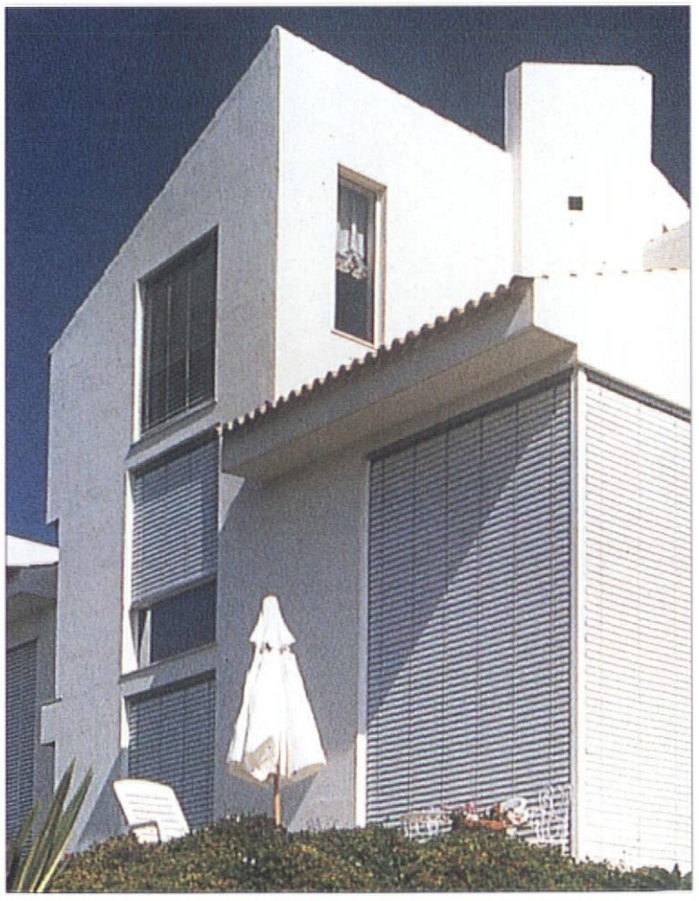
OPPOSITE, FROM ABOVE, L TO R: Site plan; floor plans; elevation; BELOW: Sunpath diagram











TIRONE NUNES URBANISMO

QUINTA VERDE

Nafarros, Portugal

In joining forces with the local housing co-operative Chesmas, Tirone Nunes Urbanismo (TNUL) has been able to realise its Quinta Verde project. Consisting of 91 passive solar houses, the development is situated on the southern edge of the village of Nafarros, approximately 30 kilometres from Lisbon.

Covering a plot of 57,130 square metres, Quinta Verde is composed of ten base typologies, of which there are 25 variations, and introduces a refreshing yet integrated approach to architecture in the region. In all the houses, the architects have achieved an annual energy consumption that is 10-20% of the current Portuguese building regulations, without compromising thermal or environmental comfort. There is also a reduction of 30% in water consumption, and a considerably reduced need for artificial lighting.

Direct and indirect solar gains are used to passively heat the residences during the winter months, although gas central heating and fireplaces, with heat recovery systems, provide back up if necessary. Similarly, during the summer internal air quality and temperature are also maintained through passive means: including increased insulation, external overhangs and blinds, efficient natural ventilation and convection.

The practice's bioclimatic buildings, especially their relationship to the climate and use of local resources, are very similar to traditional Portuguese architecture. However, certain characteristics, such as the small windows constructed when insulation materials were not widely available and glass was a luxury, are sensitively avoided. Illustrating typical sensitivity the typologies closest to the perimeter of the site, and, therefore, to the existing village, do incorporate some local architectural features. Those positioned towards the centre of the development are able to exhibit more freedom in their architectural expression. Here, the introduction of, for example, curved roofs and large bay windows opens the way for new materials and shapes to be gradually incorporated into local architecture.

OPPOSITE, FROM ABOVE, L TO R: Airflow through typical unit; site plan; section

PAUL LEECH: GAÏA ASSOCIATES

ECO HOUSE

County Cork, Southern Ireland

This combined dwelling and workplace is part of an overall permaculture proposal, and includes many interventions that are in synergy with the existing ecosystems. It is located on a woodland site of approximately one hectare, and was built for a doctor, educator and their children.

Initially, analyses and reports from an ecologist and a silviculturalist were commissioned. Similarly, a tree survey was prepared which identified significant specimens, including a magnificent Turkey Oak which in its own right was regarded as an important entity in the overall local landscape in its own right.

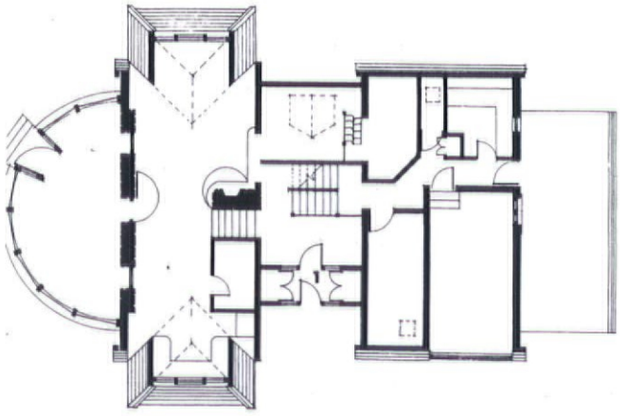
A survey of levels identified an existing knoll to the north of a natural clearing, in the centre of the woodland where there were no trees of special significance. The house is perched high on this promontory, where it is able to 'breathe' and enjoy plenty of light, yet causes the minimum amount of damage to the woodland.

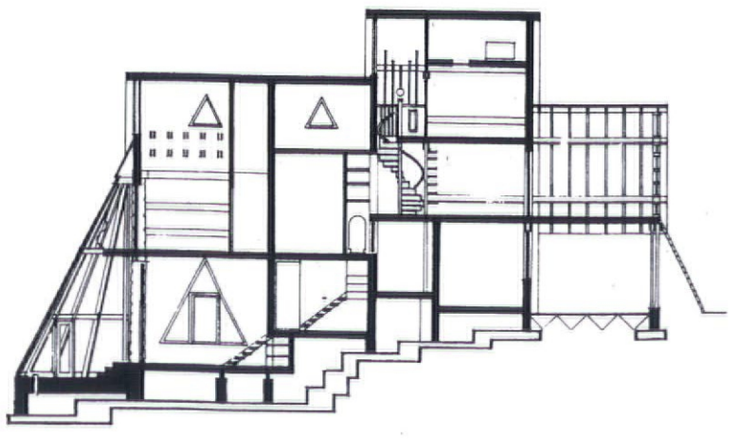
The design is based around a stepped A-frame core which: maximises high-sky luminance; minimises tree felling; sits happily among the retained trees, its narrowing form reducing shadows; creates a generous undercroft between the floor and the steep banks, and conceals the house within the woods. This core was then developed further to incorporate an additional 'teepee' sun-space, and interpenetrating transverse volumes. The plan and section, respond to the available natural light, and utilise the higher luminance of the upper sky to avoid the creeping ennui of dull Irish days.

The design attempts to go quite far into the realm of ecological design. The majority of the building is constructed from timber and other natural non-toxic materials. Passive solar heating, in tandem with a heat pump and high efficiency woodstove, has been maximised, utilising direct gains and mass storage. There are de-stratification ducts on the south-facing trombe wall within the sun-space, channelling hot air down onto the floor. During the night, these ducts transfer the heat into the house.

A reed bed treats grey waste water and septic tank effluent, discharging it into a lagoon through a system of pools. The first pool, filled with collected rainwater, reflects sunlight into the sun-space and main living rooms. This water is also used to charge the submerged heat pump coils, before it cascades down to the lagoon to dilute the water from the reed bed. All waste is therefore treated without ground water pollution, and provides an enriched soil where many plants are able to thrive.

BELOW: Ground floor plan; section





WATERFALL HOUSE

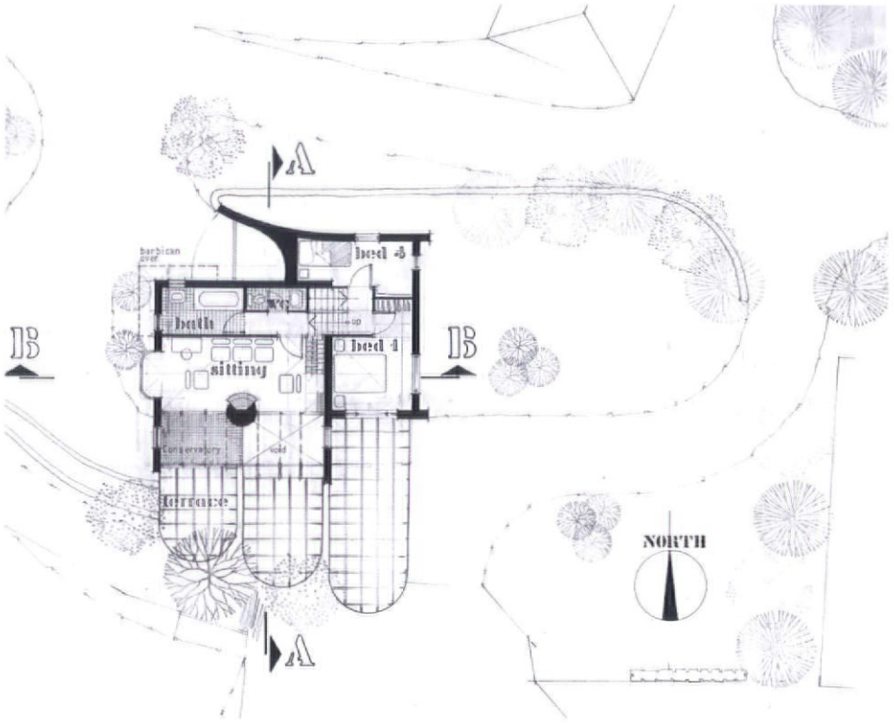
County Meath, Southern Ireland

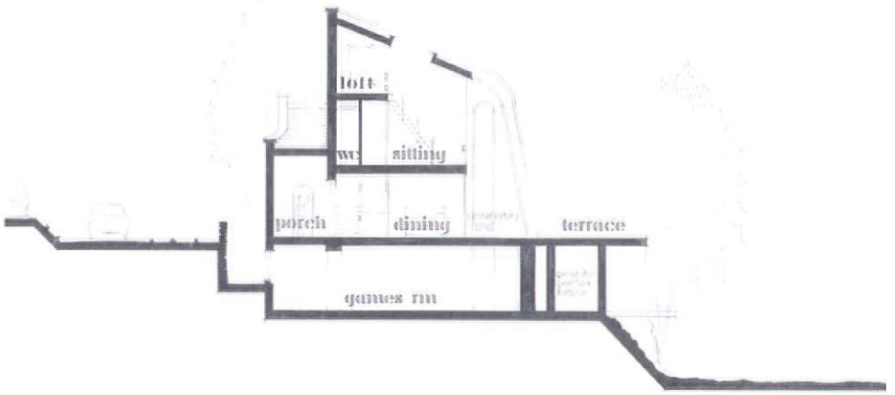
The site is unique and very beautiful, and is approached via a winding, leafy lane, leading down into a deep, gently sloping, valley along which the River Nanny flows. The site comprises 10 acres in all, including a waterfall, a large mill pond, some old mine workings and the ruins of a mill. A good deal of unsightly industrial detritus remained, and this is being removed to restore the natural serenity of the place. The house is located at the waterfall, rising out of the ruins of the old mill in which the old turbine is being refurbished to provide power, light and heat for the dwelling.

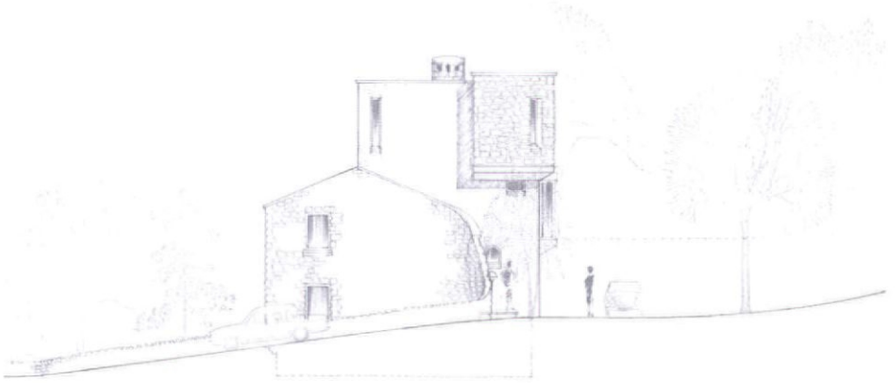
The house consists of two volumes. The first, approximately square in plan, is generated by the footprint of the old mill, and contains the principal living areas. The second volume contains the bedrooms, and is 'wrapped around' the first, offset from it in plan and section. Within the house, the rooms flow into each other in an upward spiral.

Passive solar heating provides a complementary power source to the hydroelectrics, which are at their maximum when solar energy is least available. The stone drum at the core of the house is used for structural support and as a thermal mass for passive solar storage. There are also flues and a de-stratification duct to feed solar heated air into the living spaces. Electrical output from the turbine will power the lighting etc, and the remainder will be used to warm a large water storage tank. This heat will then be distributed, via a heat exchanger and a system of ducts, throughout the house.

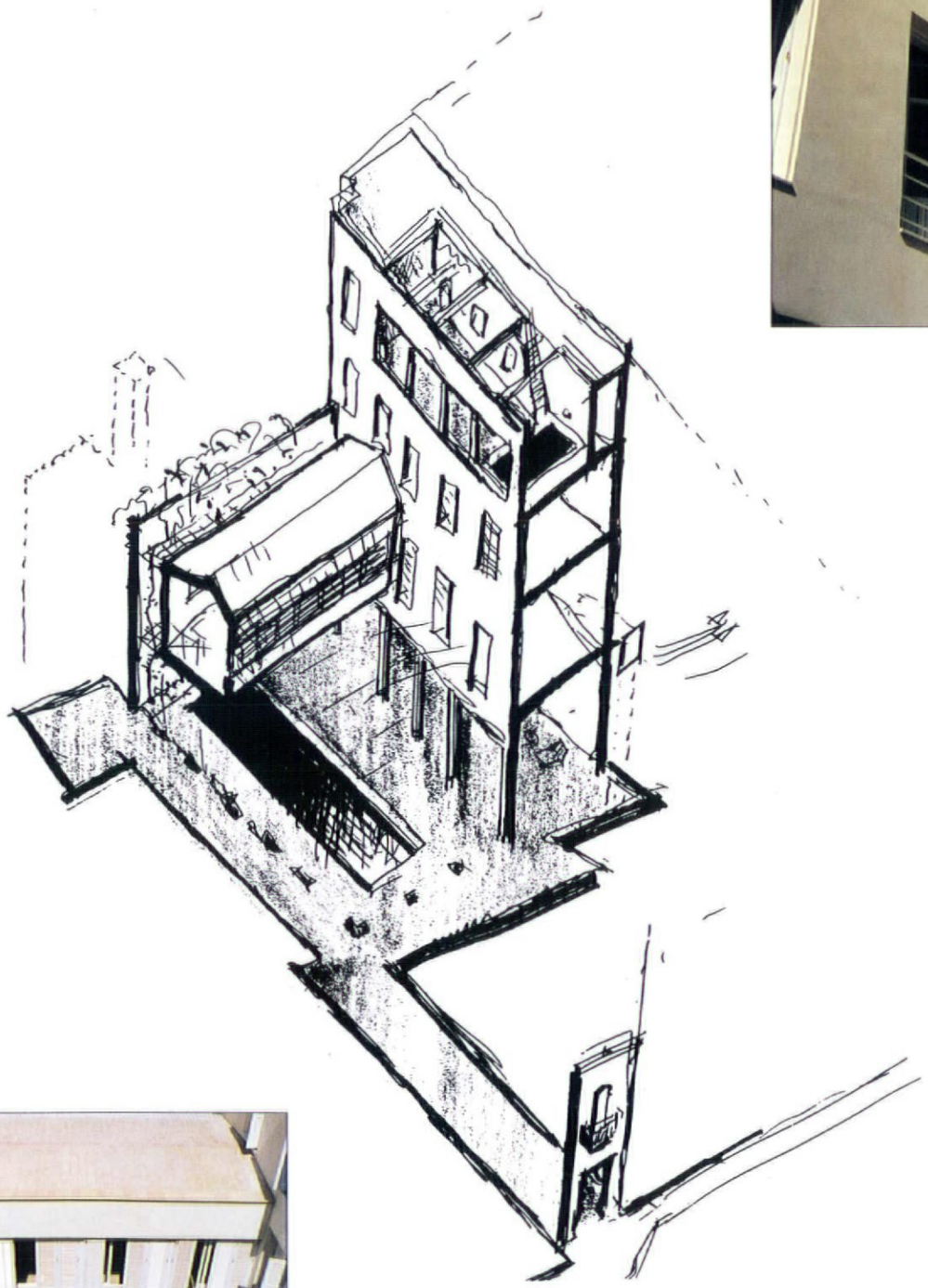
Much of the external walling is of stone, salvaged on site and from other industrial ruins. The remainder is finished in a coarse harling.

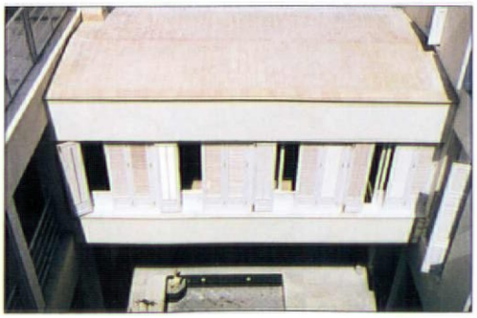






FROM ABOVE: Ground floor plan; section; elevation





ANGEL DIAZ DOMINGUEZ

ALHÓNDIGA RESIDENCE

Seville, Spain

This large family house, approximately 500 square metres, stands in the very core of the old city. It is built on an irregular site with only one narrow facade, 3 metres wide, facing the street. The majority of the building is enclosed within the very high walls of the neighbouring houses.

Due to its location, it was necessary to base the design on the patio-house typology, a solution that often entails some difficult problems. These include a lack of sun and natural lighting, combined with defective or non-existing ventilation. Together these characteristics produce a cramped, cold environment, that is lacking in humidity. Several strategies have been adopted in order to avoid this situation.

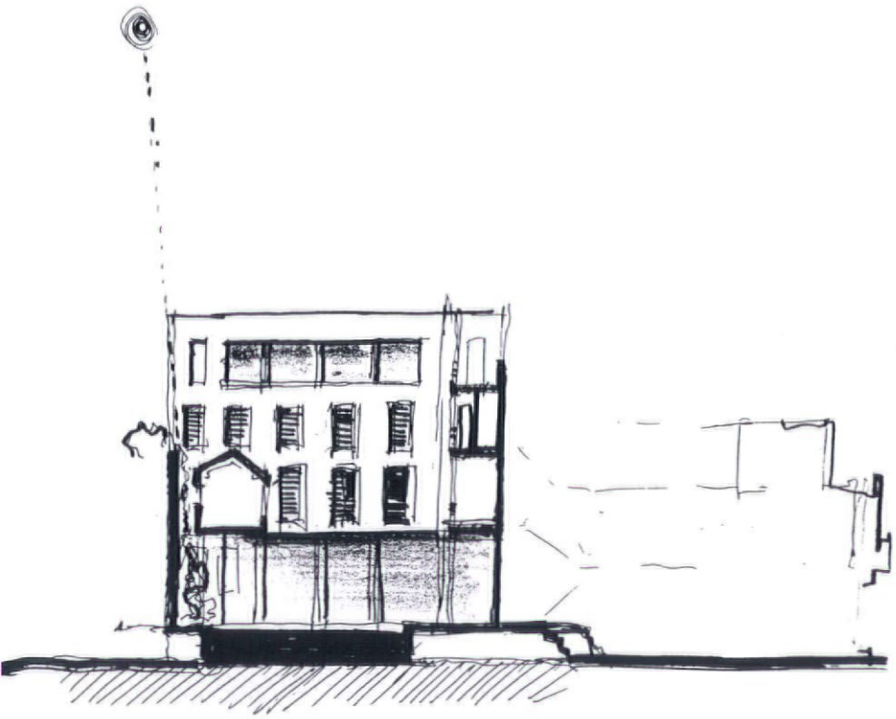
To increase humidity the floor of the courtyard has been separated from the ground, and two ponds have been strategically placed within. A warm environment is maintained by ensuring that the position and dimensions of the patio have been directly related to the sun's trajectory. Similarly, the walls have been given extra mass to improve insulation, and to act as a passive solar heat store. Ventilation has been increased by incorporating an existing tiny window, that provides access to a neighbouring patio, into the design as a vent, and by carefully orchestrating the location and proportion of all the interior openings. Care has been taken with the orientation of the house to ensure that a high level of environmental comfort is maintained. To minimise energy consumption there are hidden solar panels.

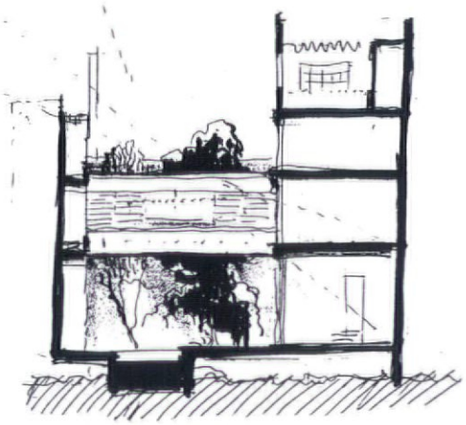
An existing house had to be demolished to construct the new one, but the old facade was maintained. Past the two-storey entrance block is the main inner patio, whose regular geometry hides many of the site's irregularities. These awkward angles are similarly absorbed throughout the house. The patio is occupied by an unexpectedly long pond and a large porch.

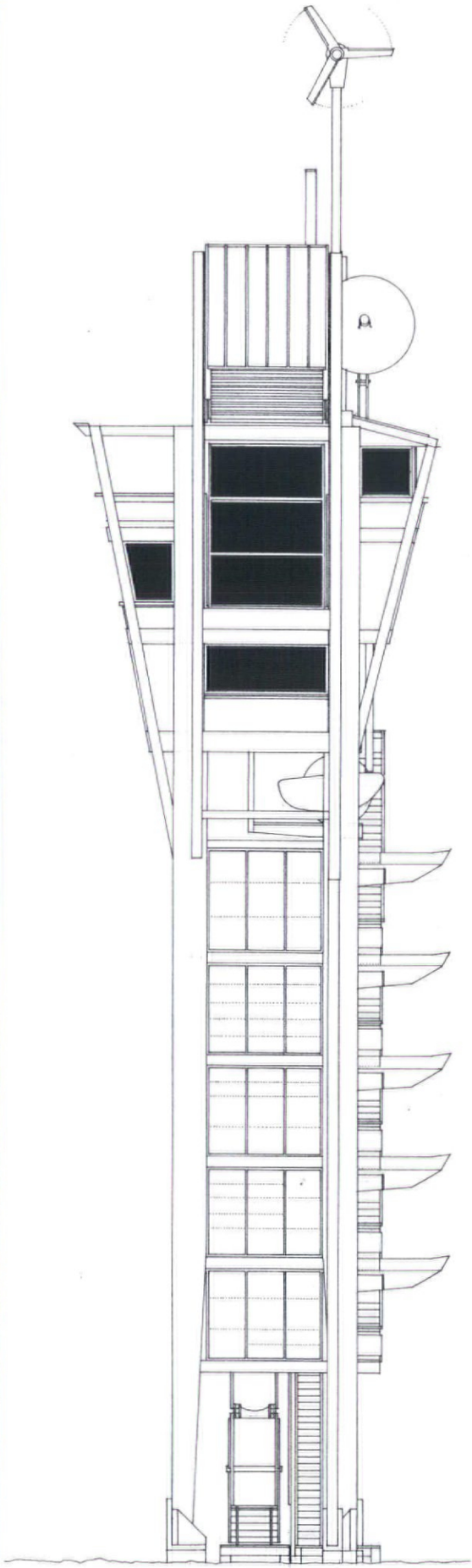
From this point, the actual family house, a compact four-storey south-facing structure, with balconies opening onto the patio, is visible. Here, a bridge projects from the first floor, crossing over the pond below and creating a volume that floats between the open galleries and the house. This feature contains the kitchen, and allows light to slide over the rear wall, greatly enlarging what should be a smaller patio.

No traditional ornamentation has been used on the interior facades, and what beauty that exists is not due to small details but to a balance in the interaction of the different elements.

OPPOSITE: Freehand axonometric: BELOW, L TO R: Freehand longitudinal section; freehand cross section







STEVEN JOHNSON

FOREST HOUSE

Scotland

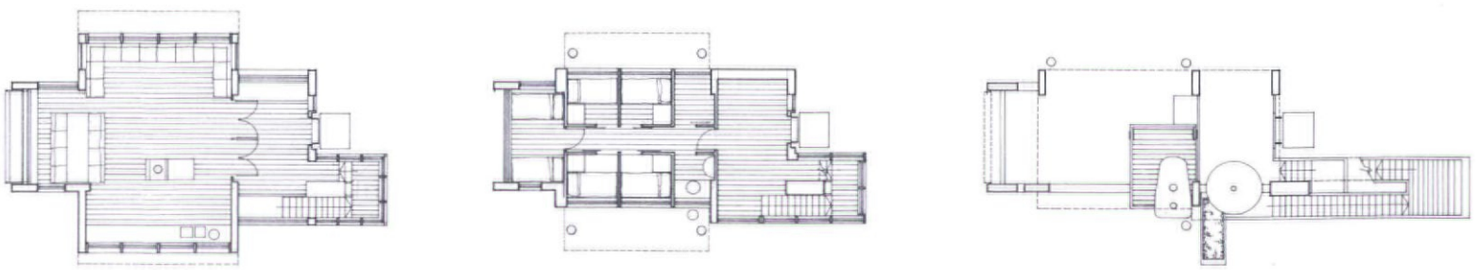
The Forest House is truly self-sufficient, and allows its occupants the freedom to live and work within a remote setting. In addition to the capacity to provide itself with heat, power and waste purification, the structure is constructed primarily of locally produced wood. This timber may even be harvested from the site itself. The construction process is designed to utilise the minimum amount of energy possible, and once it is built, the house will require no further energy input and, equally important, will produce no environmentally damaging waste products. This time-frame includes the period after the house is no longer functional, as it can be either dismantled and moved off site, or allowed to biodegrade naturally. This building system, is intended to enhance the environment, both during and after its occupation.

Traditionally, the design and construction of indigenous Scottish buildings reflected the characteristics of their localities. The Forest House attempts to respond to its environment in a similar way. After a period of prolonged reforestation, the replenished supplies of Scottish timber could be used as a major source of renewable building material. The Forest House could not only articulate this process, but will actively encourage the re-establishment of sustainable and diverse ecosystems. In countries such as Sweden, Norway and Finland, where they have maintained a much greater proportion of their forests, this period of regrowth would not be required.

The house is located in the forest canopy, where it can take full advantage of the views and allows the land below to be cultivated. This arrangement also minimises the impact that the structure has on the existing ecosystems below. Living in one of these structures is intended to be a dynamic experience as the design is responsive to its environment. For example, when the afternoon sun clears the encompassing trees, the large protective doors can be opened, exposing the interior to the light and warmth. If the building then begins to overheat, shutters to the rear may be opened to allow the movement of cool air through the building. Eventually, if the temperature becomes overbearing, the door can be rolled shut, blocking the sun completely and eliminating solar gain, while air and light filters through the louvres. During the winter the doors provide insulation.

Electricity is produced by a roof-mounted wind generator, positioned far above the trees in the wind. Liquid waste is processed in a series of hanging reed beds, suspended from the building's external structure. Solids are broken down organically within a holding tank mounted to the underside of the house. Here the waste will be gradually converted into a dusty fertilizer, used to nourish the plants grown in the series of mini-greenhouses running down the southern face of the main structural legs. These gardens are intended to provide food all year round. Rain is collected by fabric catchers at roof level, drained into either high level holding tanks or sub-grade cisterns, and pumped into the house by a wind power when required. It is the intention that living in one of these houses would greatly increase one's understanding and sensitivity to nature.

Amongst architects there is a general awareness of the main ecological issues confronting humanity, but they are at risk of allowing themselves to look superficially at these problems, assuming that green architecture is merely another transient fashion. An environmental sensibility must be much more than a marketing tool. Contemporary building designers have a wonderful opportunity to assimilate ecological techniques into their vocabularies, allowing them the freedom to design an architecture that works symbiotically with the environment and enhances the lives of its inhabitants. Architects must relate projects to ecological, sociological and agricultural needs, and then apply the economic and political ideas necessary to realise them, forming an all embracing environmental system that benefits the entire planet rather than just the human race.



OPPOSITE: Elevation; ABOVE: Proposed floor plans

LINDA WATSON

EARTH AS A BRITISH BUILDING MATERIAL

Earth is no longer regarded as a major building material despite the fact that it continues to leave an undeniable and distinctive imprint on the architectural landscapes, both rural and urban, of many countries.

Hugo Houben's statement would probably be dismissed by people as having no relevance to Britain. Few realise that we are a country that has inherited a rich and varied legacy of earth buildings. Whilst the quantity, geographical distribution and regional variation is not yet fully known, new examples are being discovered everyday as it is recognised that earth was a viable, British building material. The vast inheritance of earth (cob) buildings in Devon alone, suggests that the material was used continuously for several centuries, refining a body of knowledge past through generations of builders, to not only produce utilitarian farm buildings and simple cottages but fine gentry houses in town and country and some public buildings including, early 19th-century Sandford School.

Whilst the past use of earth presents a conservation issue to the guardians of our heritage, a more current and broader conservation issue considers the viability of using earth to build today's architecture.

A few enlightened British designers are beginning to recognise that earth has great potential, and that the modern building construction industry, which made this ancestral technique obsolete, may well experience a paradigm shift in the light of the need to produce sustainable development and relearn the skills of building from earth. Britain is not unique in this reawakening. Many countries have already made considerable advances in the use of earth. Some have over two decades of experience in achieving contemporary forms. Others never forgot this timeless material, continuing to create appropriate buildings in the most hostile of climates. This list is endless, but it is sufficient to state that an international network exists, utilising communication technology to share experiences, disseminate research findings and give advice. This support is very reassuring in our current rediscovery of the material.

But why reintroduce what many cynics believe to be an inferior material best left in the past? The material when used in building is recognised as having a number of remarkable characteristics important for the realisation of sustainable development. Its considered inferiority is irrational when the numerous ruins from the past are considered. The Great Wall of China and the Alhambra in Granada are testimony to the longevity of earth in building.

On purchasing a site, earth is one of the few building materials which comes free, and there is no financial premium put upon the suitability of the earth underfoot for building. Using this material, or at least the subsoil, for walling avoids costly and time consuming transportation, which increases environmental pollution. Generally landscaping, engineering and excavation on site provides sufficient surplus material for building purposes. The use of earth avoids the large scale, centralised extraction of alternative materials which contribute to landscape degradation and ecological imbalance.

Whilst it is likely that many of the British soils can be used in building, not every site can claim such opportunities. Where the surroundings are rich in earth building it is very likely the site materials will be suitable. The character of the soil available can determine the building technique utilised. These broadly follow either a monolithic load-bearing construction such as rammed earth or cob; a block load-bearing construction such as adobe or compressed block; or an infill such as wattle and daub. Where the soil does not suit the chosen technique it can be modified by additives or sieving. Stabilisers, such as lime or cement, may be added, posing philosophical, environmental, aesthetic and practical questions which may be difficult to resolve. For instance, laboratory testing has shown that cement improves some properties of earth and reduces others, but its addition may negate any environmental benefit.

Simple field and laboratory tests exist to analyse the soil, allowing architects to understand its suitability for the various construction techniques and the appropriateness of its modification through additives.

The preparation of the material and the manufacture of the building components require 'low technology' and little energy. Architect Gernot Minke, researching at the University of Kassel, Germany, through his tabulation of the amount of energy required in the manufacture of building products, shows earth to require only 1% of that of burnt brick or concrete elements. The recyclable characteristic of the material – the reaction earth undergoes when transformed into a building product is reversible – means there is no industrial waste. This is very important today with our problems of waste disposal and the relatively high percentage produced by the building industry. Neither does the process produce any toxic chemicals or gases assisting in the build-up of acid rain.

Financial investment in manufacturing equipment is low and this, together with the simplicity of production, makes the material very accessible. There is no mystery involved and the process is delightfully described by Alfred Howard, who equates building cob in Devon with the swallows building their nests. But time has to be invested in the relearning of old skills, and, if the contemporary techniques utilised overseas are to have an impact on British architecture, new research must be undertaken. These skills are appropriate across-the-board, from the mass building industry through to the do it yourself enthusiasts, as can be demonstrated by current earth building in Australia and southern states of North America. But should the local traditional techniques be continued? It may represent the most suitable building method in material terms, yet is it appropriate for the current construction industry and if facsimiles of the past are created as a consequence, are these appropriate to our current culture?

Glossy collections of international earth building photographs

show there to be endless possibilities in formal and textural terms from the organic cob cottage to the classical linear houses of rammed earth, the flat surfaces of lime renders to textured and profiled decoration incised into forms. All appears possible with this versatile material. The designer is not restricted to 'brown bread' architecture.

Finding out exactly how to achieve earth buildings presents a problem for the British designer today. Although internationally there is a wealth of knowledge, much of which is documented, its accessibility can be frustrating. Fortunately the United States, Australia and India have produced informative literature in English, but a great deal exists in other languages. Until there is a much greater demand for the information, it is unlikely that the British publishers will be persuaded to translate this for an English speaking market. And also the question must be asked how transferable is this information, given the variation in subsoils, climates, architectural ambitions, lifestyles, labour forces etc. A good example of this is the wealth of excellent literature produced for 'developing' countries, where generally labour is cheap and materials relatively expensive. Very different circumstances exist currently in Britain.

However, a great deal of important work has been undertaken abroad which is vital to this British earth renaissance. At present in Britain the following apparatus exists to facilitate the construction of earth buildings: suitable field and laboratory testing techniques have been developed; programmes to predict the material's performance and the modifications achievable with various additives; plant to ensure rapid and efficient manufacture and erection; standards and codes for contemporary construction techniques, and the means of training specifiers and contractors. The proposed earth centre at Doncaster could provide the vehicle to transfer this knowledge to British soil.

And once an earth building is complete, what are its benefits? Available literature and laboratory testing supports the idea that earth walling, if designed and constructed correctly, will achieve the required structural performance required of a two-storey dwelling with more than adequate factors of safety. In fact multi-storey buildings, as found in countries such as the Yemen, could mean there is no need to be restricted to low-rise developments.

The longevity of surviving buildings demonstrates the durability of the material if appropriately detailed and well maintained. But standard tests have been developed to quantify this durability in countries such as Australia.

Its thermal performance is frequently questioned and, although there is much information on earth's capacity and its improvement through additives, no definitive documentation is available for use in Britain at this present time. However, this will be rectified as a consequence of current research. A recent house completed in Sweden to the design of Sverre Fehn, used clay/straw blocks to satisfy the rigorous thermal requirements by providing very high insulating properties (K=0.28). Gernot Minke is experimenting with porous mineral aggregates, such as expanded clay, expanded glass, expanded lava or pumice, added to earth to increase thermal insulation. In addition to this, he has found that this process also eliminates any shrinkage in the material.

Similarly, acoustic performance and fire resistance have also to be quantified for Britain. Again, work abroad is already under way. For instance, the Australian research states that any earth construction will have at least a two hour resistance to fire.

However, the variation in subsoils, the numerous natural and artificial additives, the variation in construction techniques and the degree of quality control means that several thousands of tests are necessary to numerically quantify the material's performance. Fortunately many have already been undertaken, especially overseas, so in many instances it is a matter of transference and modification of existing data.

And what of the 'feel good factor' many inhabitants of earth buildings claim to be one of their greatest assets? Gernot Minke, believes this to be related to the constant relative humidity of 50% within earth buildings, the optimum level for a healthy respiratory system. Over eight years, measurement of Minke's own house were shown to vary only 5% throughout the year. Others claim there is great satisfaction gained from the occupation of a building erected from natural material taken from beneath the ground upon which your home rests. And rests is just what it does, when there is no longer any need for the building, the earth walls will return to the ground from which they came and the cycle is complete. The reaction which cause subsoil to change into a suitable building material is reversible, creating no redundant material to be disposed. What better credentials for a sustainable building material.

Linda Watson is the co-ordinator of the Centre for Earthen Architecture, University of Plymouth.

PAGE 86, FROM ABOVE: Church, Arse, near Lyon, France; Martin Rauch, rammed earth spine wall, Feldkirch, Austria; FROM ABOVE: Cob tholos, under construction, Tricombe Cottage, Tricombe, Devon; new earth building in progress, Attricombe Cottage, Devon

SUMITA SINHA

DOWN TO EARTH BUILDINGS

Earth is one of the most cost-effective building materials available. Almost 33% of the world's population, mostly in the developing countries, live in earthen homes due to its availability. Although local climate, environment and culture, as well as the physical limitations of the material itself, have contributed to distinct vernacular traditions, earth has been used as a building material in three basic ways. The first, is as masonry where it is shaped and compressed into bricks or blocks, and occasionally even balls as it is in East Anglia, England. These are then bonded together using a mortar which is very similar in composition to the basic building block itself. The second method involves pouring earth into formwork and compressing, or ramming it so that it sets into strong monolithic walls. The ramming is carried out in stages known as lifts. The third way is to use earth in conjunction with another material, as in wattle and daub.

The main problems associated with earth structures are water protection, durability and stringent building regulations that demand quality control in manufacture and functionability. Unfortunately, the communal, small scale of earth construction, combined with its spontaneity, means that it cannot be standardised. Furthermore, the favoured modern architectural image, with its open-plan spaces, expansive glazed planes and orthogonal aesthetic has eliminated the use of earth in contemporary projects. The existing palette of earth building does not allow large openings or even straight walls. Traditional earthen architecture is soft edged, thick walled and large massed, more like an elephant than the gazelle-like sleekness that contemporary design demands.

Why use earth?

Earth is defined as the accumulation of uncemented, or weakly cemented, particulate material, often of variable character and thickness, on relatively unweathered bedrock. The top portion of the soil, commonly referred to as topsoil, can support vegetation and is often not more than 0.5 metres thick. The underlying material is engineering soil and is used for construction purposes.

Excavated earth from building, landscaping or engineering works near the site can be used for construction purposes, saving on transportation, labour and processing costs which also have a high proportion of hidden, embodied energy. Similarly, unburnt earth does not create pollution, utilise great amounts of energy during its manufacture, or require extensive maintenance following its construction (see table). As earth is a non-toxic it is safe to use as a building material, and after demolition, simply melts back into the landscape without creating environmental problems. Earth walls are also highly insulative, thus lowering the need tor heating or cooling: 600 millimetres of cob walling has a superior U-value to the same width of brick wall. Finally, because earth has been used as a constructional material for centuries throughout the world, it can consequently offer an extensive tradition that can be experimented and expanded upon.

Materials	Energy content kWh/kg	Rating
Soil/earth	0.01	very low
Bricks (fletton)	0.86	medium
Concrete 1:3:6	0.28	low
Aluminium	27	very high
Timber (local)	0.2	low
Timber (imported)	1.4	low
Glass	9.2	medium
Plastics	45	very high

In 1986, realising the unique advantages of the medium and wishing to exploit the rich Gallic tradition of earth construction, the French Housing Ministry invited architects, including Jourda and Perraudin, to design a scheme which would fuse earthen and modern architectural styles, and techniques, into a coherent whole. As a result of this foresight, the housing at Isle d'Abeau, near Lyon, stands as an inspiration for what architectural inventiveness, combined with a respect for tradition, can actually accomplish. The wide breadth and scope of this ground breaking development is quite breathtaking and manages to incorporate rammed earth and concrete houses, timber-sheathed earth walls, earth and brick architecture and a five-storey earthen tower standing defiantly over the landscape.

There is also support available too in France for architects who wish to work with these versatile mediums. These include Craterre, an independent French research organisation, the architecture school at Grenoble, which runs courses on earth construction, and numerous other smaller architectural practices like Centre de Terre, which offer invaluable expertise in the full variety of techniques that are available. Other countries in Europe, like Germany, Denmark and Finland all have examples of contemporary earth architecture and there is renewed interest and research in this field world-wide.

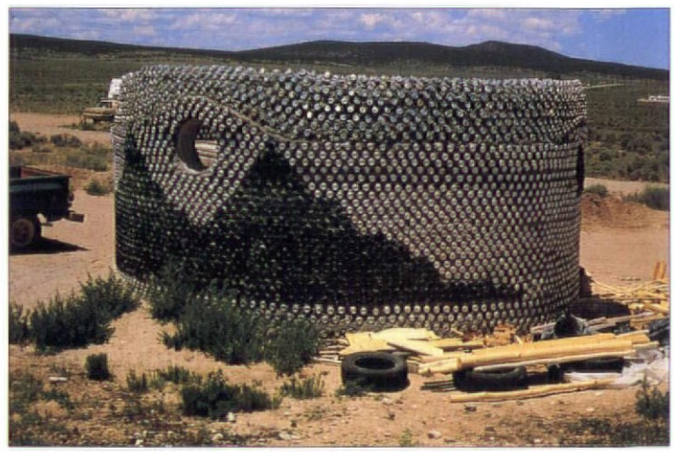
Types of contemporary earth construction

In order to ensure compliance with modern constructional requirements, various techniques have been developed to make the material more durable and water-resistant. For instance, earth is usually tested under laboratory conditions, prior to construction, to determine its composition, especially its water and clay content: the properties that determine its overall strength. If required, strengthening agents called stabilisers – typically lime, pozzolanas, bitumen or cement – are added. The following types of contemporary earth construction are utilised regularly:

Blockwork: In this type of construction earth is formed into blocks or bricks mechanically, and then laid like masonry. The mortar used is made from mud, lime or various mixes of the two combined with cement. The required strength of the mortar depends upon the type of block used. The main disadvantage with this method is the slowness and expense of buying or hiring the necessary plant.

Monolithic: Here earth is poured between vertical shuttering, like concrete, and then compacted mechanically. Although this form of construction is quick and needs very basic equipment, it is inflexible and cannot be altered once built. Both rammed earth and earth block construction require a similar composition of soil, containing clay, silt and gravel in varying proportions.

Secondary: In this type of construction, earth is used in conjunction with other materials like timber, brick or even concrete. Soils that cannot be used for the previous two methods, for instance those containing too much sand or clay, can be used in this way.



Earth building today

Although earth buildings are now generally associated with the vernacular architecture of developing countries, the work of modern architects like Jourda and Perraudin, Mike Reynolds, Nader Khalili, Robert Vint and Glen Murcutt have given this material a new meaning and lease of life. On the continents of North America and Australia, the use of earth has taken on the dimensions of an industrialised building material.

Adobe or unburnt earth brick architecture was imported by the Spanish to the southwestern states of the United States. Today, adobe contractors can be found in the telephone directory as well as in specialised directories and journals. This aesthetic is so popular, that if an individual cannot afford a real adobe construction, a number of firms will dress up an ordinary concrete block house to look like one. However, in the midst of all this, some architects have taken on the task of keeping traditional earth building alive and are currently developing a number of exciting experimental projects.

Mike Reynolds, based near Taos, New Mexico, has been working on 'Earthships': subterranean homes made from used tyres, and other waste materials, filled and plastered with earth. The finished aesthetic is very much inspired by organic architects such as Bruce Goff. The residences recycle water and use electricity from photovoltaic panels making them self-sufficient – hence the generic term Earthship. Clients wishing to live in these houses, enrol in Reynolds' courses and then design and build the majority of the house themselves. While these can be really inexpensive to finish, celebrities such as Dennis Weaver have spent as much as $1,100 per square metre to decorate theirs.

A few hundred miles away in the state of California, Nader Khalili, an Iranian born architect, has transported his native ceramic architecture to the earthquake prone state. He builds domes of earth bricks and then fires them so that the whole structure fuses together like ceramic. These buildings have proved earthquake resistant and been used by the government for emergency shelters. NASA are even developing a project to use this technique on the moon. They are intending to construct domes made of moon dust and then fuse the structure using

solar power – a cost-effective and innovative solution for a site where building materials cannot be imported. Robert Vint, an architect based in Arizona, has formulated a more traditional approach, using lime based mortars and finishes. He learnt his craft from old Native American and Mexican builders, and prides himself on a craft based, meticulously detailed, neo-vernacular style. He has designed residences for celebrities such as Linda Rondstat as well as homes and churches for Native Americans.

Australian builders, on the other hand, have concentrated on rammed earth buildings. Peter Mold, an expatriate builder from Devon who worked on the Globe Theatre in London, has been working with Ramtec, a Melbourne based company. They have been building extensively in Australia, experimenting with different types of earth mixes, limes and incised shuttering; while Glen Murcutt has recently unveiled plans for a building that uses rammed earth walls. Unlike Britain, Australia and the United States have earth building codes.

In Britain, the Plymouth School of Architecture and the Devon Earth Building Association, have started running courses and arranging international conferences aimed at not only reviving the earthen tradition, but also to generate interest in new build. Most of today's contemporary earth architecture appears to have been carried out by designers who have transported, or improvised, building techniques from other places after realising a need. To achieve a popular contemporary architectural style using this traditional material there needs to be more dissemination and sharing of knowledge, more experimentation and, above all, a realisation that earth is not a material of the past.

Sumita Sinha is a chartered architect working and teaching in the field of environmental design, who received the UIA:UNESCO award in 1987 for her work on earthen architecture. She has lived and worked in India, France and the UK, and has contributed to many conferences and publications world-wide.

PAGE 90: The sensuous curves of the Earthship's entrance, casting soft shadows, hide the rough and indelicate waste it is made from – used tyres and cans – under its coat of mud plaster; OPPOSITE, ABOVE: Nader Khalili designed these domed structures in earth bricks and fired them so that the whole structure fused together. The technique is known as geltaftan, *the Iranian word that denotes ceramic architecture. They survived the double earthquake of 1992 in California; CENTRE: The earthships are designed to be self-sufficient with photovoltaic panels that generate electricity from solar power and a water and waste recycling system; BELOW: This structure made of used cans and bottles, held together by mud and designed by Mike Reynolds, will become the hub of the Earthship projects Visitors' Centre in Taos, New Mexico; ABOVE: This five-storey rammed earth tower in Isle d'Abeau, near Lyon, France, has looked defiantly over the countryside for more than ten years. The houses next to it are made of earth blocks; CENTRE: Jourda and Perraudin, the well known French practice, designed this dramatic studio house. The massiveness of the rammed earth walls is complemented by the thick concrete columns and contrasts with the delicate roof that sits on them; BELOW: Chalk, mud and even horse hair are used as infill in these timber framed houses situated in the wine producing regions of Dijon, central France*

THE GREEN APOCALYPSE

THE PRAGMATISTS VERSUS THE IDEALISTS

An important issue that was routinely ignored in economics text books until very recently is the issue of ecological capital. The problem of unsustainability in economic terms is that we are not reinvesting in ecological capital in order to make good the various depredations that our activities and our consumption reek upon it . . . The government's role is to get the accounting system straight, to incorporate green accounts within the national accounts, to engage in the strategic planning of resources, the setting of targets, time scales and budgets to come within these kinds of sustainability conditions. Also to start incorporating in the prices of those goods and services that use environmental resources, a realistic estimate of the real cost of those environmental resources.

Paul Ekins, Economist

> In many ways we must have both the idealism and the pragmatism. We know very broadly what to do for the first few steps towards sustainability and it is not impossibly costly. But one of the reasons that we don't do it is that we're not clear enough about its implications, about what it will actually mean in daily life and about the ultimate destination of 'the sustainable society sustainable economy to which we might be heading'. So how does this relate to architecture? . . . We know that buildings use for example 40% of our energy. Much of that is a legacy of the past when people didn't know that this was an important consideration. We know that the way we build has fundamental implications for land use, for transportation, countryside, community and aesthetics. This is a pretty important part of the sustainability agenda. I know that architects aren't responsible for a lot of it. Yet on the other hand architects have an expert role to play in talking about it, in formulating policies about it, and in helping to show society what is possible.
>
> *Paul Ekins*

Sustainable development also needs idealism. It needs people who can show where it is we might be going, who can create experiments and pilot projects, sometimes on a small and sometimes on a large scale, which will overcome peoples' fear of the unknown and which will enable them to loosen their hold on the habits of a lifetime, of a generation, and indeed the habits of the Industrial Revolution as a whole. That will give them the confidence to look forward to a millennium which we can be certain will be a millennium of ecological scarcity. Much of the planet is already populated and towards the middle of the next century there will be ten billion people, twice today's number, whom that planet is expected to sustain. It is only conceivable that it can do that if we utilise both our vision and our pragmatism.

Paul Ekins

> It is still possible to produce a very low energy design and not be truly sustainable for a number of reasons. The most obvious would be that so much energy has been invested in the construction that the building only just manages to harvest enough ambient energy to repay this initial debt before it starts falling apart. The other is more subjective and begins with the concern that the quality of life within the building is so claustrophobic, stuffy and unpleasant, with poor daylight and little visual contact with the outside world, that nobody will want to live in it and the proposal will be a social failure. However, we must take the debate beyond mere kilowatt hours. There is a long history of rural exiles from the city, and we, the former hi-tech offices, have been left alone to apply sustainable principles to inner-city briefs without really having any contact with these people working in more remote areas.
>
> *Bill Dunster, Michael Hopkins & Partners*

Just as this century has been the century of electricity and nuclear energy, the next century is the century of the sun; we have a new beginning. We're just in the early days, if I was a millionaire I would invest very, very heavily in solar technologies.

Susan Roaf, Lecturer Oxford Brookes University

> The house is no longer just a site anymore, it must be seen in the local, environmental and global context.
>
> *Susan Roaf*

A second point is the degree to which the ecological movement and architects have a community of interest: that architects might be useful to the ecological movement – for at least symbolic gestures – as to what might be achieved and what aspirations might be set. Of course ecology and ecological thinking can offer architects some sort of legitimisation which is the underlying feeling of what we are discussing.

Jeremy Melvin, Building Design

We have not even begun to win the argument. I mean this whole area is still considered as an eccentric minority view by the media, by central government particularly, partly by local government, by most institutions and, as you quite rightly said, by architects – which is sad but true. People recognise that there may be right in it, but it has not entered the bloodstream of political debate and until it does we've got a real problem.

Mark Fisher, Member of Parliament, Labour Party, Stoke-on-Trent Central

Firstly, in terms of the urban issue of energy, which is what a lot of you are talking about, the solution that you must accept is solar power. You need things like Susan Roaf going on 'News at Ten', and the supplement of *The Times* showing a picture of her house, very normal, very mainstream. Now architects come up to me and say, well it's a bit ugly and I'd rather have it this, this, this and this, and have lots of quibbles about it. But she's done it, she paid for it out of her own pocket and it's in the national media, and we're getting calls from people at Greenpeace saying 'I want a solar home, how do I get one ?' . . . So that's the issue about how to champion the cause with good practice. Then you need political signals from industry. Remember you need to crystallise your view in order to instigate change.

Colin Millais

We only talk about one half of the problem which is the cost side – reducing costs. Everything is reducing costs, but you need to spend money and spend costs to obtain benefits. You can never obtain something for nothing, so it is not just the question of cost that we should be talking about, we should ask what costs will ultimately benefit us.

Marcial Echnique, ME & P Architects

It's not just the architect alone in these considerations: a consultant team is required to work together to produce an energy efficient building. I would also say that there is a risk in all this, in as much as every building is a prototype, and that a lot of clients aren't prepared to put their money into a risk element. To that extent I admire the architects who have actually produced their own houses and in a sense participated in that experiment.

Richard Brearley, John Miller + Partners

Without defending the Treasury, the interesting thing that has happened recently is that all of a sudden we have got contractors coming to us who are doing PFI [Private Finance Initiative] proposals, for many public sector buildings, and they're being forced financially to have to think about the building over a two-year life span. Consequently, the questions being asked are: how long will it last, how easy is it to maintain, and can we look at green environmental concerns.

Mark Fisher

Even in a small building it really makes sense to allow the building to take over the intelligence and to run efficiently. On a domestic, and much more on a public scale, people just don't have time to constantly turn on lights and control the heating, particularly in such institutions as a hospital. Lights are left on all the time, the same with heating, doctors are busy saving lives rather than worrying over the building's performance and I think it's one aspect where architects can really make huge input in specifying building management systems.

Gabriele Bramante, Bramante Associates

If we actually set quite modest, but exciting, targets for a 25-30% reduction in energy usage we would buy ourselves time to look at the long term solutions. We would have a huge impact, both short and long term, and we would begin to demonstrate good practice. The normality of this would then get it onto the political agenda . . . Maybe the best approach would be to reconcile short term problems, to give us a chance to look at better solutions for the future.

Mark Fisher

Quotes are taken from the Academy International Symposium, The Green Apocalypse, The Royal Academy of Arts, 23rd April 1996

ZVI HECKER

ARCHITECTURE AND NOTHING ELSE

Very often articles like 'Architecture and Ecology', 'Architecture and the Environment' and 'Architecture and Solar Energy' provide information and data about so called environmentally friendly products and techniques, but strangely enough they are more often than not incorporated into designs of no architectural value.

Such a combination of technicalities and banalities illustrates that architectural design is generally unable to cope with environmental problems, created in the first place by an overdose of the very same banal and sterile architecture.

For architectural pollution to be cleaned, it must first be stopped. Then comes the question, 'what should one build?', and for many the answer seems to be hi-tech. Once again, this is a method, a technique and a material rather than an ideology.

After all, in spite of what is being propagated, the hi-tech *Brave New World* architecture is not environmentally friendly, neither for the interior or the exterior. Such buildings demand high maintenance costs due to the artificial ventilation, air-conditioning, the need to reduce the amount of light, and above all to prevent the unpleasant and damaging effects of glare. To overcome these problems, one really needs hi-tech solutions: sun-movable louvres, closing and opening jalousie systems, intelligent facades, low-emissivity coatings, etc – what an effort to reduce the damage that could have been prevented in the first place. Hi-tech glass structures articulate the ideologies of those who have attempted to create a better kind of man: who hides nothing and can therefore be shown in a glass box.

Fortunately, these ideologies didn't succeed in transforming humans, but the idea was picked up by the world of commerce. In contemporary society no respectable commercial enterprise can allow itself not to be wrapped in glass: to be totally transparent, proud to display its clean methods and absolutely unselfish aims.

In spite of all the changes and developments there have been in human history, men and women have changed very little. We still need protection, and in the future we might even need much more. Architecture, as it did in the past, has to provide protection rather than exposure. It must deal with the classical problems of man, exploring his relationship with nature, especially the limits of its exploitation, while providing a sense of protection for all, man and the environment.