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"BIO -HARMONIC ARCHITECTURE, THE IRISH EXPERIENCE"

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Our species originated in a natural environment; inspired by nature, man developed buildings that explored and utilised renewable resources. Man was in possession of the earth, and his dwelling places were creative forms both of function and of expression. Building upon the land was natural to man. Techniques and technology used today place an excessive demand on non-renewable resources and energy and collectively undermine the critical path of nature and our own sustainability. The synthesis of our techno-culture of architecture, products and systems can cause distress and illness in our buildings within society. Architecture needs to become an element within nature rather than dominate its ecosystems. It is not limited to function and appearance. Design must take into account the social and ecological impacts of building .

New criteria are evolving for judging the acceptability of products and processes to calculate their true costs to nature. Decisions and actions that architects take can have monumentally adverse, even catastrophic effects. All to often, buildings which increase environmental illness demote our own well being. The advancement of technology has largely separated us from our permaculture. Isolation from nature, our acquired social habits and concepts of progress, clearly translate into measures of environmental destruction, rather than laudable coherence with living and regenerative systems of our planet. We are now living within a societal and technological revolution rather than evolution.

Sustainable communities, energy efficient and conservational systems are necessary for survival within global ecology. Green design is not an identifiable objective but an attitude of mind. It means seeking to adapt our way of life to a sustainable equilibrium with our fragile planet. Each culture constantly alters its environment, often creating damaging conditions that jeopardize its own and others survival. This will eventually mean radical changes to how we live, work and design. If architecture is to be of service, it must respond to the wit, intellect and creative ability of our architects to develop technical solutions that can grow with greater harmony on our planet. Buildings give tangible expression to values, priorities and aspirations.

CHAPTER 1: PRIMITIVE ARCHITECTURE

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In the words of Chief Seattle, 1854:

" How can you buy or sell the sky, the warmth of the land? The air is precious to us, the air shares its spirit with all life it supports. You must respect the earth, whatever befalls the earth befalls the sons of the earth".

(Scully, 1991,p.35)

One way ~~with~~ of dealing with historical prototype has been to indulge in myths of origins and to suggest that one might achieve authentic results by returning to beginnings known as primitivist. This position first received impetus in the eighteenth century, especially in the writing of the critic Abbé Laugier. (Knevitt, 1985,p.12) He believed that the beginning of architecture was the 'Primitive Hut' from which the ornate elements of the classical system had evolved. (Knevitt, 1985,p.12) This implied that simpler meant better and that the further one went back, the more authentic the form would be. Laugier denied that there were absolute rules in architecture and spurned accepted educational taste, arguing that the best forms were rooted in structional demand. Notions of this sort gained extra momentum in the early nineteenth century in writings of critics like J.N.L. Durand. (Copplestone, 1970, p.23)

The Australian architect, Glenn Murcott quotes an aboriginal saying that "one must touch this earth lightly". (Daly, 1979,p.55) This saying embodies an attitude to the interaction of a building and its site that is essential to a green approach, but it also implies wider concerns. A building that guzzles energy, creates pollution and alienates its users, does not "touch this earth lightly". The most direct interpretation of the phrase ("one must touch this earth lightly") would be the idea that a building could be removed from its site, leaving it in the condition it was in before the building was placed there. This relationship to site is seen in the traditional dwellings of nomads, but their lightness of touch is not just a matter of moving their homes.

Nomads are vitally concerned with the materials they use and the possessions the carry with them. The Black Tent of the Bedouin is woven from the hair of their goats, sheep and camels. When erected, the tent adapts a low, aerodynamically

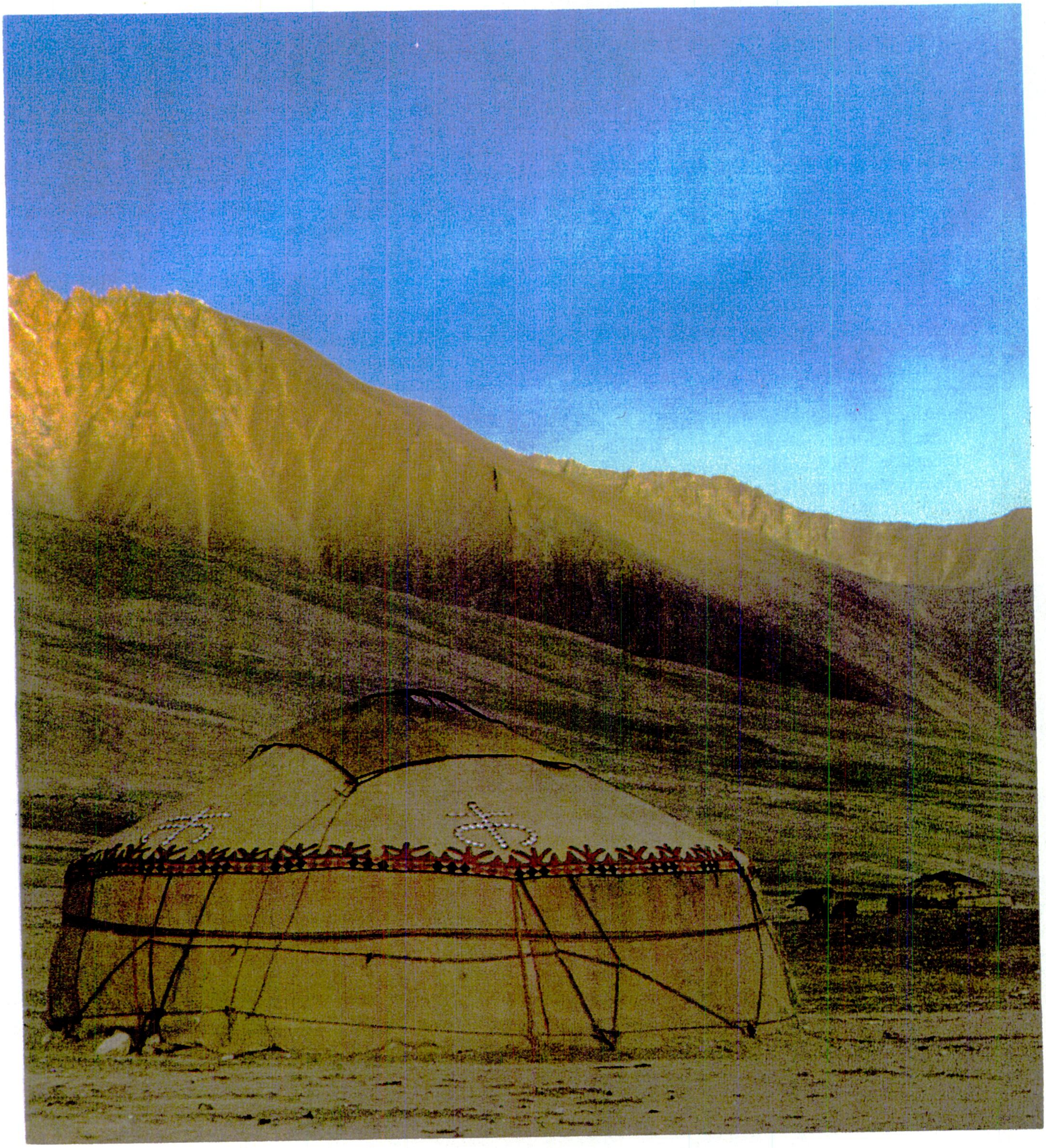

Figure 1: Nomad tent woven from the hair of their goats, sheep and camels. (Pearson, 1989, p.10)

efficient profile to avoid damage by high winds. The tent is kept in place by long ropes, also woven from hair, and supported by a few wooden poles because wood has always been a scarce resource in the desert. (see Figure 1)

The Netsilik Inuit people of Northern Canada carry their tents in summer when they need to follow the game that is their food. But in winter the skins that form their tents' cover are dipped in water and wrapped around frozen fish. Only a minimum of possessions are ever carried from place to place. The earliest settlements attempted to echo the shapes of the landscape. The tent-like structures of nomads, introduced around 1,500 AD.(Scully, 1991,p.5) were domed over the earth and picked up the profiles and the colours of the painted mesas that shape the horizons. The entrance always faced east, towards the rising sun. The tiny family dwelling was thus locked into the patterns of the sky as well as the shapes of the earth. The circular plan of the structure was an image of the enormous desert horizon, brought down literally to individual scale. Around the periphery of the circle, there was plenty of room for everyone, while the father could stand upright and fill the dome to its apex. When one of the family died, the tent was abandoned and a hole was cut into its western side, to release the soul. The little Basket-Maker pit houses in the Colorado Grand Canyon were partly dug into the earth with a Sipapu in the floor to record the emergence from below, while their low roof profiles echoed the shapes of the mesas around them.

The architectural principle at work in indigenous people's dwellings is the imitation of natural forms by human beings who seek thereby to fit themselves safely into nature's order. They regard the home as more than a shelter. It is their spiritual centre, where the spirit rests at the end of a long day. They have a sense of belonging and being part of the natural world. Their homes are a source of true well being and these spiritual aspects are most important to indigenous people. There are many accounts of how families fell ill or died if forced to leave their ancestral homes. To indigenous people, the whole land is home. Primitive society embody all elements and principles of architecture; their dwellings are socially, spiritually and environmentally responsive.

CHAPTER 2: MAN VERSUS THE MACHINE

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With the progression of architecture and by the end of the Nineteenth century, a struggle developed between the industrial revolution and the arts and crafts movement. Architecture had always been fundamentally bio-harmonic until the birth of the machine and the introduction of manmade materials. This introduction signified the beginning of the industrial revolution and the degradation of society and the environment.

The industrial revolution rallied in man's ability to manufacture all his material needs and to control his environment. The achievement of such aims however cannot be made without cost, the cost to which we are heirs to: environmental destruction. The industrial revolution supplied new methods of construction: smelting iron ore, allowed new solutions, created new patrons and problems, and suggested new forms. A split of sorts was created between engineering and architecture, with forms appearing all the more inventive. Industrialisation transformed the very patterns of life; engineers replaced architects as inventors of imaginative structures. Using mass produced iron components, they designed new structures undreamed of previously, to house industrialised machines, railway stations, docks, factories, bridges, exhibition halls, hospitals and museums. One of the best known engineering structures of the nineteenth century was the Crystal Palace designed by Joseph Paxton to house The Great Exhibition of 1851 in London(see Figure 2). The Great Exhibition displayed products of Britain and her Empire. However, leading designers, notably Ruskin and Morris were outraged by what the Crystal Palace contained and stood for.

Ruskin and Morris felt that mechanisation was bound to cause the demotion of all compartments of life at the smallest and largest scale of design, the degradation of the very earth we stand on. To them mechanisation disrupted the traditional world of crafts and hastened the collapse of vernacular traditions. Machine work and standardisation engendered a split between hand, mind and eye in the creation of utilitarian objects, with a consequent loss of vital touch and impulse. The resultant Arts and Crafts Movement called upon the restoration of an awareness of honesty, integrity and simplicity in society.

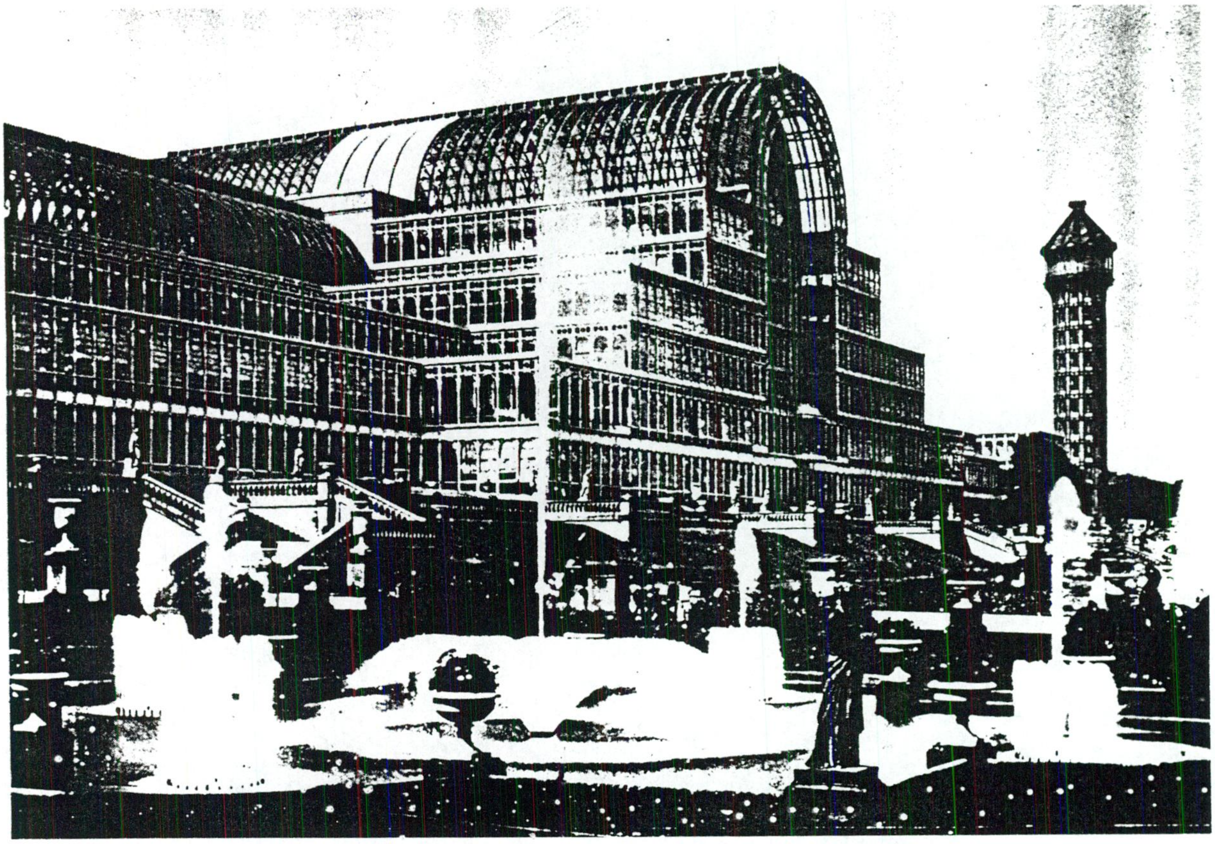

Figure 2: The Crystal Palace, 1,800 foot long and covering 19 acres was prefabricated and erected in just six months to house the Great Exhibition of 1851 in London. (Knevitt, 1985,p.11)

Led by Ruskin and Morris it hoped to usher in a new period of integrated wholeness in which the highest aesthetic qualities would be ripped from the museum pedestal and be linked again with tools and artefacts of everyday use. The direct qualities of vernacular design were emulated, to create a suitable emblem of the simple, good life. Designers immersed themselves in the simple joys of English traditional design. For example Voysey's architecture represents the perfection of a rural style: economically and carefully detailed, friendly roofs and his childlike obsession with the composition of rain barrels and gutters in facades.(see Figure 3)

The architecture of the Arts and Crafts Movement suggests continuity with local landscape, fitting materials, vernacular design and bold innovation in domestic design. The architects themselves were traditionalists, the freedom of their planning and the directness and honesty of their use of natural materials was emblematic of a reaction against manmade synthetic materials and the machine aesthetic of the industrial revolution.

Twentieth century architects worldwide have been influenced by the ideals of the Arts and Crafts Movement. Frank Lloyd Wright's designs possessed sobriety, fantasy and a noble quality of space, while his domestic ideals were stamped with the Arts and crafts Movement's values. However, Wright was more concerned with mechanisation than most of his predecessors and contemporaries in the movement. In 1901, in a paper entitled "The art and craft of the machine", Wright explained that simple geometric forms could most easily be turned out by machine saws and suggested that architecture must remain open to the tremors of a new mechanised age. (Lloyd Wright, 1953, p.54) He intended to imply that the machine should not be understood as a means to the larger end of providing a decent and uplifting environment for new patterns of life.

By 1914 fierce competition among European capitalist states for economic domination of the world exploded in the First World War. Afterwards, it seemed as if the old world of empires and distinct countries had been swept away for good and the world would be created anew. Modern architects saw themselves as leaders in the creation of a Utopia starting with a clean sheet. Tradition and history could be ignored as irrelevant. The new order would be determined by science and technology.

Figure 3: "Perrycroft" Charles Francis Voysey.
(Banham, 1975, p.50)

The birth of the modern movement saw the birth of progressive attitudes, anti-traditionalist positions and tendencies towards abstract forms, with the celebration of modern synthetic materials: concrete, steel, plastic and chemical treatments. The new movement rested on the central assumption that the spirit of the times was inevitably tied to the evolution of mechanisation: values had changed and nature was no longer a source of inspiration. Instead the machine aesthetic took over:

> "We declare that the splendor of the world has been enriched by a new beauty - the beauty of speed. A racing car with its bonnets draped with exhaust piped like fire breathing - a roaring racing car, speeding along is more beautiful than the winged graceful victory of the eagles catch".
> (Marinetti's manifesto on Futurism in Curtis, 1987, p.83)

The formation of the Bauhaus in 1919 has become a landmark in the history of the modern movement. German artists and architects transformed and extended Werkbund principles in the post war years. Using the Bauhaus as its laboratory, the school attempted to establish a methodology for design through what Kandinsky described as "The new science of art". (Naylor, 1982, p.132) What is unique about the Bauhaus is the fact that its ideologies epitomise changing concepts concerning the nature and purpose of design in the early Twentieth century. The Bauhaus reinherited, reinterpreted and then rejected the Craft ideal of the Nineteenth century. Design was inspired by mathematical order devoid of unnecessary decoration and one of the dominant artistic principles was dynamism, which sought to depict movement and the simultaneous sensations of modern life.

By 1931 Le Corbusier's ideas on the house as "A machine for living in" came to a climax: uncompromising, machine-like houses, totally devoid of organic design were the outcome. Emphasis was placed on pure functionalism and the human being was reduced to serviceable needs. The modern movement believed that the exploitation of advanced technology would make buildings not only quicker and cheaper to erect but of a higher standard. Thirty years on, society is presented with a massive bill for putting right building failure either by repair, renovations or demolition. Buildings are not machines and they must last as resources needed to build them are too great.

The modernists rejected ornament as irrelevant; however, ornament in classical architecture was not just decorative: it helped to cover joints between materials and enabled buildings to 'weather' by throwing off rainwater from facades. To try to obtain a smooth, streamlined, machine-like surface was illogical and costly. Even before the energy crisis of 1973, the failure of modern buildings to cope with a variety of climates was apparent. They relied on technology to provide comfortable conditions internally (artificial ventilation, air conditioning, central heating.) Local, traditional methods which had evolved simple and successful means of achieving comfort were ignored: large areas of glass were employed in climates hot or cold. Unfortunately, even in the few cases where sophisticated air conditioning was affordable, the energy consumption required to compensate for this was enormous. Most new buildings had to rely on inefficient heating and ventilation. The modern movement was obsessed with the 'machine aesthetic'; buildings even had to look like machines to be 'functional'.

The struggle between the ideologies of the Arts and Crafts Movement and the Modern Movement remains basic to the Twentieth century. Today 'Eco Architecture' advocates a reintensification of craft and a reintegration of art and utility. Although Eco Architects, like Paul Leech, Irish Architect, assume their area of responsibility to the environment and to society, mainstream architects today turn a blind eye to ecology and forge ahead with detrimental synthetic materials and poisonous finishes - which increase environmental illness and demote our well being.

CHAPTER 3: CRISIS IN ARCHITECTURE

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The crisis in the Irish environment is due to two underlying factors:

1. Hap-hazard rural development and bungalow blight.
2. Alienating urban architecture.

There is deep conflict between architects' and planners' objectives and the people they are supposed to serve.

1. HAP-HAZARD RURAL DEVELOPMENT AND BUNGALOW BLIGHT

In the past twenty years, rural settlement in Ireland has changed. The traditional form of rural settlement was highly dispersed, reflecting the primary role of the individual farmstead in the landscape, dominated by farms and village. Agricultural decline especially in the West, due to the inability of family farms to earn a living had a marked impact on the nature of settlements. Orme, in 1970, vividly summarised the legacy of decline of many farming communities "as a melancholy abhorrence of ruins and redundancies compromising of abandoned derelict country houses and decaying farm cluster set amid weed-infested fields". This "still remains a disgusting feature of the Irish rural scene" (Brunt, 1992, p.133).

Since the 1970's this image has increasingly less validity and is confined to the remoter areas of the West. Today their exists a rapid and untidy spread of housing through the countryside, which suggests a low appreciation of the need to preserve the physical rural environment of the landscape. Orme lamented the replacement of the picturesque thatched cottages which were healthy, aesthetically pleasing and environmentally correct, by the drab, depressing bungalows which are the same around every turn. These bungalows promote insidious pollution caused by the use of chemical treatments and finishes and synthetic, manmade toxic materials, and are a growing risk to our heritage as they spread in epidemic dimensions. This style housing detracts from the aesthetic quality of the environment which attracted the owners in the first place. A prime example of what many know as "bungalow blight" occurs along coastal roads in Connemara. In 1977 failures to curtail the rise in bungalow development has resulted in a disharmony between bungalow development

and the existing rambling cottages. Bungalows are constructed of materials which are alien to the natural environment and promote harmful products which are toxic in the making and toxic in finish. (See figure 4)

In rural landscapes, natural elements are predominant: mountains, lakes, forests, rivers etc.. Traditional rural buildings were generally subservient to the landscape and their essential visual and aesthetic qualities were created by relationships with surrounding images. In the same way, character and atmosphere were created in cities and towns from the arrangement of buildings and the spaces they formed with each other. In other European countries, towns, villages and hamlets outline a clear visual and physical separation. However here, the rural landscape is becoming suburbanised and the visual distinction between settlements and surrounding rural landscape is becoming increasingly blurred. Due to hap-hazard planning, soon there will be no visual distinction betwwen a suburb and a rural area. Rural Ireland will then exist no more.

Ireland has great potential for the "handmade", "one-off" house. Our future buildings have the ability to be exciting, fresh, fanciful and individual. Architects must first abandon the regimental fashion of the bungalow, where entire sites are cleared of trees and hedging to accommodate bungalows and then replanted mostly in the same vein. Each one-off dwelling must adopt a distinctive design approach influenced by landscape, local materials and vernacular building techniques. Entire areas have changed because of adaptation to building, instead of vice versa.

2. ALIENATING URBAN ARCHITECTURE

Much urban architecture today is out of scale with the historical structure of the city and is alienating to society. It is often produced for a public welfare agency which lacks the money necessary to carry out what it set out to do. On the other hand it is funded by a capitalist agency whose monopoly creates gigantic investments and corresponding buildings, this type of production is to make money, so cheap processes, materials and systems are employed, which are not always efficient.

Figure 4: Bungalow culture which has blighted much of the Irish landscape. 05/02/1996

The greatest cause of alienation today is the size of projects: hotels, shopping centres, housing estates and apartment blocks are to big.

In Ireland young married couples migrate to urban areas due to lack of work or for a better standard of life. More often than not they end up in concrete urban flats. They lose the bond of community life and a sense of belonging. These urban solutions to problems of lack of housing create a temporary atmosphere, where one is deprived of personal space, identity, individuality and informal relationships which exist in the rural community. The cityscape is polluted and depressing, people feel stifled and suffer from depression, apathy, lethargy and isolation.

Ballymun's "Fatima Mansions" are a prime example of this concrete nightmare. Family's are put into minimum accommodation with nowhere to play, dependent on cheap lifts which constantly break down and no contact with neighbours. The blocks belong not to the people but to the state. The vast areas of territory no one is responsible for: lifts, corridors, stairs are consequently vandalised and graffitied. On a winters evening in 1981 a 27 year old man jumped from the 15th storey of the "Fatima Mansions" flats (Hasset, 1981, p2), this must be the ultimate expression of disillusionment with urban living conditions. "Fatima Mansions" flats should be given the final "coup de grâce" by dynamite. It has been vandalised, mutilated and defaced. Although money has been pumped back into it: fixing broken windows and lifts, repainting and repairs. It should be put out of its misery "boom, boom, boom!". As Theo Crosby would say "flats are hideous, of course, there being a law, apparently respected throughout the world, that flats be as cheerless as a prison".(Knevitt, 1985, p.107), (see figure 5).

Figure 5: Urban Flats in Dublin 09/02/1996

CHAPTER 4: "ECO" ARCHITECTURE

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"Eco" architecture is a current way of expressing what people once knew instinctively and did not need to put into words. In 1984 a group set up in Norway which endeavoured to deal with the pressing state of the environment. This group called themselves "Gaia", a living entity named for mother earth. The concept of Gaia has been widely held throughout history and has been the basis of a belief which still co-exists with the great religions. Gaia is a complex entity involving the Earth's biosphere, atmosphere, oceans and soils, the total constituting a cybernetic system.

The "Gaia" group is a group of Norwegian architects, artists and craftsmen with a mutual goal; preserve Mother Earth. They combine a scientific approach with a holistic view of the relationship between buildings and their environment, born of disenchantment with much post-war building and prevalent "green" awareness and concern about chemical pollution from synthetic building materials. The house is compared to an organism and its fabric is compared to skin- a third skin, which, like our own skin (and our clothes, the second skin), fulfills essential living function: protecting, insulating, breathing, absorbing, evaporating, regulating and communicating. "Gaia" aims to design buildings that meet our physical, biological and spiritual needs. Their fabric, services, colour and scent must interact harmoniously with us in the environment. This constant exchange with inside and outside depends on a transfusive skin to maintain a healthy, "living" indoor climate.

In 1990 the "Gaia" group expanded internationally into "Gaia" International. "Gaia" accepted membership from all around the world although the group is still small and close knit with a few members from Germany, England, France, Holland and Ireland. In 1990 Paul Leech, an Irish architect joined "Gaia". According to Leech it was "the right thing at the time" for him "being always aware of the deteriorating state of the environment" (Buckley, Interview with Leech, N.C.A.D, 12/12/95). He was one of the first to embrace the green agenda in Ireland and is one of the few to mirror public concern about such threats as global warming and the hole in the ozone layer. According to Professor John Page of the University Of Sheffield, "Energy used in buildings accounts for 2/3 of the global warming risks. Clean, renewable energy, like the substitution of passive solar heating for the dirty combustion of fossil fuels for

heating. Simultaneously provided effective ventilation to keep the environment biologically clean can make important contributions to the health of individuals and of global ecosystems as well as contributing to the energy economy" (Crowther, 1992, p.102).

Paul Leech's work embodies the deeper ecological principles of natural buildings which are at home in nature and grow out of the ground into the light: his houses are integral to their site, integral to their environment and integral to the life of their inhabitants. When I asked Paul Leech which is his favourite of all his buildings was, he answered simply "the next one" (Buckley, interview with Leech, N.C.A.D, 12/12/95). His answer reflects the continuing process of refinement that he causes his work to undergo, not only during initial design stages but also as he alters buildings under construction to render them correct. After designing a building, Leech sees where an improvement can be made and uses a refined, developed system in the next one. Paul leech and his Irish "Gaia" associates work from a Dublin Georgian red brick terraced house, at 200 years old it is according to Leech "a model of sustainability, constructed of natural materials and utilising available light and green space around it" (Buckley, interview with Leech, N.C.A.D, 12/12/95). Every building they design is checked against an "eco checklist":

1. "Think of a proposed building as an integral, living and healthy thing, which is part of rather than just on the site.

2. Work with the typography, climate, urban conditions, planning issues, waste reduction requirements etc. in responding to the clients brief.

3. In using materials, check that they are derived from a sustainable ecological cycle and can be recycled.

4. Ensure that materials are free of toxins in manufacture, use and disposal and that they are resistant to bacteria.

5. Design the interior to work with the micro-climate, with insulation to reduce the need for artificial heating, cooling and lighting.

6. Consider the long term life of the building, its operation, maintenance and future adaption.

7. Assess the design of heating, ventilation and plumbing systems in terms of consuming the least resources.

8. Ensure that all systems are commissioned and installed, and provide manuals on maintenance to occupiers.

9. Have the building independently assessed after it has been occupied for a few years to see if it measures up to the design intention".

(McDonald, 1995, p.67)

CHAPTER 5: THE BLACKIE HOUSE
VIEWED ON 02/10/95

CHAPTER 5: THE BLACKIE HOUSE (02/10/95)

Two of this country's most forward-thinking dwellings are aesthetically pleasing and environmentally responsive. Both are situated in West Cork and both are designed by Paul Leech. Mrs Jennie Blackies house in Ahakista, Bantry in Co. Cork which I visited in October 1995 occurred to me to truly belong to the region: he uses vernacular materials which appear all around the site, the limestone used in the house can be seen in an old stone wall at the rear of the site and again in an early Twentieth century cottage next door (see figure 6). This house displays a sense of unity, of the altogether that makes it part of the site. You cannot imagine that house anywhere other than where it is. It is a gracious part of the environment rather than a disgrace. The Blackie dwelling is a striking example of a house and site in harmony.

Although on the cutting edge of environmentally sensitive architecture, it is a surefooted stone, slate and timber house. It breathes by drawing fresh air in through its panoply of windows, which is circulated around the house with the assistance of a destratification duct and of course back out through the windows. There is no need for mechanical ventilation, which emits harmful CFC's into the atmosphere. The windows are natural ventilators. The house attempts to use locally available materials as much as possible. The timber comes from a sustainable forest in West Cork and was cut at a local sawmill, Gringers of Enniskeane, which is not more than ten miles from the site. The stone used in the dwelling is limestone and was quarried in Bantry. Limestone is a vernacular material in west Cork which is rich with limestone (see appendix A for a geological map of Ireland). Leech's success lies in the rigour with which he has applied the principles of using local materials and responded to local conditions without allowing his architectural knowledge to override these primary concerns. The external walls are limestone-facing stone with an innerskin of lightweight concrete blocks which provide longlife and low maintenance.

The house is facing directly south over Dunmanus bay, to get the best of the sunlight and to take advantage of the scenic views (see figure 7). An old stone wall at the rear of the site provides shelter from the northerly winds (see figure 8). The house is approached by a gravel driveway which winds upwards to a parking area just below the house. The site slopes gently downwards, so the house is on a higher plain than

Figure 6: Front elevation of the “Blackie House” in Ahakista, Bantry, Co. Cork. 02/10/95

Figure 7: View of Dunmanus Bay from the front of the house.

Figure 8: An old stone wall towards the rear of the site provides shelter from northerly winds. “Sliabh na Ráitineach” can be seen in the distance.

Figure 9: Sunspace with a dome shaped roof and semi circular form.

the parking area- which means that the parked cars do not interfere with views from the house. The front elevation is a semicircular glass and stone sunspace with overhanging eaves which help to link the building to the ground.

Leech utilises a simple passive solar system together with a sunspace to heat the house. The semicircular wall of the sunspace is covered in double glazing glass which allows direct radiation from the sun to penetrate the interior (see figure 9). The windows act as solar collectors and the stone acts as a heat store. Heat is distributed around the house by normal thermal movement; fans also assist circulation and reduce the amount of thermal mass required. The sunspace heats an internal sitting room where the Blackie family relax in the evening. Heat loss is reduced with ground floor heating collected by solar panels outside. Jennie Blackie recalls being away for 3 months, leaving the house completely shut up, and when she returned she found that her house was "warm and aired" (Buckley interview with Jennie Blackie, Cork, 02/10/95).

Among the striking features of the house is the high dome-shaped ceiling in the sunspace which is attached to the outer sitting room wall by a tension ring, to ensure that the walls of the sunspace do not lean away from the house due to the weight of the slate roof.

The house is entered by means of an open porch on the rear elevation, which leads to a tiled hallway (see figure 10). The two outer doors in the porch lead to two separate "apartment" bedrooms with shower room. There is the option of closing up the external porch and thus rendering the "apartment" bedrooms part of the main house internally. At the moment it suits the Blackie family to have the bedrooms separate for privacy and personal space.

The house inside is completely open plan with a "bed loft" over the living and kitchen area. (Interior photographs are not available at owners request). All the floor and ceilings are exposed pine beam wood with the exception of the kitchen and living area which have Chinese slate floors. A large amount of natural light is designed to penetrate into almost all of the rooms, except of course the larder which is allowed to remain cool and dark (a larder is used instead of a refrigerator to save on energy). The ground floor and "bed loft" are large and yet, due to the clever design of the double

Figure 10: Entrance porch, 3 doors leading to the main house (kitchen, living area, sunspace, bedloft (and bathroom), larder, utility room) and to two separate bedrooms (with bathroom en suite).

glazed sunspace, the internal rooms receive an abundance of heat and light. This is a feature of many ecological buildings since it cuts down on the need for unnecessary electrical lighting. The atmosphere generated by natural lighting is healthier for occupants to live in and work by. Paul Leech achieves bright, fresh rooms through his clever orientation of rooms with large windows cutting out unnecessary electrical lighting.

The house also has a swimming pool which is seen as an expensive luxury in Ireland. However, this swimming pool was not expensive as it was created from a concrete platform which already existed on the site-where the previous owners parked a mobile home. Jennie Blackie believes in the ancient Chinese art of placement, Feng Shui, and wanted her home to fit into its quiet exposed setting "like an oyster in a shell" (Buckley interview with Jennie Blackie, Cork, 2/10/95). In Feng Shui, mountains are symbolic "protective dragons" and mountain streams are veins channeling (ch'i), or "dragons breath". The ideal site is thus an armchair formation: a high mountain at the rear flanked to the west by a Yin ("a fierce white tiger")- a hill and to the east by a Yang ("azure dragon")- a slightly higher hill. In front of the site a low foothill slopes down to the water. Water, symbolising wealth, is crucial and should be "alive", gently waving (Dutton, 1983, p.25). This describes the Blackie site. It is situated at the foot of "Sliabh na Ráitneach", above Dunmanus Bay (see figure 7) with sweeping hills at either side (see figure 11,12). The site and orientation echo the Blackies spiritual beliefs. The Blackie dwelling celebrates the holistic concept of being alive and the family's lives are interpreted through their home.

It must be said that the building will not date from a stylistic point of view. It could have been built 50 years ago or today. The use of slate and stone ties it in with our traditional Irish use of these materials (see figure 12). Its timeless geometrical forms render it ageless.

The house represents a number of important green ideals, fulfilling Leech's and Gaia's criteria for a natural building:

- It doesn't use any toxic treatments. Wood is treated with natural varnishes which allow it to breath. Interior pine is finished with beeswax which lends lustre and golden tones to it; its scent improves the room climate.

Figure 11: Hills surrounding the house (on the right)

Figure 12: Hills surrounding the house (on the left).
The bottom right hand corner of this photo shows the dwelling ‘next door’. It is a traditional Irish dwelling built in 1902.

- Leech has harnessed the suns energy to heat the house.

- The site and design of the house are life enhancing and increase the well being of its occupants by fulfilling the family's spiritual beliefs in Feng Shui.

- The temperature and humidity of the indoor climate are regulated naturally by the generous amount of large windows.

- The use of stone links the dwelling to the area, where a lot of stone cottages exist, and give it a feeling of strength and security. Stone is healthy, non-polluting and durable.

Jennie Blackie's house attempts to maintain the critical balance between people and nature, it is a living place fused with nature. The local beauty remains undisturbed. Plant and animal life go unharmed. The house is intimately bound up with the lives of its owners. Paul Leech's design is a microcosm of deeply felt values, concerning the environment and the meaning of the home. Details as well as overall mood are infused with a sense of reverence for the ideal of a happy family life, lived in a natural setting. The wonderful word "home" connotes a physical "place" and can have the more abstract sense of a "state of contentment". This is what strikes you when you enter this house.

Figure 13: Rear elevation of the house.

CHAPTER 6: "ECO HOUSE"

DESIGNED FOR DR. PHILIP MICHAEL.

VIEWED ON 23/10/95

Figure 14: Front elevation of 'Eco House' with 'tee-pee' sunspace at the front. Bandon, Co. Cork.

CHAPTER 6: "ECO HOUSE", DESIGNED FOR DR. PHILIP MICHAEL (23/10/95)

Paul Leech's "Eco House" is a striking A-frame house in stone, timber and glass bedded into a West Cork woodland setting (see figure 14). The house was an award winner in the 1995 R.I.A.I regional architectural awards and was designed for Dr. Philip Michael and his young family. This dwelling and workplace is part of an overall permaculture proposal with many interventions in synergy with an ecosystem. The house is situated on one hectare of woodland, not an appropriate place to build as one might think; however, Leech does not disturb plant and animal life. This "eco house" tends towards the primitive and the rustic; the form of the dwelling recalls that of the Native American Indian dwellings of the Eighteenth century: the teepee. If fits in perfectly with the taste of the Irish for whom there is nothing better than simplicity, a minimum of form and a maximum peaceful, healthy, comfortable yet lively atmosphere. The dwelling is located in a natural clearing within the woodland where a magnificent Turkey Oak is found. It is facing south so it absorbs much sun and is allowed to breath, enjoying plenty of light and air.

The house is reached by a natural dirt driveway which follows the contours of the soil, sweeping and curving around the trees, climbing up to the house (see figure 15). The design evolved with a stepped A-frame core which necessitated the minimum possible cutting of mature trees. The house rests comfortably among the retained majestic oaks with its narrowing forms casting a minimum of shadows. "Eco house" is completely hidden from the roadway and the tall form provides high views out. The wide base of the A-frame concept lends permanence to the dwelling, roots it firmly to the ground like one of the majestic oaks that surround it. Its as if it had always been there; like the great pyramids of Egypt, the narrowing form rises rapidly towards the sky giving the illusion of great height and drawing light down through the roof lights dispersing sunshine into the interiors. The plan and sections respond well to the influence of natural light.

Figure 15: The driveway which curves around the trees and climbs up to the "Eco House"

Figure 16: The east facing elevation-which is reached by the driveway.

Figure 17: West facing elevation houses the “under croft space”. In the front of the photo a “natural swing” constructed from wood found in the woodlands behind the house.

The design attempts to go quite far into the realm of "eco" architecture; the building is largely constructed of timber which comes from a sustainable forest close to the region, allowing for a stepped floor across very steep slopes while providing generous and useful under-croft spaces for fuel, composting, a heat pump plant, bicycles etc. (see figure 17). The timber for this house comes from the same sustainable forest as the timber used in the Blackie house.

Passive solar heating, together with a heat pump and a highly efficient woodstove, provide the dwelling with clean, efficient heat. There are destratification ducts on the south facing wall within the 'teepee' sunspace which direct hot air through the sunspace, building up a heat charge during the day which discharges at night through the same ducts to heat the house. Leech admitted that "the same way the sun heats the planet is the basic model for this house" (Buckley, Interview with Leech, N.C.A.D., 12/12/95). Heat radiates from the sun and warms the planets surface. This heat is stored in the land and water masses. Wind and water currents, themselves produced by the sun's energy, circulate the heat around the planet. The building structure is the store just as the land is and the destratification ducts are the wind which circulate it. The sunspace contains plants that naturally maintain humidity levels, refreshing the air and bringing sunlight to the core of the building. The plants are capable of filtering most of the carbon dioxide emitted by the buildings occupants. This in turn reduces the amount of outside air needed for ventilation in winter, thereby reducing heating energy requirements.

"Eco House" is very exciting and innovative. By using different systems (solar, reed bed), the architect is allowed to experiment with new forms. The A-frame aspires towards the heavens, exhaling an ethos of freedom and a concern of the individual dwelling with its natural setting. "Eco House" displays a sophisticated quest for natural values crystallised in an ideal setting. The materials and colours Leech chose fit admirably with their surroundings. Amid today's global pollution and tendencies towards the artificial, "Eco House" displays a pious appreciation of all things natural. A building isolated in a secluded wooded site allowed to grow and live free and away from destructive influences, senseless waste and impulses towards vanity which rules much of the urban society.

Figure 18: Fallen branches collected for the highly efficient woodstove.

Figure 19: Front elevation- window at the top provides high views out.

It is truly designed along a green brief using as few unsustainable resources as possible. Leech uses highly efficient systems to make every use of energy. An effective passive solar heating system heats the house in tandem with an efficient heat pump and woodstove. The rear of the building is sheltered by a bank at the back and trees (see figure 20). At the front a two storey sunspace is provided as a pleasant place in which to sit and relax. The house is free of toxins, built, furnished and insulated with natural materials. Kitchen organic wastes are collected and processed in a composter for use in the garden. The site is peaceful and an air of tranquility prevails.

Figure 20: The unusual triangular windows echo the 'A-frame.'

CHAPTER 7: THE GREEN BUILDING VIEWED ON 22/11/1995

Figure 21: The Green building via temple Lane.
Entrance designed by Maud Cottor.

CHAPTER 7: THE GREEN BUILDING (22/11/95)

The previous case studies were in areas of outstanding natural beauty which motivated the architect to design to an ecological brief. Psychologically, the architect's duty was to preserve this beauty, to be true to the land and its owners. In that sense it was easy to opt for a "green" alternative. However the architects of the Green Building in Dublin, Murray, O'Laoire and Associates, had more of a challenge to try and stick to a bio-harmonic agenda as they did not have the motivation of the landscape behind them. The green Building is situated in Dublin's Temple Bar region in the heart of the city centre (see figure 21). In 1970 Coras Iompar Eireann (C.I.E.) the state bus service, applied for planning to erect a transport centre on the site. However, planning was refused after considerable opposition and Temple Bar Properties took over C.I.E.'s holding, to upgrade this area. The Green Building was the first step in their exciting Temple Bar urban renewable project. Temple Bar Properties, with support from the European Commission's Thermie Programme commissioned the Green Building and now it serves as a front runner for energy technologies that employ techniques which have a minimal impact on the environment. It provides developers and architects in Ireland with a practical demonstration of the viability of these technologies.

The site is a twenty six metre long double plot with eleven metres at the front and back entrances. From the ground up, the Green Building is a universe in itself (see appendix B for the plans of the Green Building). The six storey building is centred around a courtyard (see figure 22) and contains shop units on the ground floor, offices on the first floor and apartments occupy the rest of the levels. The building is constructed of massive stone walls to enable it to sustain a microclimate within the building and not be affected by changes in external weather conditions. Thermal inertia in the massive stone walls is the reason for this sustained microclimate. Furthermore, due to the massive construction of the building, up to 41% less energy is required for heating purposes compared to mainstream buildings. The remaining 64% of heating is supplied by off-peak night rate electricity, which is released the following day. To calculate how much heat is required for the following day depends on the weather of the following day. Obviously much less preheating is required before a

mild, clam day than on a night before a bitterly cold day. The weather forecast is transmitted straight from the met. office to enable accurate preheating for up to forty eight hours. This system was developed in 1988 and tested in Trinity College and in Blackrock Clinic. It virtually eliminates the over-heating or under-heating which provide an uncomfortable atmosphere for users. Due to the unchanging temperature of the Green Building, occupants live in a stable, healthy environment. The system also demonstrates that the correct use of weather forecasts can achieve a 16% reduction in energy consumption, compared with those achieved using conventional optimiser controls.

Large glass units on the ground floor of the building contain specially selected plants which naturally maintain humidity levels thus refreshing the air and providing ventilation. Research carried out at the O'Reilly Institute in Trinity College has shown that these plants are capable of filtering out most of the carbon dioxide emitted by the occupants (Cooper, 1993, p.37). However carbon dioxide levels in the building are monitored by sensors which ensure a constant circulation of fresh air. If carbon dioxide levels exceed natural levels, a backup system automatically begins. This system employs two large diameter concentric fabric ducts suspended from the roof to provide a balanced fresh air intake system. Part of the inner duct is formed from high transmissivity foil and outgoing air is pushed by means of a fan between this and the outer duct. Heat is recovered from the outgoing air by incoming air which passes through the inner duct and foil section. Thus incoming air is warmed and directed to the lower levels of the building, reducing ventilation losses by 15% - 20%. Cork artist Vivienne Roche was engaged to design the fabric funnel which covers the ducts (see figure 24,25). The fabric funnel 'floats' over the courtyard, creating an animated, lighthearted atmosphere in the social area. A series of swirling arrows printed on the fabric surface explain the movement of air and add a refreshing dimension. This is a prime example of how when artists, architects and engineers work together, efficient systems can be realised in a fun way.

Most of the electricity needed in the building is provided by four photovoltaic panels coupled with four wind turbines mounted on the roof (see figure 26). The P.V. panels (solar cells) are simply 'wafers' of crystalline silicon. The silicon is treated with impurities that enable it to convert sunlight into electric current. Each turbine is

Figure 22. View from the 4th floor balcony into the courtyard. Left of the photo shows a 'free' standing lift. Vivienne Roche's fabric funnel is seen to 'float' down into the courtyard.

Figure 23: Specially selected plants hang from each balcony for ventilation purposes.

Figure 24: Looking down on the fabric funnel designed by Vivienne Roche.

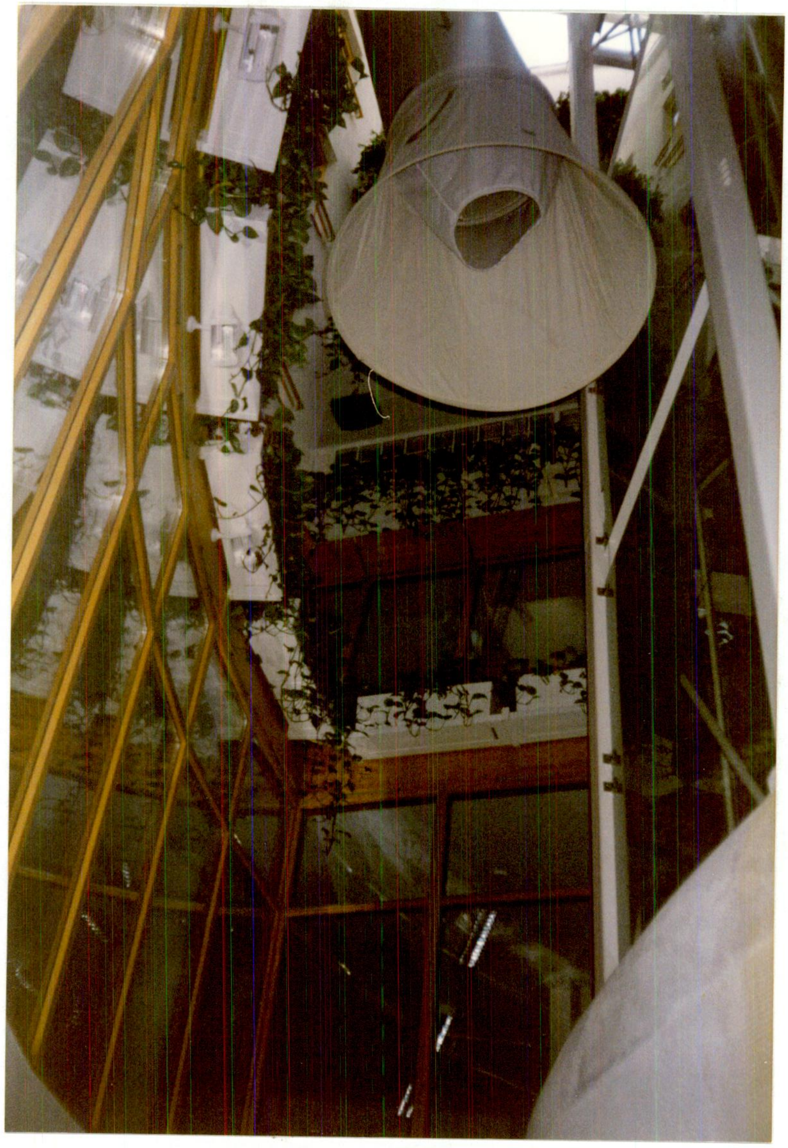

Figure 25: Looking up from the courtyard at the fabric funnel.

capable of generating up to one thousand five hundred watts, some of which is stored in batteries in the basement to be used on calm or overcast days. The wind turbines, together with the solar panels, provide 100% of the electrical lighting load and 56% of the hot water requirements.

The architects of the Green Building were obviously conscious that the materials they specified and the construction techniques they employed would have an impact on the environment. Environmental impact was a major factor in choosing materials. A general principle which was adopted when endeavouring to achieve harmony with ecological laws was according to Tim Cooper "to use materials as natural as possible" (Buckley, interview with Cooper, Trinity College, 15/11/95). The windows are constructed from softwood from managed plantations in Ireland treated with water-based, solvent free paints. The same wood is used in the kitchen fittings in the apartments (see figure 27) which were treated with beeswax.

Where recycled materials were employed: the Temple Lane entrance by artist Maud Cotter is a striking display of recycled materials, which refuse to rest but instead swirl and dance upwards towards the first floor (see figure 21). Cotters entrance seems to be making a statement: because the materials were used previously and are 'second hand' does not mean that they are 'dead'. The suggested movement forces you to take notice and realise that indeed they can be used again.

The Crow Street entrance by James Garner uses recycled copper water cylinders as cladding and recycled bicycles in the balustrades (see figure 28). The most striking feature of this entrance is the mottled green shade of the copper, showing that the entrance is not static. This green "weathers" with the door and changes seasonally as a result of changes in light, rain etc..Where recycled and natural materials could not be used, materials were assessed and chosen on a basis of minimum environmental impact. Energy consumed in manufacture, transport, installation and maintenance was considered,i.e: the material life cycle (see appendix C). However, there were some materials in the building for which there were no "green" alternatives: steel roll hollow box section beams were used to span the roof. Steel is by no means an environmentally friendly product: it uses very high energy in its manufacture and is difficult to recycle because it contains a certain percentage of two or three types of metals.(e.g. chromium and nickel).

Figure 26: Solar Panels can be seen at the top centre,
Behind the near 'star'.

Figure 27: Elegant kitchen using softwood in one of the apartments. Wicker baskets replace wooden drawers to save on wood.

Figure 28: Crow Street entrance designed by designer James Garner which uses recycled copper water cylinders and bicycles.

Figure 29: Recycled T.V. screen for emergency lighting in the corridors.

Figure 30: Recycled copper lamp shades designed by James Garner. The electric lights use advanced energy efficient technologies designed to compliment daylight. High efficiency background illumination of 160 lux is also used.

It was hoped that hardwood could be used for the beams but the wood's tensile strength was too low, and the wooden beams would have to have been reinforced with steel anyway. "It worked out that more steel would have to have been used to reinforce the wooden beams than was used in the whole steel roll hollow box section beam" according to Tim Cooper of Trinity College (Buckley interview with Cooper, Trinity College, 15/11/95).

The atmosphere in the Green Building is peaceful and refreshing after the busy streets of urban Dublin outside. Entering the Green Building is like entering a different world. Very little noise penetrates the massive stone walls and a waterfall in the courtyard, together with the surrounding plants on the balconies on each level, make for a serene, almost rural setting. The bedroom windows of each apartment look down upon the courtyard. The building is unique as an urban prototype and in terms of the technology used; it promotes energy efficiency for future developments. The building is a positive contribution to Dublin, not only to the people who live in it and use it daily, but also on a broader level, in the development of the debate on renewable energy within the confines of a dense urban fabric. The Green Building demonstrates the feasibility of constructing and operating a modern building that has been designed from the outset with the intention of achieving exceptionally high standards of energy consumption at no extra cost. The eight apartments, four retail units and office space are housed in a structure that represents a major attitude change in design.

Figure 31: All the rubbish is sorted into areas: Papers, glass, regular rubbish and aluminium to facilitate recycling.

CHAPTER 8: THE PRESENT SITUATION

CHAPTER 8: THE PRESENT SITUATION

During the last decade, the building sector has exhibited one of the fastest growing energy demands in Ireland. According to Environmental Management Ireland, a conservative estimate of the annual energy consumption of buildings in the city centre of Dublin alone is approximately nine hundred million kilo watt hours per annum (assuming they conform to current building regulations) at a cost of £36,000,000. Most of the energy is derived from fossil fuel : coal, turf, oil and gas: with only a small portion (0.06%) coming from clean, renewable hydro and wind power. The combustion of these fossil fuels generates approximately three hundred thousand tonnes of CO_2 annually, all of which is released into the atmosphere.(Fearon, 199,p.2). CO_2 is a major 'greenhouse' gas. Anthropogenic CO_2 emissions are believed to be responsible for the global warming that has occurred since the middle of the last century. The consequences of this global warming include greater barometric disturbance, leading to more frequent and violent storms, melting of ice caps and rising sea levels. Many of the climatic aberrations that have occurred in recent years (droughts in Africa, storms in North America) are thought to be indications of increased 'greenhouse' effects. There is a great fear that global warming may cause catastrophic climatic changes.

The decision by the 'hard-nosed' professional risk assessors (the insurance industry) in 1992 to take account of global warming when providing cover against storm and tempest was an ominous indication of risk associated with anthropogenic CO_2 emissions. The modern building industry impacts on the CO_2 balance in three ways:

- Firstly, it places demands on the eco-system by purchasing large quantities of timber (from non-renewable sources) for use during construction. This leads to the destruction of forests, forests that take one hundred years to mature and which play a crucial role in maintaining the natural CO_2 balance.

- Secondly, large quantities of CO_2 are emitted during manufacturing processes involved in the refinement of materials and components for the building industry.

- Thirdly, the consumption of energy when the building is in use results in continuous emission of CO_2 throughout the life of the building. As the service life of most buildings is generally in excess of eighty years, the latter effect is by far the most significant.

GOVERNMENT ACTION

Energy conservation is an important government priority to be promoted in all sectors of the economy. While making economic and financial sense, energy conservation also contributes to environmental protection. In the national CO_2 abatement strategy published recently by the Department of the Environment, the energy conservation programme, along with measures in areas like waste management and afforestation, form the basis of the strategy to limit the levels of carbon in the atmosphere by restricting annual emissions to ten million tonnes by the year 2000. This strategy, while accommodating the need for economic growth in Ireland, will contribute to the E.C. objective of stabilising CO_2 emissions at 1990 levels in the community as a whole by the year 2000 (Fearon, 1993, p.2).

The CO_2 reduction target is one of the driving forces behind the E.C. S.A.V.E.(Specific Action for Vigorous Energy Efficiency) programme. This is a 5 year programme, approved by the European Council on 29th of October 1991, designed to promote the rational use of energy through the development of integrated energy-saving policies both at community and national levels. Under the programme, progress is being made in the establishment of standards and regulations; national measures are being supported and a coordinated information is being established (Fearon, 1993, p 2). As part of the S.A.V.E. programme the council has adopted a directive 93/76/EEC of 13th of September 1993 to limit carbon dioxide emissions by improving energy efficiency. The directive requires member states to introduce and implement programmes in the following areas:

- Energy certification of buildings.

- The billing of heating, air conditioning and hot water costs on the basis of actual consumption.

- Thermal insulation of buildings.

- Regular inspection of boilers of an effectively rated output of fifteen kilowatts.

- Energy audits of industries with high energy consumption.

(Fearon, 1993, p.3)

The concept of audits, an important part of the initiative both in domestic and industrial sectors, is not new and has been a feature of Irish conservation programmes for a number of years. Indeed the Department of Transport, Energy and Communications operates a grant scheme which provides up to one third the cost of undertaking such audits in certain cases. (Fearon, 1993, p.3).

CONCLUSION

CONCLUSION

Most architecture today is not environmentally friendly nor does it carry an ecological message. More often than not it requires extreme manipulation of nature by bulldozing and sometimes dynamiting the earth. These degradations are not criticised for their negative impact on the land. To many observers, their aesthetic is inherently insensitive based on the mastery of nature. The buildings today illustrate a domineering attitude which is in essence a celebration of the status quo, i.e. technology subverting nature.

" We stand now where two roads diverge" but unlike the roads in Robert Frosts familiar poem " Stopping by the woods on a snowy evening", the road we have long been travelling is deceptively easy, a smooth, straight superhighway on which progress travels with great speed, however, at the end of it can only lie disaster. The other fork of the road is the one 'less travelled by' and offers the only chance to reach our destination. It is also a road of progress, because we can only go forward, however, it cares for our mother earth and assures the preservation of the world.

The need to preserve our universe and to 'convert' countries travelling down the superhighway with ever rising population and falling natural resources is surely a challenge that should attract architects. We are faced with the vital question, what does the future hold for architecture?, or perhaps more importantly, what does architecture offer the future? Society places an implicit call for architects to address the green agenda, as the solution to the problems of the 20th and the 21st centuries absolutely require the redesign of societies to change human destructive and wasteful behaviour. This is the mission of the architect of the future. However no one can predict the direction the architecture of the future will take, Although we can trace an obvious world and Irish movement towards sustainable design.

The architecture of Paul Leech and the Green Building in Temple Bar have addressed some of the main areas of change within architecture. These projects have provided developers and designers not only in Ireland but also in Europe with practical demonstrations of the viability of energy efficient technologies and the use of natural materials. The work of these architects, especially Paul Leech, have laid sturdy foundations of an ecological architectural movement in Ireland. All the time

Paul Leech is providing valuable groundwork and information for use in other projects.

Significant deterioration of ecological conditions may well colour the years ahead in spite of the deepening ecological consciousness of the present. The situation has to get worse before it gets better. Continued deterioration of life conditions may strengthen and deepen the urge to stop environmental destruction. Major changes in economic, political, ideological and educational structures may then at last unfold.

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APPENDICES

APPENDIX A: CARBONIFEROUS LIMESTONE REGIONS

Courtesy of Dr. P. Jarvis, Geologist, 15/08/1995.

Carboniferous limestone is in abundance in West Cork. Mrs Jennie Blackies house is constructed of this limestone as the area in which her dwelling rests is rich in limestone and for hundreds of years it has been a local building material. The geological map of Ireland illustrates where the stone occurs.

The great river deltas were gradually submerged under the sea during the late Devonian and early carboniferous Times. It was not the kind of sea which chills our feet at Brittas Bay, of Tramore, or Ballyheigue, or Salthill, but a warm, shallow, sun-drenched sea teeming with sub-tropical forms of life.

Little by little the shells of the multitudinous creatures of the Carboniferous Sea accumulated on the sea floor and became the raw materials for the construction of, arguably, Irelands most important and certainly its most widespread rock, the Carboniferous Limestone. It is formed largely of the broken and pulverised remains of shellfish which lived and died hundreds of millions of years ago.

The Carboniferous Limestone formed some 300 million years ago. It underlies some 60% of Irelands surface area. Carboniferous Limestone is underneath our best agricultural land and the limestone contains most of Irelands great metallic mineral wealth (mainly zinc and lead), as well as providing the principal raw material for our thriving cement manufacturing industry.

The Carboniferous Limestone is generally a shy rock, hiding beneath the thick blanket of clays, sands, gravels and soils which form the actual surface of most of Ireland. Only in the Burren, Co. Clare is the limestone well exposed to view.

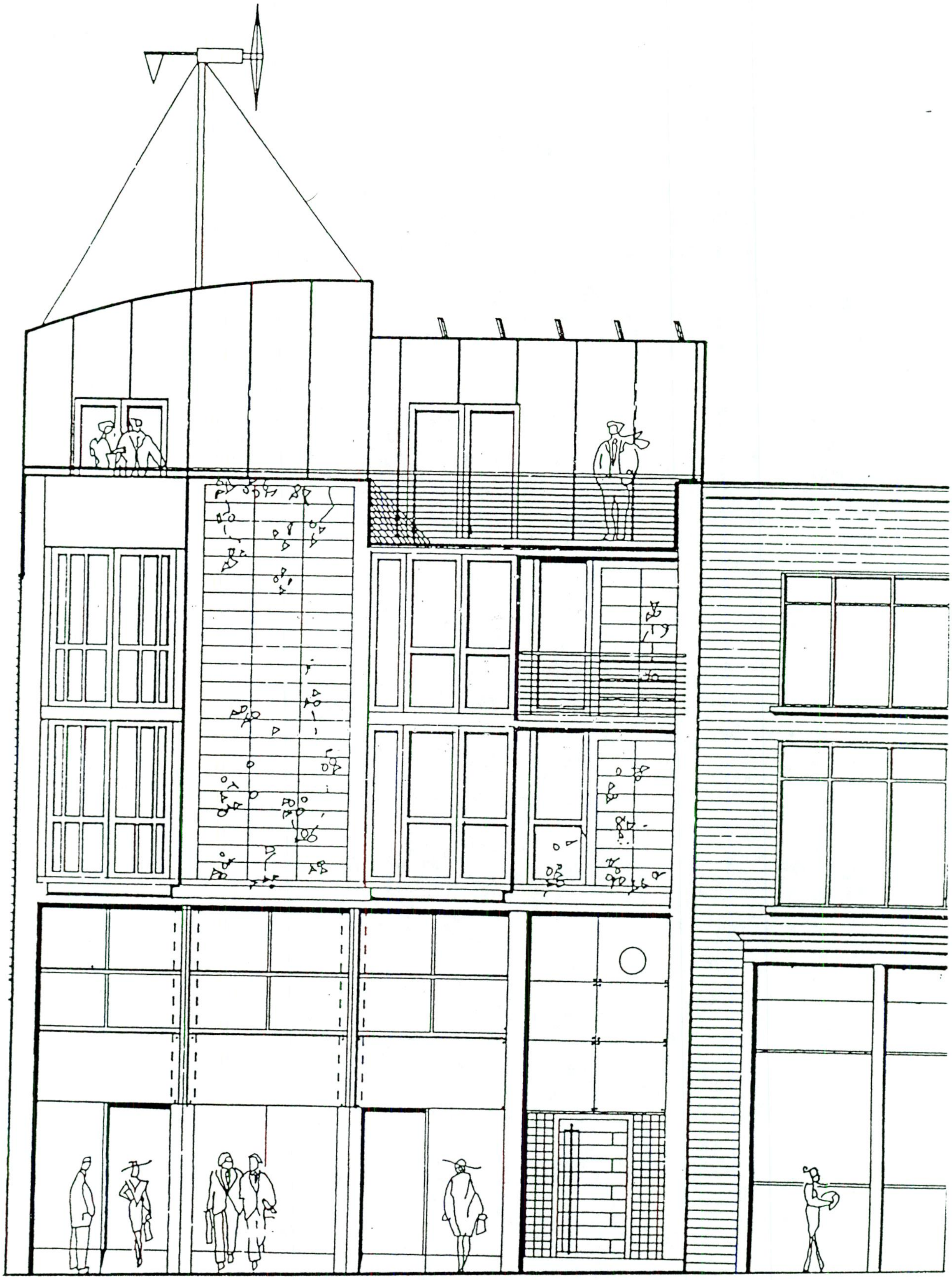
Appendix A: Carboniferous Limestone regions.
(Jarvis, 1995, p.12)

APPENDIX B: PLANS OF THE GREEN BUILDING

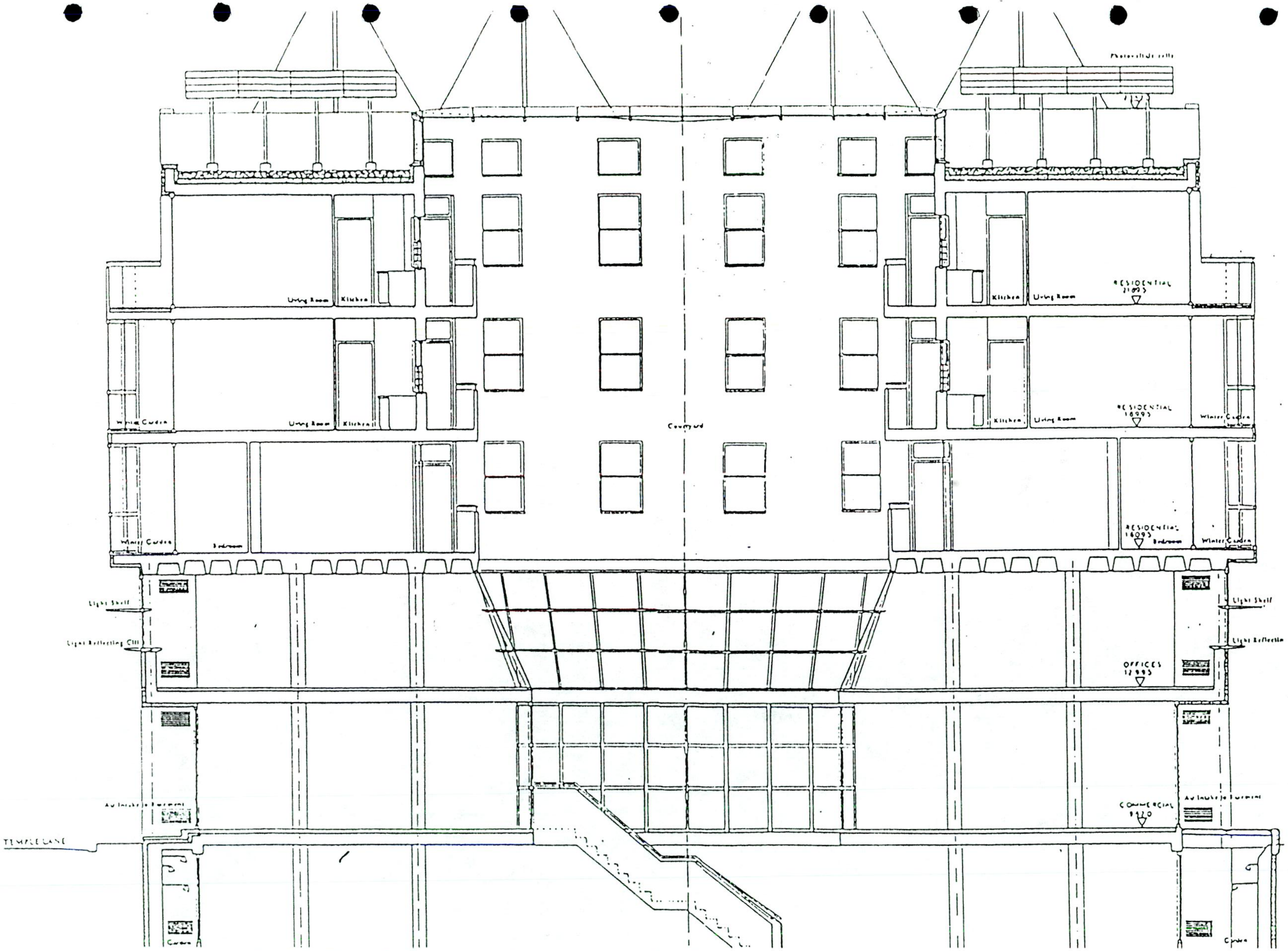
Courtesy of Tim Cooper, Professor T.C.D., 12/11/95

The Green Building is situated in Dublin's Temple Bar Region and forms the root of Temple Bar Properties redevelopment policy. The site is a twenty six metre long double plot with eleven metres at the front and back entrances. The Green Building's structure is laid out around a six storey central courtyard and houses shop units on the ground floor and basement levels, offices on the first floor level and eight apartments on the upper three levels.

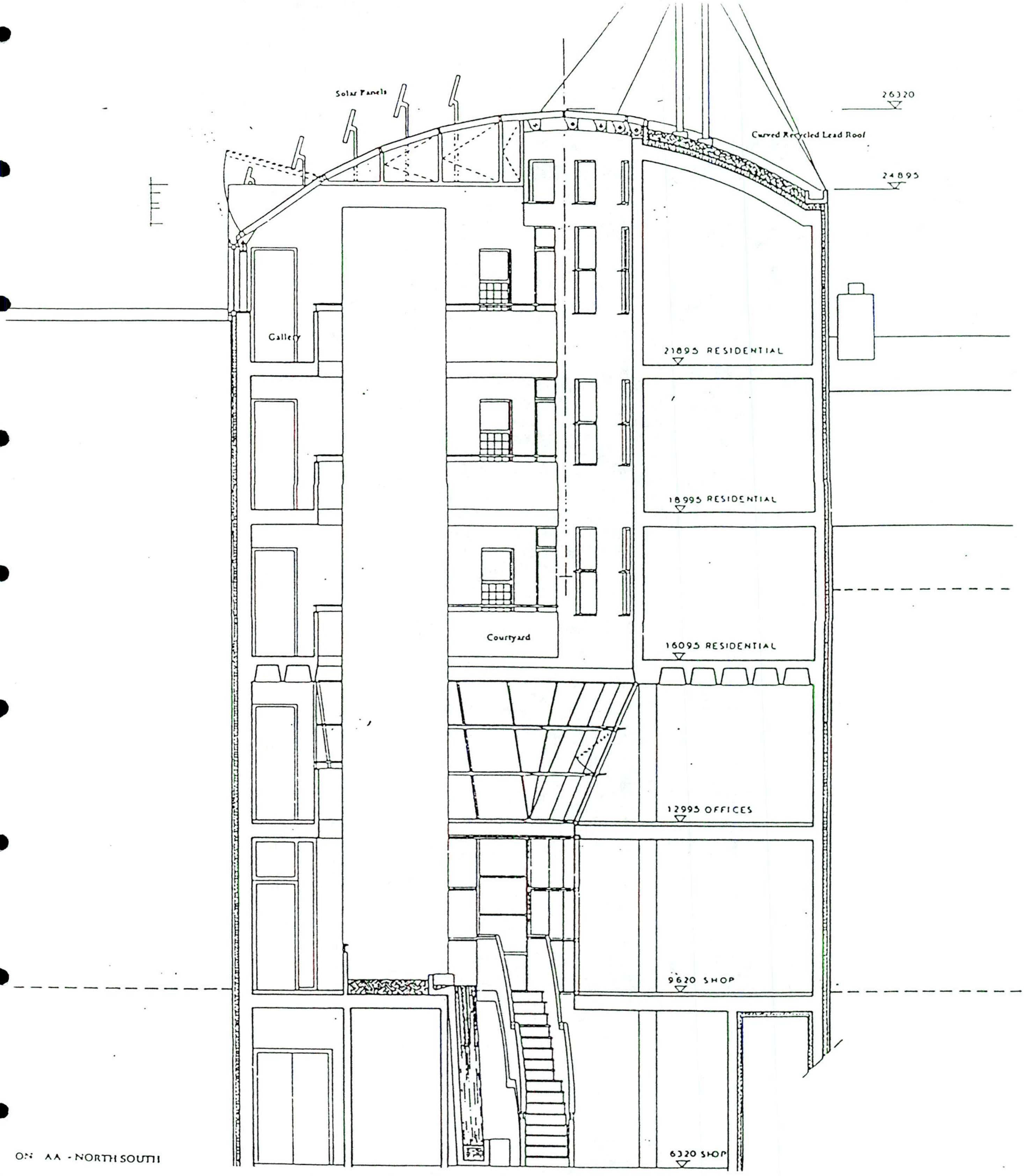
Appendix B1: The front entrance of the Green Building
via Temple Lane entrance(Cooper, 1993, p.32)



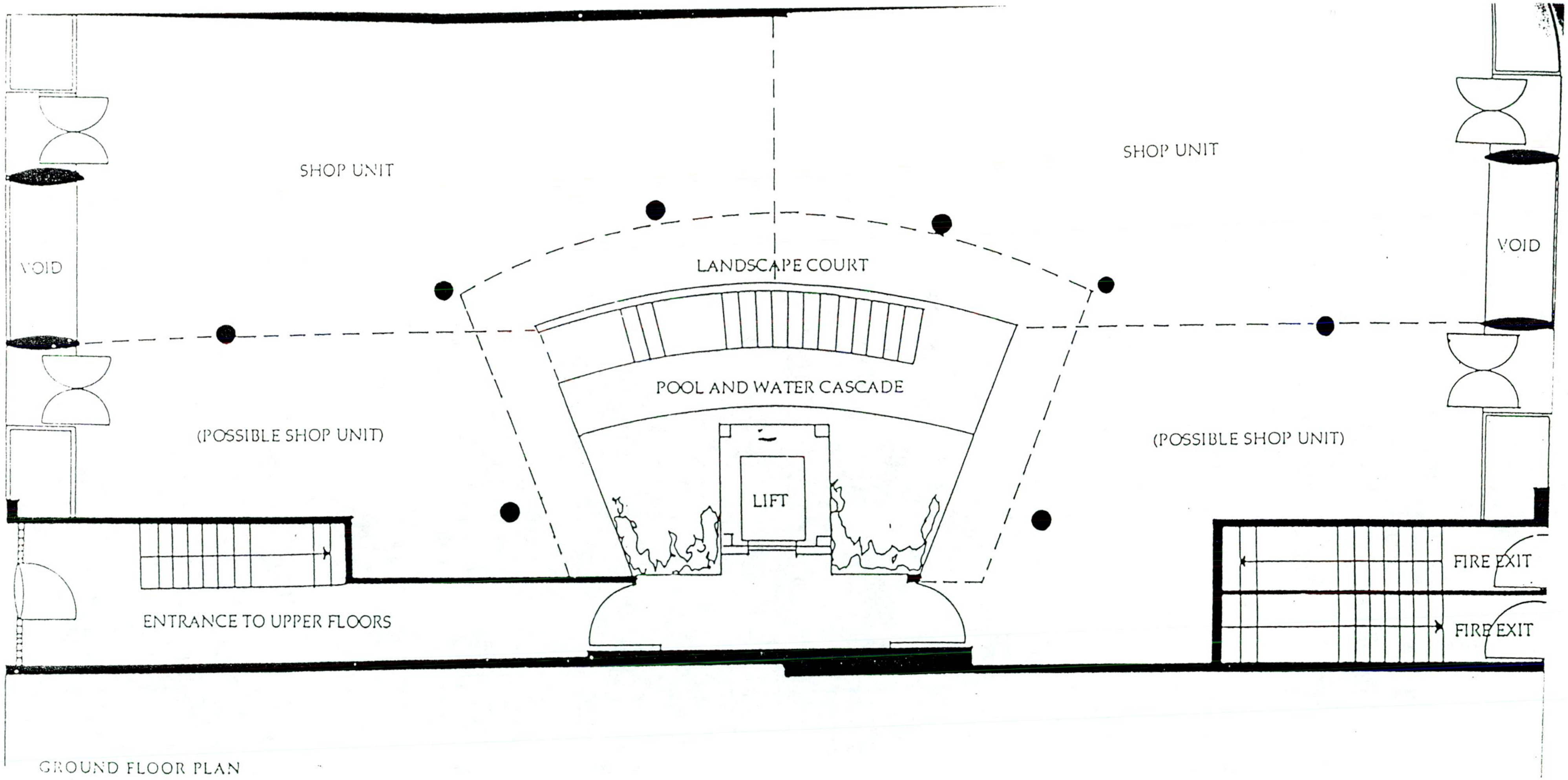
Appendix B2: The entrance to the Green Building via the Crow Street entrance (Cooper, 1993, p.33)



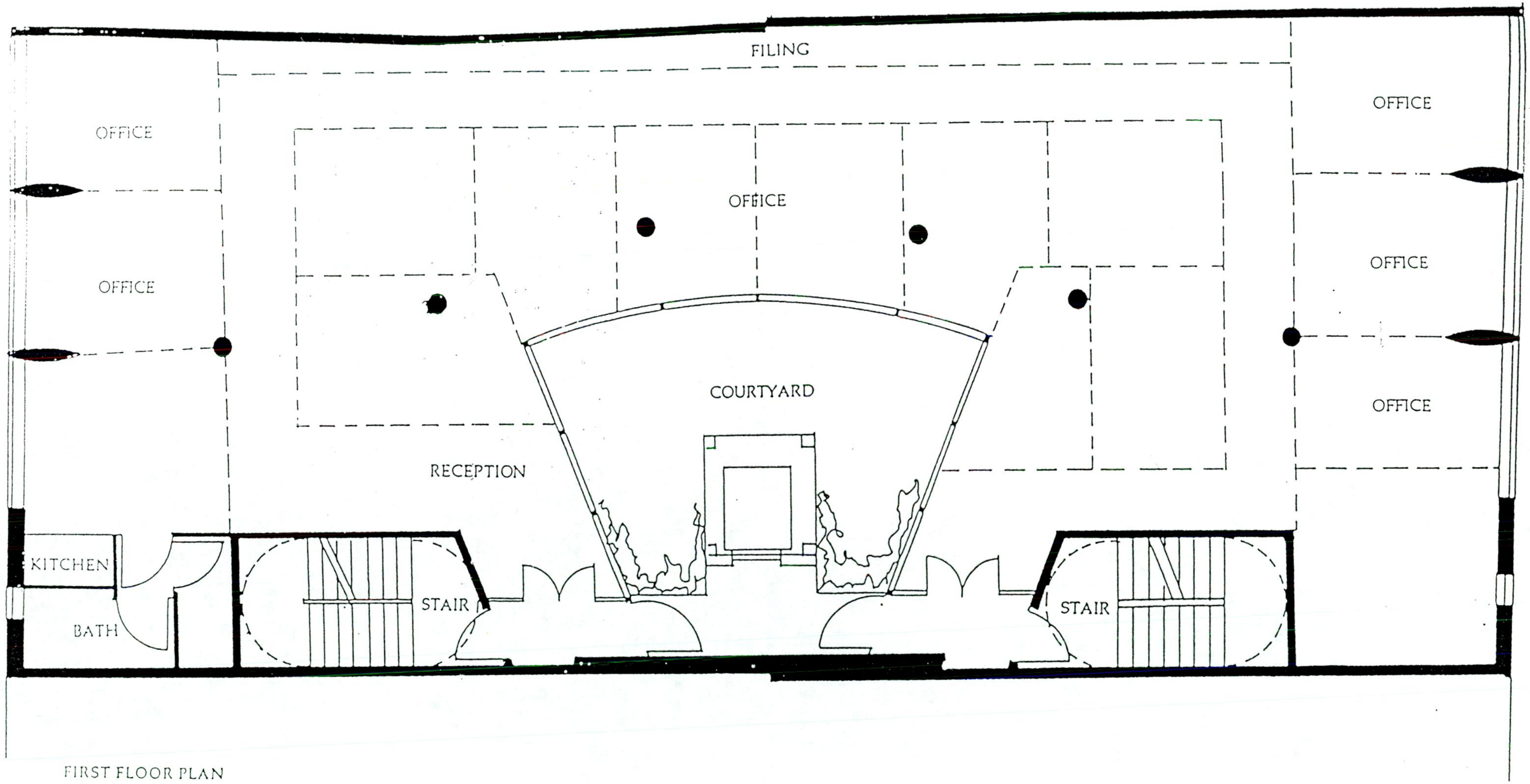
Appendix B3: Temple Lane, sectional view of the Green Building (Cooper, 1993, p.34)



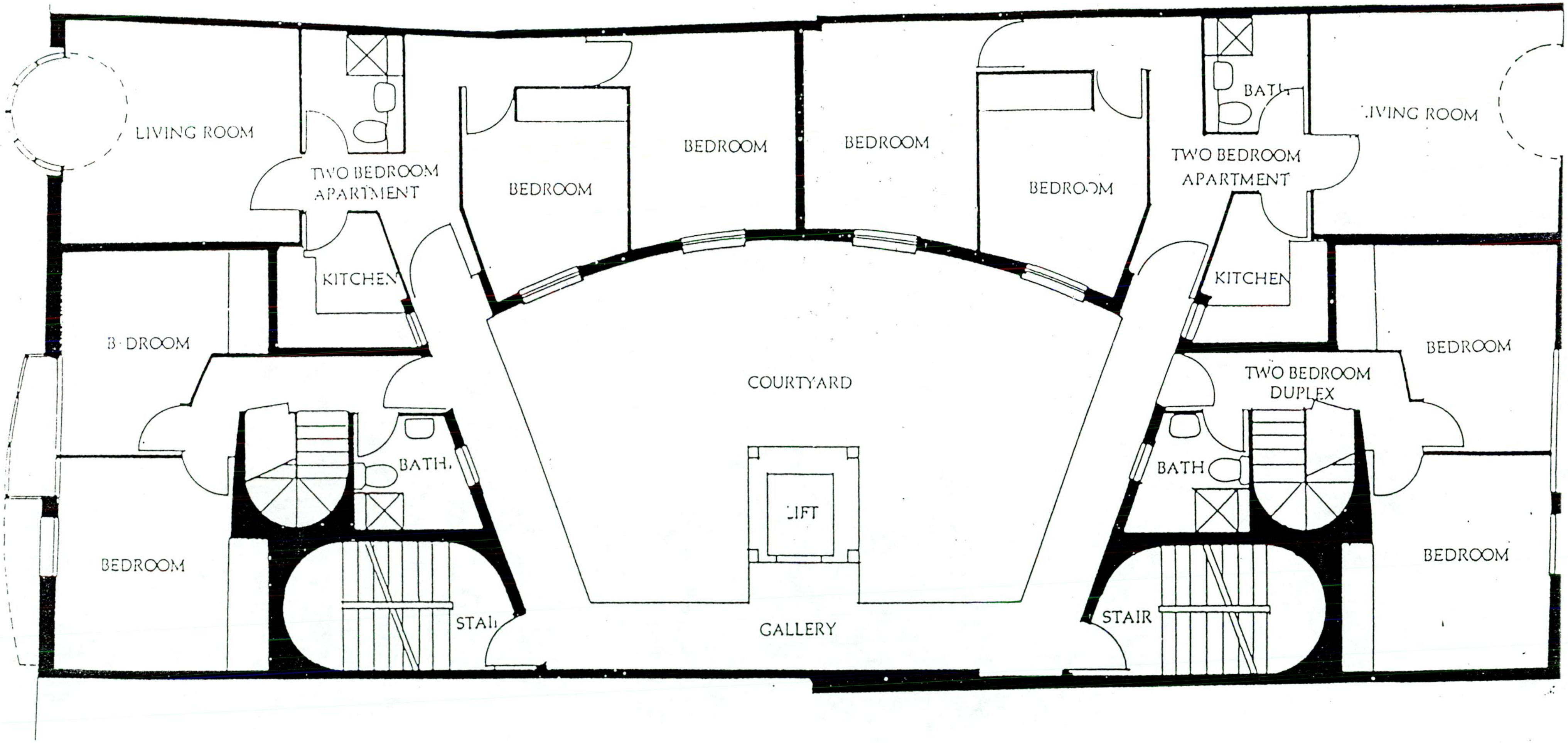
Appendix B4: A sectional view (North, South)
of the Green Building (Cooper, 1993, p.35)



Appendix B5: Ground floor plan of the Green Building (Cooper, 1995, p.13)

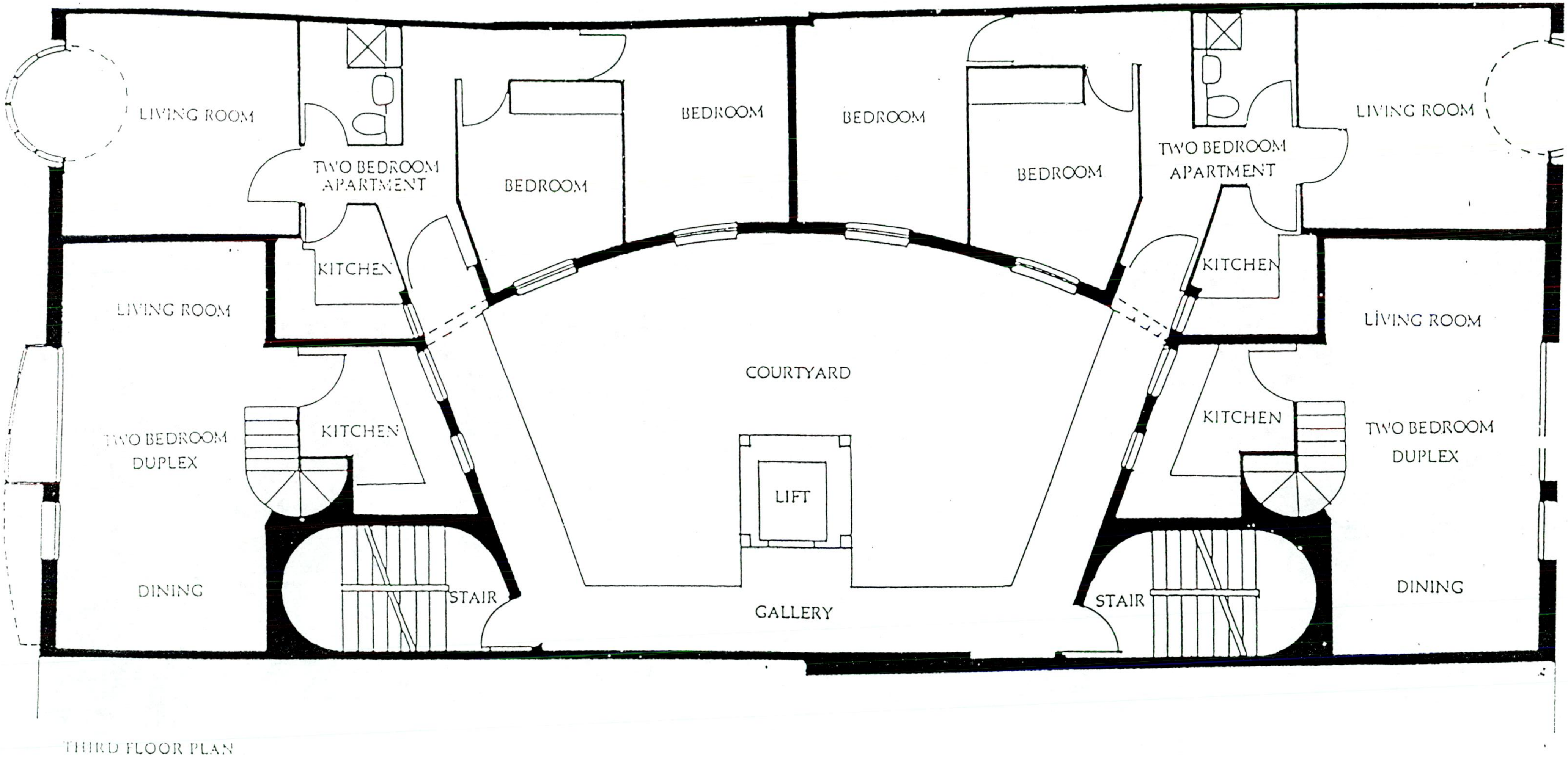


Appendix B6: First floor plan of the Green Building (Cooper, 1993, p.35)



SECOND FLOOR PLAN

Appendix B7: Second floor plan of the Green Building (Cooper, 1993, p.36)



Appendix B8: Third floor plan of the Green Building (Cooper, 1993, p.36)

APPENDIX C: THE LIFE CYCLE ANALYSIS

Courtesy of Jos Brouwer, Materials Expert,

Eindhoven University, The Netherlands, 10 /10/1995.

LCA

* Environmental problems
* Life cycle thinking
* Life Cycle Analysis (LCA) in detail

ENVIRONMENTAL PROBLEMS

Exhaustion
* Metals
* Energy (fossil fuels)

Pollution
* Greenhouse effect
* Acidification
* Eutrophication
* Smog
* Ozone layer
* Human toxicity
* Eco toxicity

Waste
* Solids

ENVIRONMENTAL PROBLEMS
Exhaustion

Metals

causes: * use of scarce metals, like:
* lead
* cadmium
* mercury
* tin

effects: * not available for next generations

unit: - (amount (kg)/worldwide stock (kg))

ENVIRONMENTAL PROBLEMS
Exhaustion

Energy consumption

causes: * use of fossil fuels

effects: * not available for next generations
* other environmental effects, like:
  * Greenhouse effect
  * Acidification
  * Eutrophication
  * Smog

unit: * MJ (Mega Joule)

ENVIRONMENTAL PROBLEMS
Pollution

Greenhouse effect

causes: * CO_2 (50%) (burning of fossil fuels, deforestation)
(putting in ground ca. 5 cents per kWh)
* C_xH_y (o.a. CH_4, methane)(fossil fuels and rotting)
* CFCs (10%),
* N_2O

effects: * warming of the earth, causing:
  * changing climates
  * shifting climate zones
  * storms and floods

unit: * GWP (Global Warming Potential)

ENVIRONMENTAL PROBLEMS
Pollution

Acidification

causes: * NO_x (burning of fossil fuels)
* SO_2
* NH_3 Ammoniac (in manure (shit))

effects: * dying of woods,
* less crops/harvest
* corrosion of stone and galvanized steel

unit: * AP (Acidification Potential)

ENVIRONMENTAL PROBLEMS
Pollution

Eutrophication

causes:
* Nox (and nitrates)
* NH3 Ammoniac (in manure (shit))
* P2O5 (phosphates)

effects:
* monocultures (only plants which florish on rich soils) causing less biodiversity
* eutrophication of drinking water

unit:
* NP (Nutrification Potential)

ENVIRONMENTAL PROBLEMS
Pollution

Smog (smoke and fog)

causes:
* CxHy (Carbohydrates, a.o. solvents, fossil fuels)
* CxHy chloro
* Nox

(in combination with sunlight forming of ozone (O3) on ground level

effects:
* health damage plants and animals (a.o. lung damage, smaller crops and harvest)

unit:
* POCP

ENVIRONMENTAL PROBLEMS
Pollution

Ozone layer

causes:
* CFCs (foams, aerosols, coolants)
* solvents (CxHy)

effects:
* skin cancer
* less growing of plants

unit:
* ODP (Ozone Depletion Potential)

ENVIRONMENTAL PROBLEMS
Pollution (airborne and waterborne)

Human toxicity

causes:
* organic substances:
  - CFCs
  - CxHy (a.o. benzene, benzopyrene, solvents)
* heavy metals (Cd, Cr, Pb, Ni, etc.)
* chlorine compounds (dioxides, PCBs)
* pesticides

effects:
* poisoning of humans (health damage)

unit:
* HCA/HCW

ENVIRONMENTAL PROBLEMS
Pollution (airborne and waterborne)

Eco toxicity

causes:
* organic substances:
  - CFCs
  - CxHy (a.o. benzene, benzopyrene, solvents)
* heavy metals (Cd, Cr, Pb, Ni, etc.)
* chlorine compounds (dioxin, PCBs)
* pesticides

effects:
* poisoning of flora and fauna, causing:
  - less vital plants and animals
  - less biodiversity (less plants and animals), causing less stable biological balances

unit:
* ECA

ENVIRONMENTAL PROBLEMS
Waste

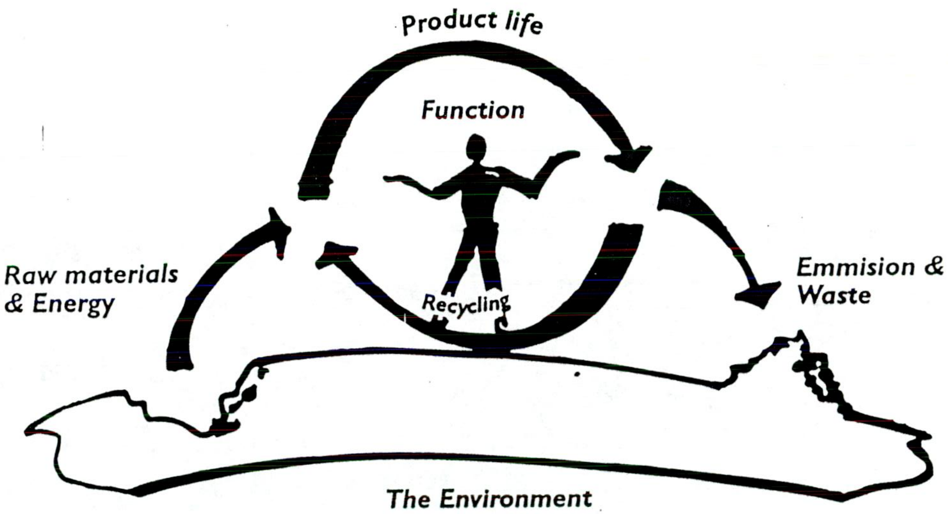
Solids

causes:
* Discarding of products (obsolete) which are not recycled or reused

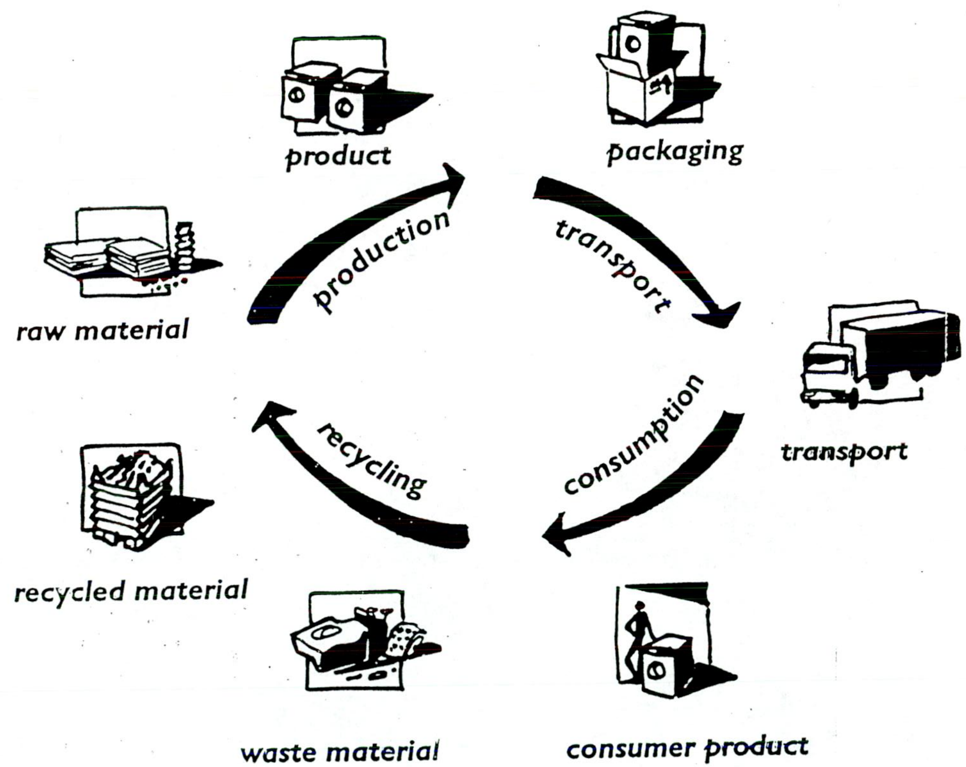
effects:
* Use of scarce space to dump the waste, causing:
  - pollution (of air and water)
  - exhaustion (materials are taken out of the economy)

unit:
* kg

Product life

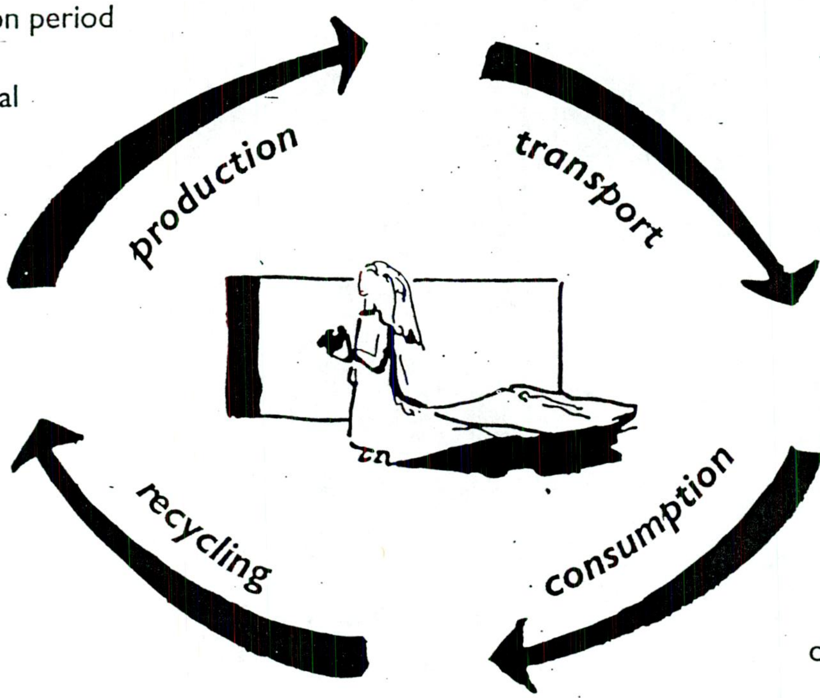


Product life cycle



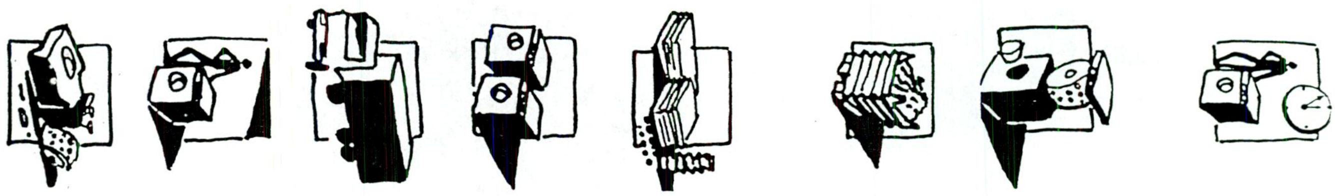
starches
a lot of extras
long production period
a lot of white
a lot of material

heavy
alot of packaging
volume



train gets soiled
rarely washed
chemically cleaned
excusive
short time in use
related businesses: hairdresser etc.

for the cradle
second hand
second and third wedding



Milion do's and don'ts

Do's		Don'ts
■ Less volume/weight ■ Less types of material ■ Try to avoid composites	Raw material	■ Use much raw material ■ Many types of material ■ Composites/laminates
■ Less parts ■ Less production steps ■ Easy to disassemble	Construction	■ Many parts ■ Many production steps ■ Hard to dismantle/glue
■ Avoid toolings ■ Modular construction ■ Simple and functional	Design	■ Many toolings ■ Many 'loose' parts ■ Complicated forms
■ Smaller volumes ■ Avoid packaging ■ Less weight	Packaging	■ Big volumes ■ Double packaging ■ Heavy packaging
■ Less colors ■ Other inks ■ Other printing process	Printing	■ Many colors ■ Ink with solvents ■ Many printing stages

Simple strategy

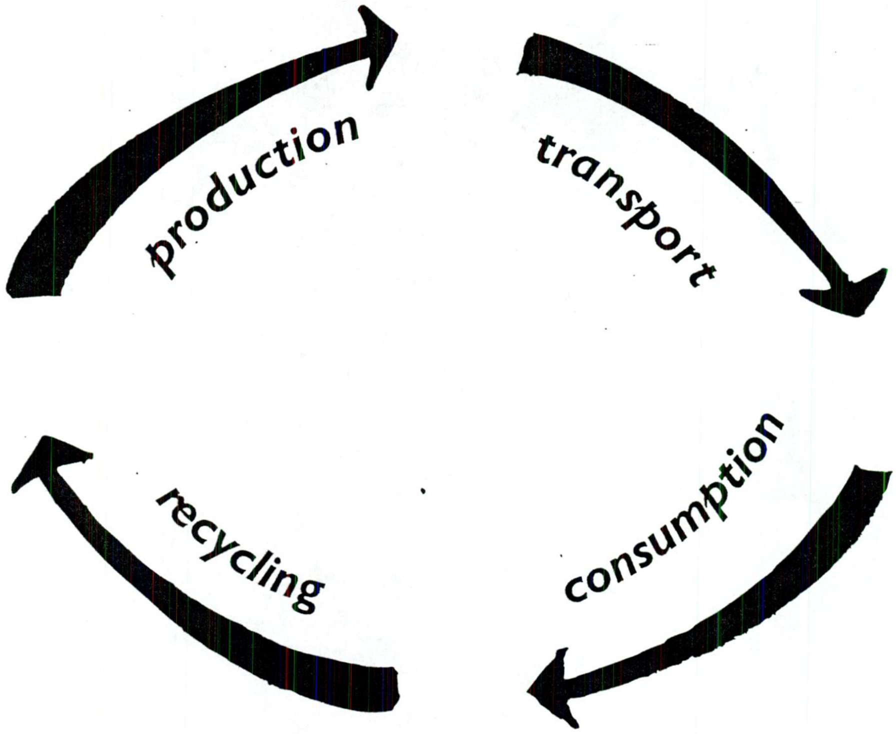
Phases

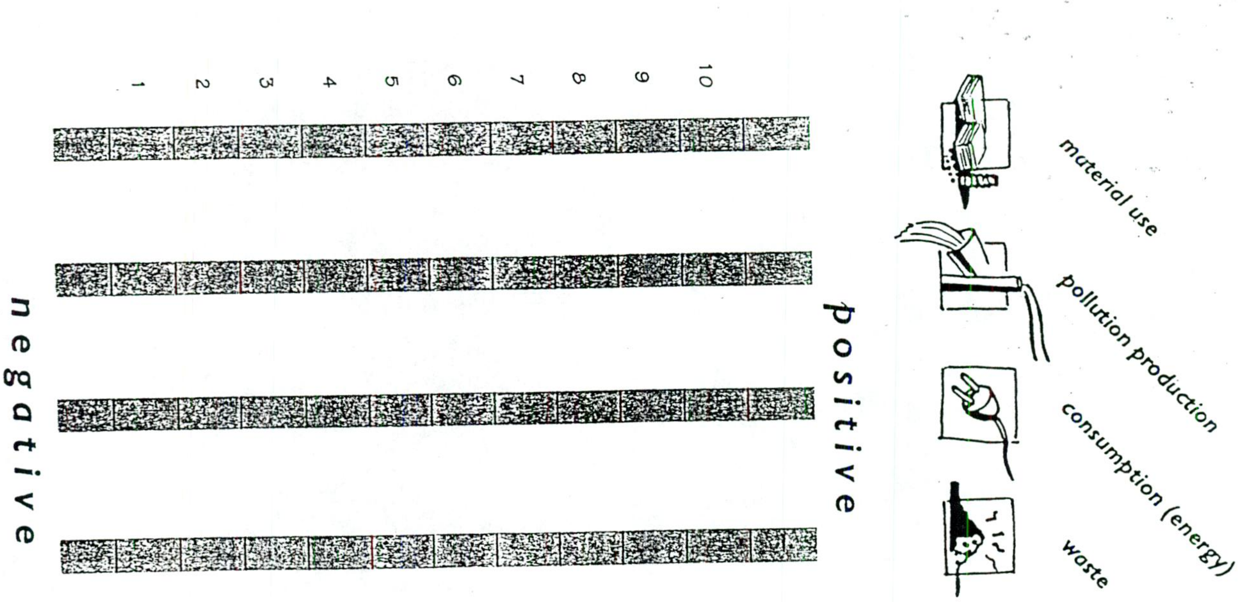
1) **Sum up the environmental problems of your design**
tools: life cycle
design guidelines

(2) **Scale the main problems**
If you found (too) many problems, you can scale them to find the ones which have the most environmental impact
tool: product scale

3) **Generate solutions**
tools: life cycle
design strategies
design guidelines

4) **Scale the solutions**
tool: product scale


production
transport
consumption
recycling


material use
pollution production
consumption (energy)
waste
positive
negative
10
9
8
7
6
5
4
3
2
1