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CREATING A HEALTHY HARMONIOUS AND ECOLOGICALLY SOUND HOME

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A- Introduction

Over the past several years, there has been a growing awareness of the need for humanity to stop the destructive trend of modern industrialization and provide a harmonious and sustainable alternative for future generations.

The most important question that is being asked by all people who are eager to solve the environmental problems is "what can we do?" However, this time, when the natural living space is becoming more polluted, and the natural resources are being exploited without considering the consequences, diffuses a sad feeling of helplessness. This feeling can be eliminated only when alternatives are developed for each ecological problem humanity is facing.

Of the major industries that are causing harm to man and his environment is the building industry. Homes are living spaces. People and their children spend a long time of their lives within their own four walls - often for many generations. However, health hazards are widely existent in the homes, and the ignorance of these hazards has an effect on people's health and in a wider sense on the survival of this planet. Thus the ecological quality of the house constitutes an important feature of this big long-term investment.

The design of the house should be adaptable to changing lifestyles, affordable and aesthetically pleasing. In addition, the materials and construction techniques that are to be used should reduce or eliminate toxins and pollutants.

In their project experience -Health House 94- a group of engineers and architects described the basic requirements of the healthy house: (13)

1- Good quality indoor air

2- Efficient use of energy and resources

3- Maximum use of natural lighting

4- Minimum construction and domestic waste

5- Optimum use of existing site amenities

6- Usage of environmentally benign materials

Such requirements are the key to success in ecological building. Thus, they will be fully discussed and other criteria shall be added to them in order to convince the environmentally concerned people of the feasibility and necessity of building ecologically sound homes.

B- Historical overview

Old man moved from place to place as the seasons changed and animals migrated. As cultures developed, they accumulated over generations a detailed and intimate knowledge about everything around them- climate, seasons, animals, and plants. Although their lives were insecure, they were happy and enjoyed the freedom and the intimate relationship with a virgin and beautiful world. Their homes, represented by caves, trees, shelters or hide tents, took maximum advantage of local topography for security and to give shelter from cold winds and heat from the sun.

Under the pressure of increasing population and decreasing wind resources, in addition to the development of agriculture, man started to build permanent

homes and settlements. However, these settlements continued to express a close link with nature. The materials used in housing responded well to local climate and were integrated with the landscape *(fig.1)*. However, the importance of social, culture and spiritual contexts should not be underestimated since not all ethnic houses were appropriate to their climate nor do local people even when sufficient natural resources and spaces were available. For example, the Masai house is too low to stand upright in and smoke from cooking fires fills the inside *(fig.2)*. Nevertheless, most ethnic houses integrated both spiritual and physical needs to be in harmony with the local environment. (2)

As for the city builders, archeological findings prove that they fully understood the principles of natural ecology. The Greeks appreciated the benefits of the sun and made the equal access to sunlight a legal right. For example, the city of Olynthus in the 5th century BC was planned with streets oriented so that all people received equal sun. Similarly, Sumerians, Egyptians, Romans and others proved through their archeology that they have a develop understanding of health and comfort. Most of this earlier knowledge was lost in Europe in the dark ages after the fall of the Roman Empire. (2)

With the advancement of mechanization, after the industrial revolution, most of the concepts of natural houses vanished. The New World view caused the architecture to completely change its direction. The homes were no longer craft-built in villages or small towns. They became uniform, anonymous urban places situated around the factory or in the suburbs of the city. Because of neglecting

the home health was also neglected. Problems of overcrowding, diseases, dark, airless conditions emerged. Nevertheless, some people in the 19th century recognized the danger and thought about different ways to stop it. In fact, John Ruskin, William Morris and others in the arts and crafts movement provided a new-old vision of housing. They emphasized on craft revival, appropriate use of materials and simple functional designs. Contemporary buildings use materials such as synthetic plastics, metals and resins that are the main cause behind the disruption of harmonious equilibrium established between man and his environment. On the other hand, aware individuals today want and demand pure air and water for themselves and their families. They desire homes constructed of non-toxic materials. They seek insulation from the potentially harmful aspects of today's environment and they pursue designs that allow their homes to reflect the eternal structures and cycles of natures. (2)

In response to these demands, many construction companies have shifted to build ecological houses. They might have different approaches but they share the same definition and ecological criteria.

Some of the ecological building details that are adopted by most of the companies are:

- Use of passive solar features where possible through orientation and window layout.
- Use of solar panels for domestic hot water heating.

- A district heating system using a gas condensing boiler for highest fuel efficiency.
- Super sufficient insulation.
- Low-energy light bulbs throughout.
- Triple glazing.
- Cellulose insulation (made from recycled paper).
- Non-toxic organic paints and wood preservatives throughout.
- Boarding manufactured wihtout the use of toxic glues or resins.
- Locally grown and harvested timber from managed forests.
- Local stone for skirting, patios and pathways.
- Roofing with natural clay tiles.
- Innovative "breathing wall" construction allowing a controlled exchange of air and vapor, and eliminating the need for conventional vapor barrier.
- Suspended timber floors for underfloor air circulation to avoid any possible build-up of radon gas.
- Isolating electrical circuits to reduce electromagnetic field stress.
- Water conservation (showers, low-flush toilets and self closing taps).
- Collection and recycling of rain water for garden use.
- Shared facilities (laundry, kitchens, lounges) avoiding unnecessary duplication.
- Simple timber frame construction and detailing, suitable for self build.

C- The Gaia House

It is a house that provides a down to earth vision of architecture far from the expensive technological dreams. It is integrated with a sustainable lifestyle using life-support systems, materials, and spatial designs that meet specific health conservation and spiritual criteria *(fig.3)*. These criteria are health for the body, peace for the spirit and harmony with the environment. The principles of building a Gaia house are grouped into a charter divided into three categories each one respective to each criterion. (2)

The Gaia House charter:

1- Design for harmony with the planet

- The home should be sited, oriented and sheltered to make best and conserving use of renewable resources. Sun, wind and water are to be used for all or most of the house's energy needs in order to less rely on supplementary non renewable resources.
- Green materials and products that are to be used should be nontoxic, non polluting, sustainable, renewable, produced with low energy and low environmental and social costs and biodegradable or easily reused and recycled.
- The design of the house should be "intelligent" in its use of resources and complementary of the natural mechanisms by efficient control systems to regulate energy, heating, cooling, water, airflow, and lighting.

- The house should be integrated with the local ecosystem; thus, planting trees and flowers. Organic wastes should be composted and natural pest control should be implemented –no pesticides. Grey water should be recycled and low-flush or waterless toilets should be used. Rainwater should be collected, stored and used.
- Special systems should be designed to prevent export of pollution to the air, water and soil.

2- Design for peace of the spirit

- The home should be harmonious with the environment –the community, the building styles, sale, and materials around it.
- A wholistic, living design should be seeked at every stage.
- Proportions, forms, and shapes should be harmonious to create beauty and tranquillity.
- Colors and textures of natural materials and natural dyes, paints and stains should be used to create a personal and a therapeutic color environment.
- The site and the design of the home should be life enhancing.
- The home should be connected with Gaia and the natural world and the rhythms and cycles of earth, its seasons, and its days.
- The home should be a healing environment in which the mind and spirit can be free and flourish.

3- Design for health of the body

- Indoor climate should be kept healthy by allowing the house to breathe. Natural materials and processes should be used to regulate temperature, humidity, and air flow and quality.
- The home should be sited away from harmful EM radiation from power lines and away from negative ground radiation. The design should also prevent the build-up of static and EMF from domestic equipment, and avoid interference with beneficial cosmic and terrestrial radiation.
- Safe and healthy air and water, free of pollutants, with good humidity, negative ion balance, and pleasant fragrance from herbs, materials, and polishes should be provided. Natural air flow and ventilation should be used.
- The home should be quiet, protected and insulated from external and internal noise, and contribute to a pleasant, sound-healthy environment.
- The design should allow sunlight and daylight to penetrate and less artificial light is used.

D- The dangerous house

The home has always been a symbol of safe and protective environment. However, a new generation of problems has arisen and it is causing danger to human health and the environment. This danger is resulting from the massive increase of chemicals and synthetics used everywhere.

People are spending most of their times in artificial, possibly hazardous and stressful surrounding and they are removed and alienated from the natural habitat, the environment.

Nevertheless, the environment s also in danger from pollution by the same chemicals and synthetics. In fact, every time an aerosol is used, dishes or clothes are washed, a room is painted, overpackaged goods are bought, crease-resistant fabrics are chosen, the pressure is increased on man and the environment. (7)

On top of this, homes are high consumers of valuable resources- energy, materials and water- and are extremely wasteful of all of these. They also generate unmanageable amounts of waste, much of which is toxic and eventually enters the environmental system. (7)

There have to be limits to how much individuals and the planet can stand and it is possible to strike a balance between living in good health and comfort while conserving the natural environment.

Pollutants and toxins

Although there are many pollutants, not all are toxins. In definition, pollutant is a general term for any material released into the environment as a by-product of human activity. Some are excess loads of naturally occurring substances, such as ozone, CO2 or radon; others are chemical synthetics. Many pollutants are absorbed or broken down harmlessly by our bodies or the environment; but many do not exist in natural concentrations and are, therefore, persistent once introduced into life chains. Moreover, some, such as dioxin, are lethal toxins, even in minute concentrations. (4)

A- The sick home

Sources of pollution are found everywhere at home. Starting at the top, roofing timbers may have been treated with toxic fluids or insulated with unhealthy materials, and the roofs of older buildings may contain asbestos-cement products. Cavity walls could have been injected with insulating foam emitting formaldehyde vapor. As for interior decoration, it may consist of petrochemical-based paints or vinyl wallpaper, which emit more dangerous vapors especially when new. Older paints may contain lead. Timber floors and stains may have been treated also. Synthetic carpets may cover them emitting formaldehyde and creating dust. Plastic tiles, if used, can emit chemicals. Furniture is often filled with highly flammable polyurethane foams and synthetic fabrics. Kitchen units and living room or bedroom furniture could be constructed of processed boards

containing formaldehyde, glued with vapors adhesives and finished with plastic. In addition, fumes and gases are produced by poor combustion in open fire stores, cookers and heating appliances; lead is in water pipes; mold, bacteria and airborne organisms are spread everywhere. Moreover, there are the modern products such as the household cleaners, polishes, bathroom cosmetics, medicines, processed and sprayed foods, garden pesticides and others. Furthermore, the services applied to the home such as water, gas and electricity have their own hazards. Water may be polluted; electricity, apart from the dangers of shock, may generate fields that interfere with the body's natural rhythms. In addition, gas is not explosive but it may be an allergy trigger. Even the ground on which the house stands may not be healthy. (3,4,9)

Of course no home is going to contain all these pollutants, and both concentrations and individual susceptibility vary widely. However, caution is advisable where health is concerned.

The sick building syndrome

Most people are aware that outdoor pollution can damage their health, but may not know that indoor air pollution can also have significant effects. EPA studies of human exposure to air pollutants may be 2-5 times, and occasion more than 100 times, higher than outdoor levels. Over the past several decades, the exposure to indoor air pollutants is believed to have increased due to a variety of factors, including the construction of more tightly sealed buildings, reduced

materials and furnishings, pesticides and household cleaners. The World Health Organization (WHO) estimates that about 30% of all buildings may be "sick", based on the criteria that 20% of the occupants may be experiencing health or comfort problems. (9)

This exposure is leading people to have what is known as sick building syndrome. By definition, "sick building syndrome (SBS) is a phenomenon which occurs when a building structure has air quality that adversely affects the building occupants." (20)

The EPA definition, "sick building syndrome (SBS) is a situation in which occupants of a building experience acute health effects that seem to be linked to time spent in a building, but no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be widespread throughout the building." (9)

Building occupants complain of symptoms associated with acute discomfort. These symptoms include headaches; eye, nose and throat irritation; a dry cough; dry or itchy skin; dizziness and nausea; difficulty in concentrating; fatigue; and sensitivity to odors.

With SBS no clinically defined disease or specific chemical or biological contaminant can be determined as the cause of the symptoms. Most of the complaints disappear after leaving the building. Ther are some common patterns that emerge when looking at SBS, these are: (7)

1. Symptoms are mostly non specific
2. Forced ventilation is common
3. Buildings are energy efficient
4. People complaining also perceive they have little control over their environment.
5. More complaints come people densities are higher
6. Symptoms are more likely in afternoon than morning.

While specific causes of SBS remain unknown, the following have been cited as contributing to sick building syndrome. These elements may act in combination or may supplement other complaints such as inadequate temperature, humidity or lighting. (2,9)

- Chemical contaminants from outdoor sources: outdoor air that enters a building can also be a source of indoor pollution. Pollutants from motor exhausts can enter building through poorly located air vents, windows and other openings.
- Chemical contaminants from indoor sources: most indoor air pollution comes from sources inside the building. For example, adhesives, upholstery, carpeting, copy machines, manufactured wood products, cleaning agents and pesticides may emit volatile organic compounds (VOCs) containing formaldehyde. VOCs can cause chronic and acute health effects at high concentrations, and some are known carcinogens. Environmental tobacco

smoke and combustion products from stoves, fireplaces and unvented space heaters all can put chemical contaminants into the air.

- Biological contaminants: they include pollen, bacteria, viruses and molds. These contaminants can breed in stagnant water that has accumulated in humidifiers, drain pans, and ducts or where water has collected on ceiling tiles, insulation or carpet. Biological contamiants can cause fever, chills, cough, chest tightness, muscle aches, and allergic reactions. One indoor air bacteria, legionella, has caused both Pontiac fever and Legionaire's disease.
- Inadequate ventilation: in the 1970s the oil embargo led building designers to make buildings more air tight, with less outdoor air ventilation, in order to improve energy efficiency. These reduced ventilation rate have been found inadequate to maintain the health and comfort of building occupants.

Solutions to SBS problems usually include combinations of the following measures: (7,9)

- Ceilings, walls and air should be professionally cleaned once a year.
- Vent system should be cleaned or modified to increase circulation of fresh air throughout the building.
- Air filters and intakes should be kept clean and dry. Humidity levels should never be higher than 60%.
- Air intakes should be moved away from loading zones or parking areas. Air filters should be replaced regularly. In addition, housekeeping is imperative.
- Products with formaldehydes or VOCs should be avoided.

- Equipment should be placed in well ventilated areas. Manufacturers directions should be followed strictly. Filters changed regularly.
- Computers should be cleaned every six months.
- Products should be used and stored in well ventilated areas. Sanding or burning old paints should be avoided because it may be lead based.

B- The polluting home

Home is a potential source of a variety of polluted materials and products *(fig.4)*. Polluted waste water, indoor air, smoke and vehicle exhausts, rubbish, garden pesticides, and nitrate fertilizers are all emitted from the house and garden. What usually starts as simple, everyday action, such as washing the dishes or clothes, lighting a fire, starting the car, killing garden pests or using an aerosol air freshener, finishes up causing complex problems locally as well as generally for the environment.

Smoke and exhaust gases, together with industrial emissions result in local smog. In addition, they are blown away by prevailing winds across continents and seas where they react with moisture in the atmosphere to produce acid rain. Aerosols containing CFCs in their propellant gas are contributing to the destruction of the ozone layer. Carbon dioxide is one of the greenhouse gases and is gradually warming the environment and the resultant climate changes will alter the globe as the polar caps recede.

Most home-generated pollution gradually and inevitably finds its way into the larger planetary systems and contributes to the growing contamination of the land, air and water. Pollutants whether they are in the air, soil or water that enter the food chain will work their damage on all levels and eventually back to humans via the food eaten no matter where in the world it is produced. (2)

C- The wasteful home

The world is tempted to consume on a massive scale. Powerful and seductive advertising generate the need to process the latest products and styles. People continue to consume non-renewable resources at an ever-increasing rate with no regard for the future when those resources will be unable to meet demand. Homes are part of this system and they are wasteful and inefficient not only in their design but also in the way in which they are maintained.

1. Processed and scarce materials (14)

   The production of processed materials consumes the most energy. The production of plastics from oil presents a typical example of wasting resources. For instance, oil is a limited resource and the production of plastics is done through an energy-intensive process that uses more scarce resources. More than 30% of plastics in the UK are devoted to packaging used once, then discarded. While plastic should be regarded as one of the most valuable processed material, it has become the symbol of the "throw-away society".

Moreover, in the past it was possible to repair defects in equipment of such sophistication that replacement is cheaper than repair.

2. Water consumption (2)

   The developed world takes for granted clean, piped drinking water, while over half of those living in developing countries do not have access to safe supplies. However, now even in the west over consumption and water pollution is making clean and safe tap waters an expensive resource especially in dry, hot regions. The more energy is needed to collect and process it, pipe it to homes and treating it afterwards.

3. Energy consumption (14)

   People use too much energy and most of what is drawn from main supplies is wasted anyway. Moreover, it costs only one-tenth as much to save energy through conservation measures as it does to produce more of it. Therefore, it is worth it to start conserve rather than produce energy.

   Of the total amount spent on energy, 40-60% depending on climate and level of insulation goes on heating, 20% on hot water and 15-30% on cooking, lighting and electrical appliances. The remaining goes on maintenance and standing charges.

   By improving insulation and drought proofing and by using better control, it is possible to save at least half the money now spent on heating and hot water. On the other hand, siting and orientation of the houses are two important factors that stand in the way of the home to become energy

efficient. In cold climate, the natural heating benefits of the sun are lost and shelter of buildings from cold prevailing winds is not applicable. Similarly, in hot climates, the house could not be shaded from the sun neither the cooling effect of prevailing winds is benefited from. Added to this poor insulation, gaps around doors and windows and opening chimneys contribute to making the home energy-inefficient.

4. Household waste (2)

   Most of the household waste is glass, metals, plastics and paper that are expensive processed materials cheaper to recycle than to produce from new materials. As for toxic substances, they cause pollution unless specially treated or disposed of.

D- The Alienating home

The intimate relationship with the land, seasons and local climate is disappearing as more people are settling into urban or semi-urban environments. For many people, the new order is a growth-oriented and materialistic view. The preoccupation pushes humans to a world view where "having" rather than "being" is the prevailing theme.

As for the homes, the kitchen becomes the end processor of convenience foods; the living room a furniture show room with TV and stereo; and the garden a weekend in nature with noisy, polluting machines and the destruction of wildlife with pesticides and herbicides. (2)

E- Life systems

The natural house is a human settlment that is sustainable ecologically, culturally and spiritually. It expresses the essential relationship and connection of man to nature through its forms and structures. Sustainability is the ability of an ecosystem, a community or a person to maintain itself over the long term without depleting or damaging any essential functions. In fact, the needs of nature and the natural systems should be recognized and respected when trying to meet the human needs.

A. Climate

Human population can adapt to the harshest climatic conditions. However, the human body is comfortable only in a relatively narrow range of thermal conditions *(fig.5)*. The factors that affect the variation in this range are age differences; racial and cultural differences; temperature and humidity; air quality and other related factors such as the presence of high ratio of negative to positive ions, electromagnetic radiation and air pollutants.

In order to function properly, the body needs to maintain an average temperature of 37 C. Heat is produced by metabolic processes and it should dissipated if the body has to maintain the average temperature. Normally, the body loses about 45% of its heat by radiation, 30% by convection and 25% by evaporation and to remain thermally comfortable, these three factors must be in balance. (2,8)

Regulation of thermal processes could be achieved by changing body's activities, location or clothing; however, these controls are limited and are not sufficient in severe weather conditions.

1. The energy-efficient home (2,12,14,19)

   A house should be constructed either in a way that it supports the natural ecology –vegetation, water, and wildlife- or it can be disruptive and damaging.

   The fundamental principle is to work with nature instead of against it. Careful attention should be directed towards the location, siting and orientation in order to take maximum advantage from the winter sun and also from the hills and trees for their shelter protects the home from the winter winds and summer overheating. In addition, wind combined with passive and active solar systems in new buildings, form a viable and sound energy alternative to polluting and non-renewable fossil fuel and nuclear energy options.

   Whatever is the climate of the area, the natural home should be located and built in such a way to be adaptive to the local conditions.

   a- Hot humid climate

      The house should be shaded with a bunch of deciduous trees planted nearby. Air movement is increased by facing the house into cool prevailing winds and siting it high up slopes. The structure should be elevated and the verandahs open to the wind.

b- Hot arid

Trees should overhang the roof in order to have most shade in the ate morning and all afternoon. The house should be sited to catch summer wind. Light colors are critical. In hot/cold extremes, heavy materials are helpful to store heat and protect against the cold.

c- Temperate

The house should be sited in a way to benefit from the winter sun. Trees are used to prevent overheating. The presence of water in ponds reflects the winter sun into the house and cools it in summer. Roofs should be pitched to throw off rain.

d- Cool

The house should be built into the ground with a roof covered with earth and grass. Dense trees should be planted on exposed sites. For extra insulation, pitched and shallow roofs are necessary; as well as the thick walls with dark tones.

2. The solar Home (2,12)

Similar to the sun function, the solar home acts according to the four principles of radiation, retention, storage and circulation. The fabric of the building should have insulating properties to retain the heat and opening should covered with glass, curtains or thermal shutters. The heat is stored at the interior in solid partitions and it is circulated by the floors and the thermal movement.

Heating the home by the solar methods could be achieved passively or actively. In a passive solar system, windows or sunspaces are used to directly warm the interior. The structure is designed to store heat and release it at night or on cloudy days. Large windows are to be placed facing the sun so as to absorb heat. Light entering the house should be reflected from the walls and reflected again by a paper-thin layer of precious metal, therefore preventing it from repeatedly exiting to the outside. The energy warmth gained in this way should be stored in massive chalk sandstone interior walls and is slowly released. Circulation of is achieved by the natural thermal movement and by the use of ceiling fans. The active solar system uses mechanical components such as solar panels or rock beds.

The advantages of passive solar system over the active one are:

- No maintenance since no mechanical parts are used.
- Initial installation cost and running costs are low.
- Repays the investment in a short time.

However, depending on the climate, both systems could be used to achieve most effective heating and cooling.

The free energy of the sun could be also used to warm the water in the house. The water is warmed by means of a carrier fluid that circulates in a closed circuit insulated storage tank to be used as needed. A two-circuit system could be used where the solar circuit system is always initiated when the temperature reaches one degree more than in the storage tank. When needed,

the temperature of the water already in the storage tank can be raised to the desired temperature by means of the second circuit. When appropriately used, one solar system can supply up to 60% of water needed yearly.

3. The earth covered home (2,13,15)

   Earth is a natural moderator of temperature; therefore, it is beneficial to integrate the house with the surrounding ground and cover the roof partially or entirely with grass.

   Below the frost line, the temperature of the earth remains constant and it is close to the area's average annual air temperature. Nearer to the surface, temperature will follow the daily and seasonal changes; however, the earth will still act to moderate the larger variations. In brief, the earth covered home will have an extremely stable year-round temperature compared with a surface-built structure.

   The soil, depending on its depth and thermal properties, slows the passage of heat gained or lost to such an extent that the heat gained in the summer will reach the house in early winter and the cooling effects will flow through to the house until early summer.

4. The cool home (2,10,11)

   In hot or humid climates, the use of air conditioning systems could be replaced by natural alternatives. First, air temperature should be lowered, the movement of the air should be speeded up, surfaces cooled, and humidity reduced.

a- Shading

The house structure should be shaded by trees, shrubs, creepers and earth-cover. Where shading is difficult, the roof and outside walls should be painted white to reflect as much light as possible or cover the roof with shiny, reflective aluminum sheeting.

b- Ventilation

In many hot areas, there are prevailing winds that can cool the house by natural ventilation. In dry climate, the air is moistened by allowing it to pass over water in a pool, in earthenware containers or through vegetation. In the middle cost, wind-scoop devices are used instead. They catch cool air at the roof level and channel it down a shaft to lower-level areas. The principle is very simple; the high pressure on the windward side and low pressure on the leeward side of the building ensure that cool air is sucked downward. Where no prevailing winds exists, the thermal stack effect should be used to induce ventilation. It has the same principle as convection (when air is heated, it expands, becomes lighter and rises. As it passes over less hot objects, it gives off some of its heat, cools, contracts and then falls.) and should be supplemented with passive solar systems working in reverse. The passive solar system deliver the warm air at high levels to the outside cool air is drawn at low level. The thermal mass of the materials helps to keep the cycle going at night. For example,

in Australia solar chimneys are used for ventilation and act as a reverse wind scoop.

c- Radiant cooling

Another way to use passive thermal system in reverse is by cooling the thermal store at night, then the heat of the next day can be absorbed. Vents and blinds should be open at night from the outside and closed from the inside. The next morning, the store will be sufficiently cool to absorb the day's heat. And the cycle repeats itself.

5. Fuel and power (2,14)

Today, three quarters of the world energy consumption comes from nonrenewable energy sources –1/3 of this amount is oil, ¼ is coal and the rest is natural gas. The other quarter is a mixture of nuclear power, hydropower and biomass. Developing countries depend much on biomass and the burning of wood and animal dung is causing serious environmental destruction. The aim is to rely on sustainable renewable energy sources or soft energy such as sun, wind and water.

A successful application of modern wind energy is the 'wind park' consisting of a number of medium-sized, electricity producing wind turbines connected directly to the national electricity grid. Energy is produced at precisely the voltage and frequency needed, by means of an induced magnetic field inside the generator. Reliability of production is enhanced by the use of a number of a small

machines as opposed to one large one. If a particular machine break down, energy will continue to be produced by the others. The connection to the national grid also eliminates, to some degree, the need for energy storage. Previously, early wind turbines needed batteries to store the energy, usually in 24V-DC systems. In this more advanced system, electricity can be sold back to the grid when not required for owner use through simple metering devices. Wind parks have been tested very successfully around the world, but particularly in the USA and Denmark, the latter country being the world leader in wind energy technology and production. Many wind parks are now planned in the UK as the part of the Non-Fossil Fuel Obligation [NFFO] program to supply 10% of the nations' energy from wind by the year 2010. The design envisioned for the Wind Park consists of three wind turbines, in the range of 75kW to 225kW per machine, up to a generating capacity of around 500kW.

On the other hand, some companies are designing and manufacturing high efficiency, selectivity coated flat plate solar collectors that may provide savings of 55% to 65 % on domestic water heating.

Such solar panels provide the highest possible efficiency. Components of the highest quality are incorporated to provide maintenance free operation. Tedlar outer glazing, developed by DuPont for solar glazing, allows maximum light into the panel whilst retaining the heat more effectively. The Teflon inner glazing even more light in and acts as a double glazing retraining even more heat. The state of the art collector plate comprises of copper waterways and aluminium

fins with a selective surface method combining metallic nickel in aluminium oxide, which gives the highest possible photothermal performance.
In combination the extruded aluminium frame and high quality closed cell foam insulation the solar panels ensure durability and lightness.

6. The electric home (2,16)

The presence of high tension power lines near the houses is associated with the risks of cancer including leukemia. All domestic circuits and appliances produce electric and magnetic fields that are associated with physical and psychological disturbances. Certain, domestic appliances such as TVs and VDUs emit various forms of static electricity and radiation and also deplete negative ions in the air. Therefore, ventilation and humidity are necessary to prevent dry air and to remedy negative ion deficiency. As a precaution, people should sit well back from the screen of TV and not to one side where most leakage occurs. Microwave ovens need testing regularly since the door may become defective and release radiation.

Electromagnetic fields and especially extremely low frequency EMF are of concern since all living organisms react to the weakest electromagnetic stimuli. The reaction to ELF is variable depending on the person's susceptibility. It can cause high blood pressure, nervousness and disturbed sleep. It may act as a trigger to allergic people and cause sickness, headaches, nausea and sweating. Practical actions that could be implemented at homes are:

1- Sleep away from metal pipes and radiators holding waters since they are a source of EMF.

2- Use shielded cables or conduits.

3- When shielded cable is impracticable, switch off the main fuses at night. Leave one spur for appliances such as refrigerator.

4- Sleep away from the power lines.

7. Energy conservation (14,15)

Many factors affect the energy conservation process; the local climate and shelter; the type of structure; its orientation; construction; type of heating systems and fuel sources available; and lifestyle and comfort needs.

B- Water

Water is an essential component of life. Today, it is in danger from the increasing pollution -acid rain, toxic by-products, and agricultural run off- and over consumption and waste. Water should be appropriately distributed to all houses and this should be on national or at least on the district level. The pipes inside the house should be properly placed and maintained. (2)

Rainwater could be stored in a sufficiently large tank available for use. The collected rain water could be used for toilet flushing, watering the garden or any other process that is wasting fresh water. When widely used, approximately 50% of fresh water needed can be saved.

As for waste water disposal, the effluent of the house should join the general sewerage system that is treated according to the district waste water management plan. Cesspools are forbidden. While septic tanks with leak proof ground and walls are permitted if the owner of the house aims at treating it at household level. The most practical solution is to have a stabilization pond at the back of the house where water could be treated by the presence of microorganisms and oxygen and the water could be used for irrigation later. The stabilization pond should be installed under the supervision of a professional and maintained regularly. (2,15)

The living machine

Sewage could be treated as apart of a national plan in special treatment systems. The Living Machine is an ecologically engineered sewage treatment plant designed to treat sewage from the population of up to 300 people.

Living Machines treat wastewater based on a 'whole systems' approach to biological technology. They utilize a set of sequenced, complete ecologies. Treatment can be taken to advanced standards in cost effective projects which are reliable, robust and aesthetically pleasing. The approach represents a shift from high energy, chemically intensive treatment to the adoption of the principles of ecological engineering. Diverse communities of bacteria, algae, micro-organisms, numerous species of plants and trees, snails, fish and other living creatures interact as whole ecologies in tanks and bio-filters. Depending on the climate, Living Machines can be located out doors, in protective greenhouses,

or under light shelter. In the Living Machine system, anaerobically treated sewage arrives in a greenhouse containing a series of tanks. These contain species which break down the sewage naturally as it moves through the tanks. In many systems, by-products of fish and plants being produced can then be sold. Living Machines mirror processes that occur in the natural world, but more intensively. At the end of the series of tanks, the resulting water is pure enough to discharge directly into the sea or to be recycled. The technology is not only capable of meeting tough new sewage outflow standards, but uses no chemicals, and has a relatively inexpensive capital cost attached.

The treated waste water for non drinking uses could be reused in the process. These uses include washing, irrigation, boiler make up, etc.

a- Performance

Performance of the system varies according to circumstances. The following table provides information on the influent and effluent of the Living Machine.

Component	Influent mg/l	Effluent mg/l
Biological Oxygen Demand	250	< 10
Total Suspended Solids	160	< 10
Nitrogen Level	40	< 10
Ammonia Levels	50	< 2
Nitrate Levels	0	< 5
Total Phosphorous Levels	7	< 5

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b- Design

The Living Machine could be housed in a single-span greenhouse, approximately 10 Meters [M] wide by 30 M long.

c- Treatment processes

1. Anaerobic Primary

The first component of the treatment process is 3 anaerobic bioreactors buried outside the greenhouse. The function of this component is to reduce significantly the organic material and inorganic solids in the waste water, promoting the growth of anaerobic and facultative bacterial populations.

2. Closed Aerobic Reactors

Effluent from the anaerobic primary, flows into an closed aerobic tank in the greenhouse. Gases from the closed aerobic pass through a filter system to eliminate odors.

3. Open Aerobic Reactors

The four aerobic tanks have diaphragm aerators and are planted with plant species with large root masses on floating plant racks. The BOD and TSS is reduced at this stage and ammonia nitrified.

The primary function of plants is to provide favorable environments for enhanced microbial activity. Secondary functions include nutrient removal, metal sequestering, pathogen destruction and some control of gas exchanges. The main objective is to have a healthy and diverse

sequence of ecosystem present. The wide variety of plant species filling ecological niches in the system is a key to the robust nature of natural treatment system. The ecological network of species creates internal biological redundancies compared with a purely microbial system, or a monoculture duckweed system. This gives the potential for improved efficiency and greater resilience.

4. The Clarifiers

   After the aerobic tanks, a clarifier settles solids which are returned to the anaerobic primary. In those tanks you may see tiny water creatures such as Cyclops living in the water. They perform an important part in both treatment and creating a complex food chain.

5. The Ecological Fluidized Beds

   The three Ecological Fluidized Beds in each train are filled with light rock media. For aerobic operation, air lift pumps raise the water from the bottom of the fluidized bed to the surface, where the water flows down through the bed. Recycle rates can be varied up to 100 times the flow rate through the component.

   The aerobic operation provides reductions in BOD and TSS and nitrification. For the anaerobic operation of the fluidized beds for denitrification, mechanical pumps circulate water up through the bed. The fluidized beds are planted and benthic animals graze the surface.

The dissolved oxygen level in the wastewater is close to zero after the clarifier. The first fluidized beds are run anaerobically for denitrify The second fluidized bed is run aerobically using air lift pumps to further nitrify any remaining ammonia in the waste stream. The third and final fluidized bed is run anaerobically for final denitrification and polishing. The underlying concept behind the design involves rapid flows of water by recycling through the media filled zones. The key attributes of an Ecological Fluidized Bed are:

- Stable high surface area micro-environment sites for bacteria.
- Ultra rapid exchanges across biological surfaces.
- Direct NH4/NO3 uptake.
- Nitrification and denitrification cycles.
- The supports of higher plant life and root systems within the media and in the self aquatic environments.
- Self-cleaning.

The biology is managed as a balanced ecosystem. The levels of dissolved oxygen, and carbon to nitrogen ratios and bioaugmentation, are adjusted with the overall objective of reducing levels of BOD, ammonia total nitrogen faecal coliform and solids.

6. The Greenhouse

The greenhouse is built from a galvanized steel frame, clad in high performance glazing. The walls are 10mm polycarbonate. The roof is composed of high light transmission panels, with good thermal efficiency.

The quantity of water consumed has an equal importance as its quality. Therefore, water conservation should be considered as a principal aim. Water saving devices are: (2)

1- Toilets

Efficient toilets that use only 4-6 liters have been developed (the usual flush is from 9-20 liters). More efficient one is the waterless compost toilet that treats wastes on site using no energy *(fig.6)*.

2- Showers

Instead of the ordinary head, use a water saving head such as flow restrictors, aerators and sprayers.

3- Taps

Fit on them flow-control aerators that will reduce the flow from 10 to 3 liters.

4- Washing machines

Choose a washing machine with a front loader that allow the person to adjust the water usage to match the size of the load, that reuses the rinse water and has an economy cycle.

B. Air

The balance of air quality and energy depends much on climatic conditions. In the extreme hot or cold climates, mechanical ventilation is the most cost effective solution. In temperate climates, houses should be less tightly sealed so that passive ventilation is effective *(fig.7)*. (8,20)

Integral whole house systems extract air conditioning pollutants, odors, and excess moisture through ducts or designed air flows. Indoor air should be monitored by permanent sensors that detect pollution and automatically regulate ventilation. However, such devices are very expensive. (7)

The design, siting and orientation are three important factors that have effect on the balance between the needs of energy conservation and ventilation. Simple ventilation is a non-expensive, non-energy consuming mean to keep the air inside the house fresh and comfortable.

Another way is to have natural diffusion of air through porous building materials that can absorb and release excess moisture thereby helping to regulate indoor humidity and expel pollutants such as brick, stone, timber and plaster forming what is known as the breathing wall. (2)

A breathing wall is one that allows outside cold winter to mix with warm air inside the wall cavity providing an exchange of air to the interior space that is preheated by passing through the mass of the wall. In the summer a breathing wall allows outside warm, humid air to mix with dry cooler air of the inside wall, providing precooled fresh air to the interior.

Medical sciences have proved that the human body requires between 1 and 2 air exchanges per hour for balance, registration of body cells and elimination of environmental toxins. However, most modern construction techniques advocate the use of vapor barriers which only allow between .2 and .5 air exchanges per hour. On the other hand, breathing wall systems typically provide between 1.5 and 3 exchanges per hour providing a nourishing, vital, living interior environment for healthy living.

The breathing wall has also energy advantages for through the combined effects of thermal insulation and mass storage in the floor, walls andd roof systems, heating and cooling requirements can be substantially reduced or eliminated.

A new generation of structural building blocks is being manufactured. These are aerated concrete that provide a non-conductive masonry building shell without the massive weight, low energy efficiency or environmental degradation of conventional construction. Some of the features of aerated blocks are:

- Non-toxic: 85% air, 5% white concrete, 5% lime and 5% sand.
- Lightweight: about 1/5 the weight of the standard concrete.
- Structural load bearing: low-rise structures require no reinforcement.
- Fire, rot and bug resistant
- Breathable: micro inhaling and exhaling prevents mold, moisture and toxic build up.
- Energy efficient
- Acoustical

C. Scent

Indoor and outdoor air pollution damages the sense of smell. The most common air pollutants are decorating products, plastics and adhesives, artificial fragrances from household cleaners, cosmetics, air fresheners and aerosols, tobacco smoke, nail polish remover, paints, vinyl wallpaper and paper removers. These pollutants not only have unpleasant smells but they also are toxic and cause respiratory problems, congestion, blocked nose, asthma and allergies, headaches, nausea, increased intolerance to chemical odors and a range of nervous disorders.

To avoid harmful and unpleasant smells in the home and to create an environment that is naturally scented, the home should be detoxified, cleaned and artificial scents should be replaced by natural ones. (2)

1- All sources of pollution should be removed or reduce. Offending items should be replaced with safe natural materials, furnishings, fabrics, floor covering and natural paints that have their natural aromas.

2- All rooms and cupboards should be kept clean. Only safe and nontoxic materials are used such as herbal soaps, furniture creams, floor polishes and fabric shampoo. Bicarbonate of soda has the preference to be used to remove unpleasant smells from fabrics, Refrigerators and rooms.

3- Rooms should be ventilated adequately in particular bathrooms, toilets and kitchens to remove cooking smells and moist air.

4- Aromatic plants and flowers are advised to be grown in window boxes or in the garden close to windows and doors.

D. Sound

Noise is one of the least recognized and regulated of all pollution sources. There are three main ways in which noise can invade the home: airborne sound, impact sound and flanking transmission *(fig.8)*. (2)

Airborne sound is carried in the air and includes noise from traffic and fabrics. This sound enters the home through open windows, doors, and small cracks and gaps. Impact sound occurs when the floor is vibrated by the sound of a falling object or refrigerator. This sound travels through floors and walls and will be heard loudly on the other side. Heavy objects and hard surfaces transmit most sound; softer surfaces absorb impact sound. Flanking sound is heard because impact sound travels along walls and floors, so even distant impacts can be heard. (2)

Outside noise could be reduced by planting trees and shrubs. Kitchen, bathrooms and halls should be placed on the noisy side of the building to act as buffers.

All edge gaps should be sealed and secondary glazing installed to reduce sound. Adding window shutters or heavy curtains is preferred. External and common walls between apartments should be of rigid mass construction.

As external noise is reduced, noise generated inside the home will become more obvious. Therefore, noisy appliances such as washing machines and refrigerators should be placed on thick rubber mats or concrete floors. (2)

E. Light and color

Natural outdoor light is variable. It changes in intensity during he year as well as during the day. Moonlight varies too according to the lunar cycle and the weather. These natural variations and cycles help to keep people stimulated and alert. These varieties and qualities should be introduced to the homes *(fig.9)*.

Light can be direct, reflected or diffused. Its color quality depends on the season, time of the day and the weather. Direct sunlight is the strongest casting shadows and causing glare. Reflected light is light; it is affected by brightness, texture and color of the reflecting surface. Light is diffused when it passes through a filter such as net curtains; it is soft and almost shadowless. (2,11)

Amount and quality of the light should vary according to the needs of each space. Direct lighting is used for kitchens, workrooms, stairs and sunspaces where bright light is essential for safety or plant growth. In living rooms, reflected and diffused lighting is more preferred to insure a relaxed and comfortable atmosphere.

The potential for admitting daylight into the homes depends on location and climate. For example, well designed home built in temperate regions should allow for lack of daylight for large parts of the year.

In order to avoid glare from windows, the contrast between light entering the room from the sky and the interior lighting of the room should be reduced. If the room is lighted from two or more directions and walls near windows are made as bright as possible glare will be certainly reduced. The amount of reflected light could be increased by using light-toned decoration, carpet and furnishing. Another way to reduce glare is by reducing the amount of light entering in the first place using shading devices.

Although the principal aim in a natural home should be to rely as much as possible on daylight and thus reduce the use of artificial light, supplementary light is inevitable at night and probably during hours in winter. The type of artificial light source and the position of light fillings have a considerable impact on the wellbeing of all members of the household. The object of good artificial lighting is not only avoiding health problems such as headaches and eyestrain, it should also contribute toward a supportive mood and atmosphere within the home. Thus, the color rendering of the spectrum should be considered as well as the colors cast by lampshades. (2,17)

Naked bulbs or bright light sources need shading on the characteristics of each room, the amount and placement of furniture and the style of decoration.

To create energy efficient lighting, general measures are applied, these are: (2)

- Eliminate unnecessary sources of artificial light.
- Create a lighting scheme that is well designed and spesific to the activities in each room -adequate light in the right position and casting illumination in the right direction.
- Increase effectiveness of illumination by using light-colored sources.
- Use energy efficient instead of regular incandescent lamps.
- Carry out a regular maintenance for all lamp fittings.

In the natural home, color will tend to come more from the materials used to build and furnish the interior. Natural materials such as wood, plaster... have their own beautiful and subtle colors and textures. For additional color, possibilities inherent in wood stains and transparent color washes should be considered. (2)

F- Materials of housing

The home interacts with its inhabitants. It can be supportive to their health and the environment or harmful to both. Just as clothes constitute the second skin of people, a house acts as their third skin. Thus it is important that buildings surrounding humans are healthy and life giving.

Over many centuries, individual regions developed homes and crafts that were harmonious and appropriate to particular localities. However, with improved transport systems, local materials were dispersed to distant places to be used in inappropriate ways. The industrial revolution speeded the process. In addition, it introduced new materials produced by fabrics –iron and steel- that required engineering rather than craft skills.

Today, the chemical revolution exposed the public to increased production as well as the use of synthetic products mainly from petrochemical sources. These materials affect the environment. Their production and transportation depletes resources and consume energy.

Traditional materials –clay, lime, stone- and timber can be easily reused and recycled. They produce little or no pollution and they are reabsorbed into the natural cycles of the environment once their use as building materials is over. However, non traditional sustainable materials are processed such as cellulose and rayon derived from plant fibers. They are examples of the potential for new materials from other than petrochemical sources. (2,11)

Since energy is becoming scarce and the amount used in the production and transportation of materials is high, the best materials are those that need little processing and/or are local. Materials used for housing comply with the government standards if available, the personal health and the environment. Special criteria differentiate healthy and ecological material from toxic and destructive ones. (2)

Healthy material should be:

- Clean and contain no pollutants and toxins, emit no biologically harmful vapors, dust, particles or odors either in manufacture or use. They should also be resistant to bacteria, viruses, molds and other harmful microorganisms.
- Quiet, producing little or no noise themselves, or have good sound reduction properties.
- Radioactive safe and not emit any harmful levels of radiation.
- Electromagnetic safe and not allow the conduction or build up of static electricity or emit harmful electric fields of any type.

Ecological materials should be:

- Renewable and abundant, coming from diverse natural sources and whose production has low impact on the environment.
- Non polluting, emitting no harmful vapors, particles or toxins into the environment either in manufacture or in use.

- Energy efficient, using low energy in production, transport and use and generally coming from local regions. Additionally they should be good energy conservers with high insulation values that retain heat in winter and keep the home cool in summer.
- Durable, long lived and easy to maintain and repair, tested and tried over several generations as is the case with natural materials.
- Equitable and produced via socially fair means which include as a minimum, good working conditions, fair wages and equal opportunities. Direct sales from co-operatives in the developing world to consumers in affluent countries should be supported.
- Low waste and capable of being reused and recycled, thereby saving the vast amounts of energy spent on processing raw materials. Recycled steel, for example, saves more than 70% of the energy used in manufacturing new steel from primary ore. Using salvaged doors, beams, stoens, bricks, tiles, slates, shingles, and even furniture is an environmental option even cheaper than recycling.

A- Stone (2,15)

Since prehistoric times, stone has been used as the strongest and most enduring of building materials. Lack of transport made local stone the obvious and most aesthetically pleasing choice. Away from quarrying areas, stone was used for facing brick and timber houses for lintels and window frames, steps and paths.

Small stones and boulders are collected from the surface while large blocks are excavated from quarries, swan into regular pieces and slabs, or broken into irregular chunks.

Traditional stone houses give a feeling of strength and security. Stone is healthy and nonpolluting if it is set in plain cement mortar and on a damp-proof foundation. Radon can be a problem. However, in some granite and slate areas, and quarry workers and stone masons may contract silicosis from inhaled stone dust. From an ecological viewpoint, quarries disfigure the landscape, and high energy costs are involved in the quarrying, handling and transporting of stone. The chief drawback with using stone is its expense, in terms of the raw material and labor costs. In spite of its structural strength stone does not always weather well when removed from its locality; water and frost may split the home unless it is protected by overhanging roofs, copings, and drip stones. Limestone is liable to be damaged by acid rain.

B- Glass and Plaster (2)

The Romans perfected the art of glassmaking. In addition, Egyptians had created delicate drinking cups by carving rock crystal, a translucent, colorless quartz. Early glass was opaque or greenish colored from the iron oxide in the sand, but the Romans produced plain glass to which they added colored mineral oxides and gold particles. From the Roman Empire, glassmaking spread to other parts of Europe and the Near East. However, blown glass failed to continue to meet

the demand and clearer glass was the next technology inquired. The addition of lead made the glass softer and appropriate to carve intricate designs.

Ordinary glass is inexpensive but fragile and breaks easily. Tempered or safety glass is up to five times stronger and, if broken, disintegrates into harmless fragments. Laminated safety glass consists of two or more panes layered with plastic; it may crack but the glass sticks to the tough plastic. Wire mesh incorporated into window panes prevents the glass splintering and it also acts as an effective safety barrier in areas such as skylights. Solar control glass is tinted to reduce glare and heat gain, and it protects fabrics from fading by strong sunlight. As a conservation measure, low-emissivity glass reflects heat back into the home.

Glass consists of silica (sand), sodium oxide (soda), and calcium oxide (limestone), with mineral oxides, colorants and cullent (broken glass). These are melted at temperatures of more than 1500 C, shaped and then cooled to prevent crystallization and cracking. Improved glassmaking techniques introduced thin sheet glass and thicker plate glass, but the float processes, in which a continuous ribbon of molten glass is floated along the surface of liquid tin, now produce most flat glass.

Plaster was used in early villages as a thick layer to cover wood, reeds, stone or mud bricks that constituted the materials of the settlements at that time. Plastering protected the walls from the effects of weather and gave the walls a smoother, more pleasing appearance.

Lime plaster is the oldest and the finest plaster. Plaster of paris is made from gypsum and is used for interior ornamentation and molded objects. Portland cement, a modern rendering material, is stronger than other plasters and does not need the protection of paints or washes if used outside.

Lime plaster is a compound of slaked lime and sharp, Coarse and mixed with water; fibrous materials, such as animal hair, provide extra binding. Plaster of paris is produced by heating and grinding gypsum (calcium sulfate) and mixing it with water; while Portland cement is made from lime and clay, which, when mixed with aggregate, such as sand or gravel, makes mortar and concrete.

Glass and plaster are both made from abundant, natural resources. They are healthy and non polluting, and while glass is inert material, natural plasters have good breathing qualities. Glass is a poor thermal and noise insulator unless it is double or triple glazed or has a low-emissivity coating. Water and frost action causes exterior plasters to crack and badly polluted air discolors them. Protective washes should be renewed on regular basis.

Extraction and manufacturing processes can disfigure the environment and glass production consumes vast amounts of energy, as well as creating combustion pollution. On the positive side, glass is easily reused and recycled, but all too often glass bottles and jars are discarded.

Glass is extremely versatile with a huge range of applications in the home. It is a basic ingredient of solar design, incorporating such features as energy-conserving windows, solar panels, and sunspaces. Larger areas of glass can

admit more daylight, when needed into homes thus reducing dependence on artificial light. For safety, glass is tempered or laminated in high-risk areas, such as patio doors, low-level glazing, and bathrooms.

Natural plasters can have pleasing colored and finishes such as white, cream, pink, or gray in mat or high gloss. As a background for natural materials and fabrics, unpainted plaster can enhance the "natural" ambience of a room.

C- Metals (2)

The types of materials used and the invention of metals have been fundamentally important to cultural development. But, it was the industrial revolution that brought metal engineering to building construction, using first cast iron, then wrought iron, and finally steel and steel-reinforced concrete. The range of metals used in the home today is enormous. The most common are: mild steel, zinc, copper, galvanize steel, and aluminum for roof coverings, gutters, and flashing; zinc-coated steel for ducts and expanded metal laths for plastering; aluminum foil backed plasterboard and vapor barriers. In addition there are steel reinforcing rods in concrete; coated steel windows; enameled cast-iron and steel baths; copper pipes; and brass for electric wiring, plumbing and hardware.

Apart from construction, metals are used for kitchen and laundry appliances, light fittings, furniture, and even cooking foil. Cans are made from aluminum,

tin, or steel, or of mixed metals, which makes recycling impossible. Most, though, are now of one metal to aid recycling.

All metals are precious. The mineral ores from which they come are a non-renewable resource. Although about 75% of the 80 minerals on which we depend are abundant enough to meet the anticipated needs, there are about 20, including lead, tin, tungsten, and zinc, that even with greater recovery, stockpiling and recycling are becoming scarce.

From the point of view of health, many metals can be harmful if ingested in sufficiently high concentrations. Arsenic and lead are the best known of these but others, such as mercury, nickel, zinc, aluminum and chromium can be harmful if ingested in the form of paint, for example. Mostly, however, the concentration of these metals in the home is negligible and should not be of concern. But there are other factors that should be considered. Steel beams and water-filled radiators and pipes can disturb natural electromagnetic fields. While steel frames and metal laths and decking as well as metal furniture and magnetized bedsprings may cause adverse effects. Metal ducts used for space heating and ventilation can also affect the ion balance of the air. Despite this, metal furniture is inert and free from chemicals and resins and is often essential for chemically sensitive and allergic people.

D- Earth (2,15)

It is the most ancient of all worked materials. Earth is a simple, durable, and an adaptable material, abundant locally, plastic yet strong, rot and termite proof, cool in summer and warm in winter. Mud walls, dried in the sun and protected from excessive wet, can last for centuries and, once fired, earth can survive for thousands of years. It is easily dug at little or no cost. In many arid regions, earth may be the only material available. Shaped into bricks or tiles and dried in the sun or kiln fired, earth has excellent thermal-storage qualities. A properly built earth house has an indoor climate that regulates air moisture and sound and helps to absorb and expel polluted air. In construction, it uses only about 3% of the energy expended on a similar concrete building.

Although many types of soil can be used for earth buildings, the best soil for bricks contains 75% sand and a minimum of 10%. For rammed earth, less sand and more clay and silt is preferred. Well compacted soil usually requires no stabilizers, but poor soils will.

Earth in its natural state is vulnerable to water and has a low resistance to impact. An earth house is less suitable in wet, temperate regions of the world unless it is built up on a well-drained damp-proof foundation and with a wide roof overhang. Unless they are reinforced and well sited, floods and hurricanes can destroy earth buildings.

E- Timber (2,15)

Timber is one of the healthiest building materials. Wood is a natural regulator of the indoor climate; it "breathes and assists ventilation; it stabilizes humidity and filters and purifies the air; it is warm to the touch and absorbs sound. It also does not disturb the natural, subtle electrical and magnetic fields as do most other materials. However, some people have an allergic response to the aromatic terpenes in pinewood resins. However, wood is not used in a sustainable manner. Worldwide, trees are cut and thus forests are diminishing without adequate reforestation. Therefore, people should avoid buying endangered hardwood and instead use sustainable softwood and the most carefully managed temperate hardwoods tree species.

Timber is divided into softwoods and hardwoods, a botanical distinction that does not always affect the relative hardness of the wood. Softwoods come from coniferous tree species, chiefly evergreen in the tropics. They are slower growing than soft woods, denser and more resistant to fungal and insect attacks, to moisture movement and distortion and also more expensive.

In relation to its weight, timber is stronger than any other material except bamboo. The strength:weight ratio of structural timber is greater than either mild steel or reinforced concrete, yet a timber building might weigh only 1/8 as much as much as a similar structure in concrete and brick.

The most traditional use of timber is as unsawn poles or roundwood. It is cheap and readily available in many parts of the world. It is used in the construction of

roofs for timber-and-earth homes. In fact, it is the most conserving way to use timber: the cost and wastage associated with sawing is eliminated and poles can be cut annually from thinning.

However, most modern timber construction is with sawn wood. One of the major advantages timber has over brick and stone-built houses is that the structure can be pre-assembled and the house shell erected very quickly and work on the inside could start immediately. In addition, it is a dry construction method. Moreover, timber can be split into shingles, carved and many other decorative styles to suit different climates and cultures.

Properly seasoned timber can last for years. Nevertheless, it is subjected to molds and fungal decay especially in damp conditions and presence of beetles and termites. Hardwoods such as oak and teak are generally resistant to water and to insect attacks. Softwoods except for redwood are more susceptible. The safe approach to conserving wood is to ensue that all timber is kept dry or if it becomes wet, it should dry as soon as possible by eliminating the source of the problem. Central heating will keep internal wood dry and eliminate the favorable conditions for the beetle larvae to grow. Termite infestation can be avoided by elevating the structure on steel supports and using foundation shields and grooves. These measures will greatly increase the durability of timber and reduce the need for additional protection from toxic preservatives. If necessary, safer yet effective treatment could be used such as borax, soda, potash,

linseed oil and beeswax. Painting timber with natural resin-oil stains, varnishes will help to preserve it.

F- Canes and Grasses (2)

Canes (reeds, sedges and bamboo) and grasses were used as traditional building materials wherever timber and stone were scarce.

Grasses are harvested at the end of the growing season, tied into bundles of equal length and used for thatching or woven into mats. Reeds and straw are also tied into bundles ready for the thatcher who fixes them in overlapping courses to the roof timbers with wooden sticks and iron hooks. Sometimes for structural building reeds are tied together to form thick bundles and curved columns with the spaces between filled by woven wall panels and sunscreens.

Bamboo is a unique plant lending itself to a multitude of applications and craft techniques. The culms are harvested in the dry season left for a few days to allow the sap to drain and then immersed into water for many weeks to reduce the sugar and starch contents. Bamboo can also be pulped for paper, used either by itself or combined with wood pulp to ease timber shortages. Since bamboo is light and strong under tension it is ideal for building and scaffolding purposes.

The barbed rattan canes are dragged to the ground, stripped of leaves and left dry in the sun before they are cut into lengths and graded according to size. After being washed and scoured with sand the canes may be left whole or split in half. Strips of bark are used for the weaving process.

In their natural untreated state all these vegetative materials are healthy. And until recently the impact of harvesting and processing on the environment has been negligible. The resources are generally renewable and harvesting and processing involve neither energy costs nor heavy machinery. In addition, they provide local employment and help to maintain traditional local crafts. Now, however following close on the destruction of tropical rainforests is the erosion of the natural habitats of reeds, bamboo and rattan and with that the disappearance of wildlife.

However, once harvested these materials are often treated with chemical preservatives and finishes. Bamboo, rattan and reeds may be treated with DDT and lindane. It is possible to prolong the life of these materials by treating them with borax, linseed oil or beeswax or by coating them with natural varnishes.

G- Natural fibers (2,16)

Natural fibers come from abundant and renewable resources and are produced As annual crops or animal by products. But natural does not necessarily mean healthy mainly due to the use of chemicals and pesticides during cultivation or afterwards as additives.

The choice of fabrics and fibers for the home can be confusing but the hidden environmental costs of petrochemical based synthetics make it clear that they should be avoided. Not all natural fibers are problem free however but on the whole they do come from abundant diverse and renewable sources, it is possible

to produce them without pollution and processing them usually requires far less energy than is used for producing synthetics.

In the home different fibers and fabrics are suited to different purposes depending on such factors as durability, rot and flame resistance, strength and cost.

For instance, cellulose could be used for insulation. It is derived from used newspapers. It is a pure product of recycling that does not require the destruction of any landscapes to produce it. The amount of energy required for production is minimal. Through special drying processes, all types of strain on the earth and water are avoided. The cellulose insulation wool remains elastic and is very light.

H- Straw

Straw is a renewable resource consisting of highly compressed bales of hay coated with clay plaster. The hay is treated for resistance to fire, fungus and rodents, and the clay can be applied in various densities and thickness to ensure the correct ratio of thermal mass and high insulative value. This technology is used as a vibratory insulation.

I- Paints and Varnishes (20)

The criteria for a healthy product are that it should be harmless to the user, the manufacturer and the environment. Synthetic paints, varnishes, stainers, and adhesives follow none of these criteria.

On the other hand, paints and varnishes coming form natural materials have many advantages out of which they have subtle colors, pleasant scents and a healthy environment.

G- Spaces

People are accustomed to thinking of their homes as a collection of separate rooms –living room, dining room, bedroom, bathroom, kitchen and so on- that is difficult to conceive of them in other way. In addition, the use of such terms limits the scope and potentialities of these areas. Therefore, one should think in terms of activities and processes rather than rooms. Instead of bathroom, "bathing and cleaning" should be considered; instead of kitchen, "food chain"; and rather than bedroom, peaceful sleep. (6)

Then instead of "rooms", spaces should be considered.

A- Living spaces

The family living space needs to be versatile enough to be put to a variety of uses: it should be a sociable gathering place; a peaceful retreat for relaxation; and also a happy setting for special events, such as anniversaries and parties. The changing seasons bring different rhythms and moods, and the living spaces should harmonize closely with them. (1)

In cold and temperate climates, living spaces should be located on the sun-facing side of the building. Spaces oriented within 30 segment east and west of due south all have the advantage of midday sun, particularly valuable when this is low in winter. (2)

In hot, dry climates, living spaces are conventionally shielded from the sun and either look on to cool, shaded courtyards or they are protected with wide

verandahs and porches. Trees, climbing vines, large water surfaces, and softly playing fountains help to disperse excessive heat.

In hot, humid climate, Priority should be given to the prevailing winds so that living spaces can be located in the path of through-ventilation or cross-ventilation. (2)

The focal point is the corner hearth, where a circular seating platform becomes the natural gathering area. Beyond, on the sun-facing side, is a new, semi-circular sunspace, which is light and airy and acts as a transition between the private inner room and the outside garden –a feature enhanced with plenty of indoor plants. The roof canopy shields the inner room from the high angle of the summer sun, while the solid insulated floor of the sunspace acts as a solar collector that releases heat into the room on cold winter nights. Double glazed solar windows, with top and bottom vents to regulate the temperature, are insulated with outside shutters or interior padded blinds that prevent the heat from escaping in winter. In summer, through-ventilation from front to back keeps the interior cool. Thick solid adobe walls are molded into flowing curves and platforms with old timber beams avoid rigid, straight angles. (2)

B- Sleeping space

On average, one third of man's time is spent in his bed. Therefore, the bedroom is one of the most important rooms in the home.

If it is located on the east side, it will catch the morning sun; while, if situated on the west side, it will avoid the hot noon sun and overheating and benefit from the beautiful sunset view..

Natural light should be reflected and indirect to create a soft and subtle illumination; light could be diffused with net curtains or blinds. Double glazing of the windows and double doors or a small enclosed entrance lobby may be necessary to shut out the sounds of the city; noisy apartments can often be improved by soundproofing the walls and ceilings. The ideal temperature is 13-15 C, slightly higher for children and the elderly, with adequate humidity and fresh, clean air for good ventilation and easy breathing. However, avoid creating any through draughts; very low temperatures can easily induce hypothermia in the vulnerable. Natural and untreated, nontoxic materials and fabrics breathe and will help to regulate the room climate. (2,8)

C- Kitchen spaces

The kitchen should be a warm and friendly place, somewhere full of activity, busy and comfortable. It should be a healthy and conserving processor at every stage.

The natural kitchen is designed as a closed system, conserving water and energy, recycling all packaging, and linking organic waste to compost and new growth in the garden. It has storage and work centers designed for home-grown and organic produce, and more basic tools and equipment for cleaning, preparation and cooking. The main activities of storing, preparing, cleaning and cooking need separate work centers. These should be close to each other, though, to reduce unnecessary walking. Heights, surfaces, and tools are designed for specific purposes, such as a large double sink for washing vegetables, a marble slab for pastry making, a chopping block and a generous-sized table for social and family gatherings. Since food is handled in the kitchen, it, more than any other space, should be free of toxins and pollution. Hygiene is obviously important, but there is no point using products that leave surfaces with a "sparkling clean" shine disguising residuals of harmful chemicals. Many safe, natural alternatives are available.

Kitchen and food storage areas should be ventilated should be ventilated. An extra hood should be placed over the cooker and a heat exchanged system should be considered. Tap water should be filtered at the supply or in a filter jug and plastic containers should not be used for food storage.

All waste is presorted for recycling, first into separate kitchen bins and secondly into larger, outside bins for collection or delivery to recycling centers. Organic waste is consigned to the garden compost bins where it breaks down into humus that is used as manure and organic fertilizer for the garden and for indoor growing spaces. (2,6)

D- Bathing spaces

Bathing spaces in the home must necessarily serve several purposes, combining a place for cleanliness with a room for stimulation and relaxation as well as a healing atmosphere. In addition, it sometimes becomes a more social environment. Ideally, a large room should be chosen so that it functions as another type of living space. For practical reasons, the toilet is better sited in a separate, adjoining room and fitted with a wash basin.

The natural bathroom is designed in a way to have an intimate relationship with green space. The bath itself could be the conventional western type, but a deep tub with a built-in seat is better for soaking; water is recycled through a small heater to keep it at a constant temperature. A raised floor area can accommodate the depth of the tub or access can be via a step. The adjoining wet area is larger than usual and handy for quick showers or a thorough cleansing and scrubbing prior to soaking. The non-slip tiled shower tray can be stoppered to provide a shallow bathing and water play area; small children should never be left unattended; backache could be avoided by placing the bowl on a low stool -also

useful for elderly people while showering. Good and permanent ventilation and windows that open are essential to expel excess moist air and radon "hot spots".(2,6)

E- Green spaces

Green spaces are crucial for the health and spirit. However, creating a natural outdoor greenspace does not mean letting everything go wild –there is a design for it. First garden assets should be assessed –sunlight and shade, shelter and exposure, vegetation and wildlife, soil and water. Then see the appropriate way to naturalize it and turn problems to advantages. (1,2)

H- Lebanese Housing Laws

The Lebanese Law almost completely ignores standards and regulations concerning the building industry such as the plumbing code. However, there are some laws concerning the general safety of the people. These regulations should be satisfied by the architectural plans in order to receive the license or permission to start the building. Nevertheless, no penalties nor fines are present to force the people to abide by them.

On top of this, the issues mentioned were tackled superficially with no specifications or real standards. These were: (21)

- Fire hazard
- Natural hazards
- Forbidden materials (without specifying the kinds)
- Rain collection (not a must)
- Planting of trees
- Waste water disposal (just for the sake of getting rid of the waste water)

I- Conclusion

In conclusion, we all care about our homes and spend time, effort and money trying to make them more comfortable. For most of us our homes represent the biggest investment we ever make they are lifelong, a center of our concern and our wellbeing. So it probably comes as something of a shock when we realize that the home today can be a very uncaring place –uncaring of us and uncaring of the environment. Our homes can damage our health, the air we breathe, and the water we drink without our even being aware of it. But home doesn't stop at the front door: it affects, and is affected by its surroundings. However, the natural home is not just a collection of energy efficient systems or green gadgets from solar panels to CFC free fridges. The need to create a truly sustainable lifestyle encompasses the physical or environmental issues of humanity, though it includes these. If we were as conscious of the needs of the environment as we are of the needs of our homes, it would indeed be the first step in changing the world.

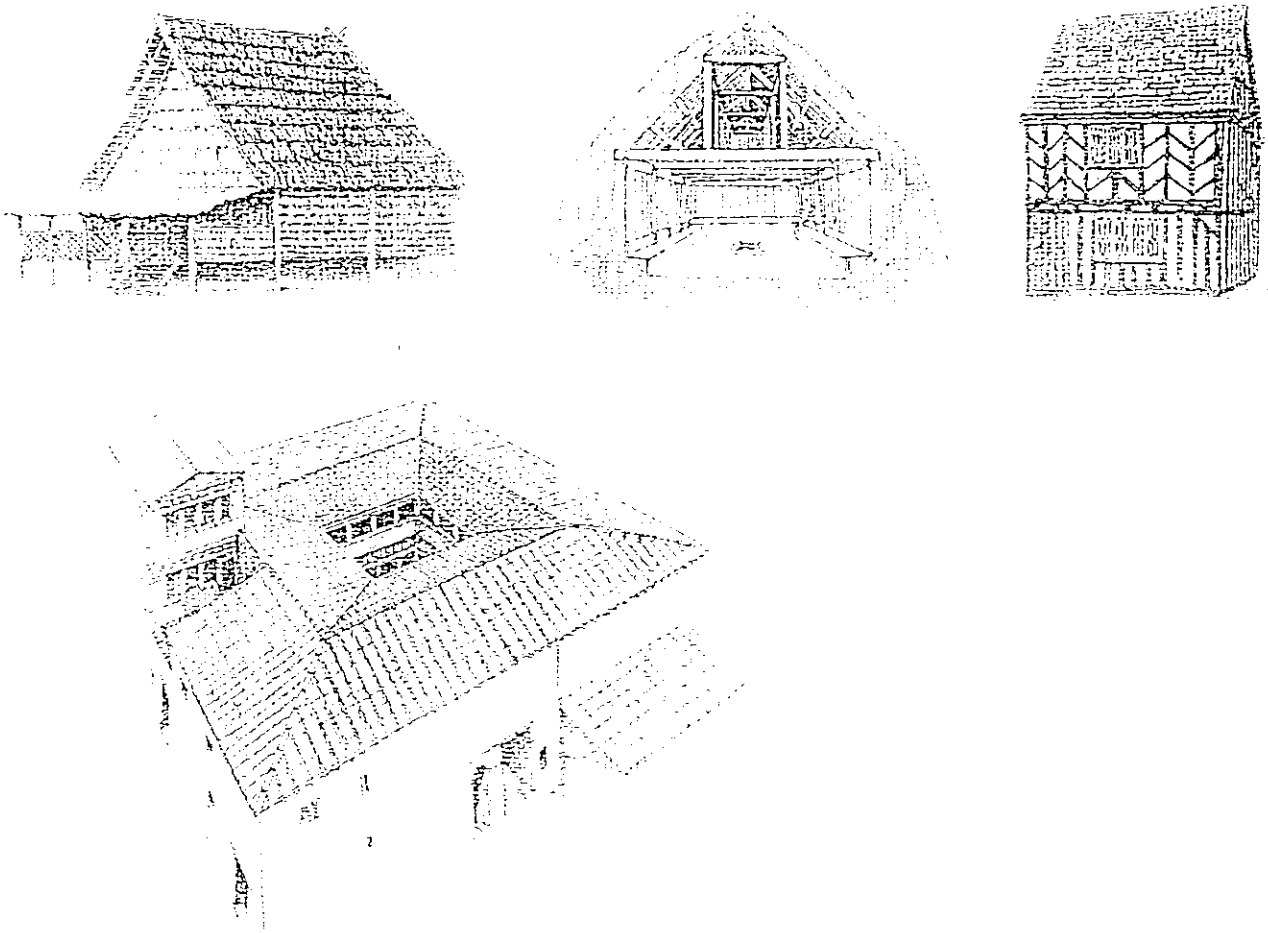

Fig 1: Historical Houses

Fig 2: The Masai House

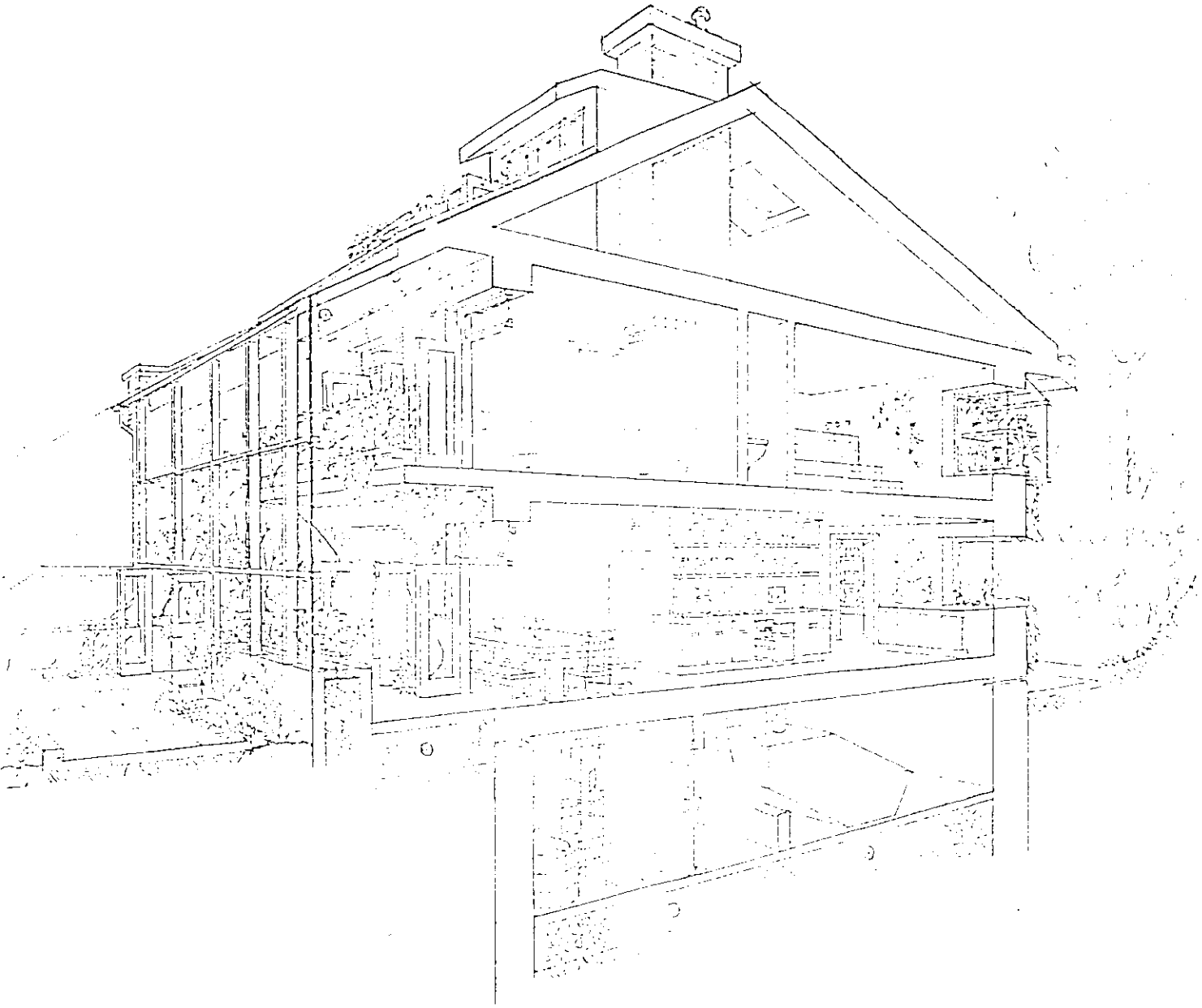

Fig 3: The Gate House

Fig 4: The polluting Home

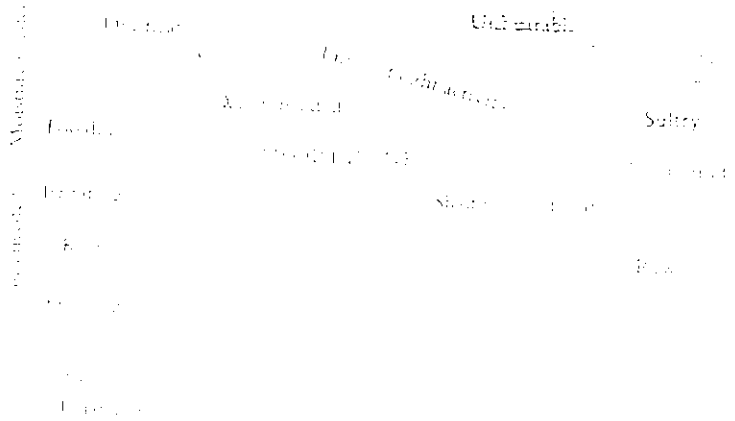

Fig 5: The Comfort Zone

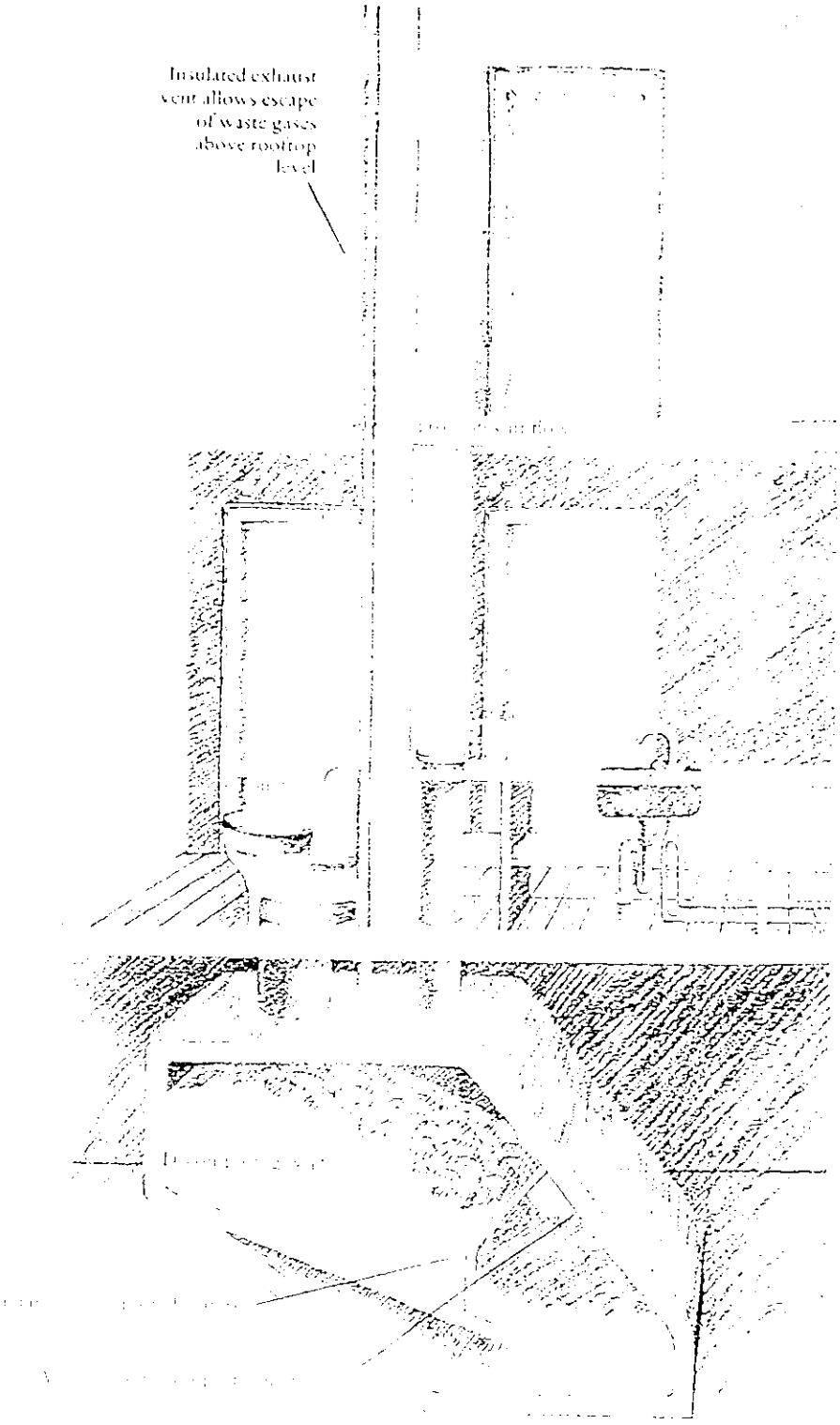

Fig 6: Waterless Toilet

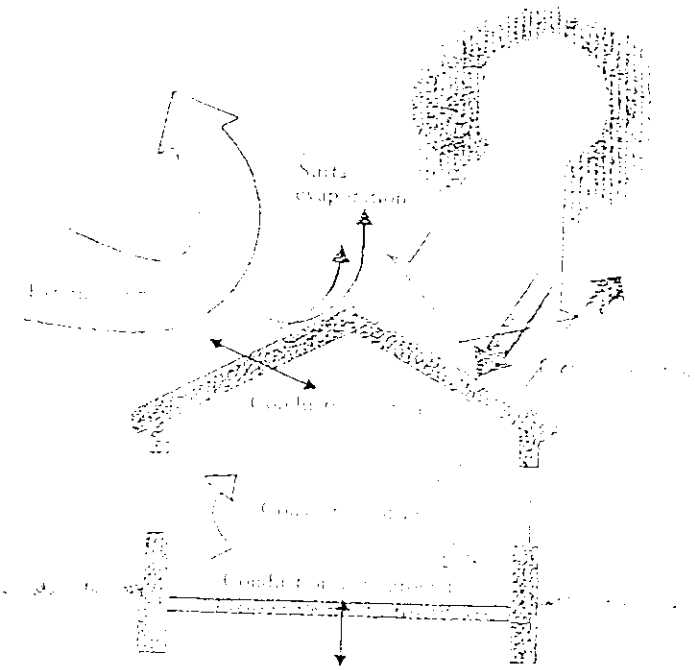

Fig 7: Air Movement

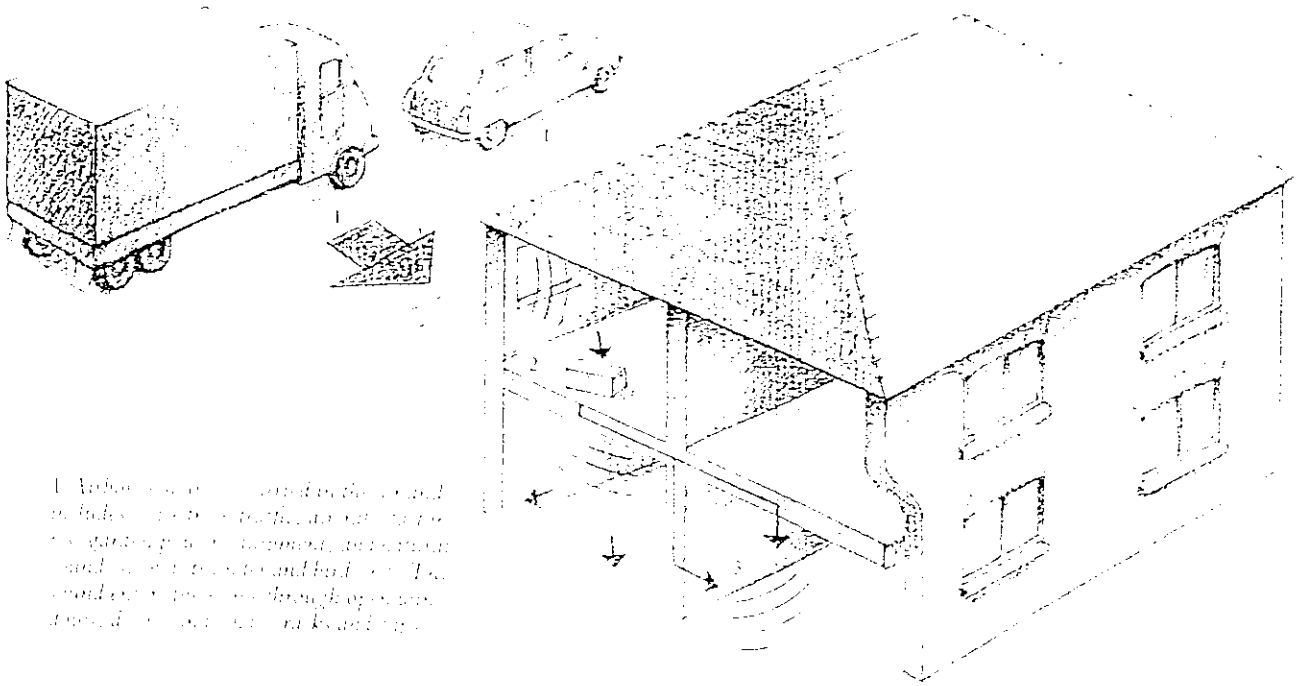

Fig 8: Sounds

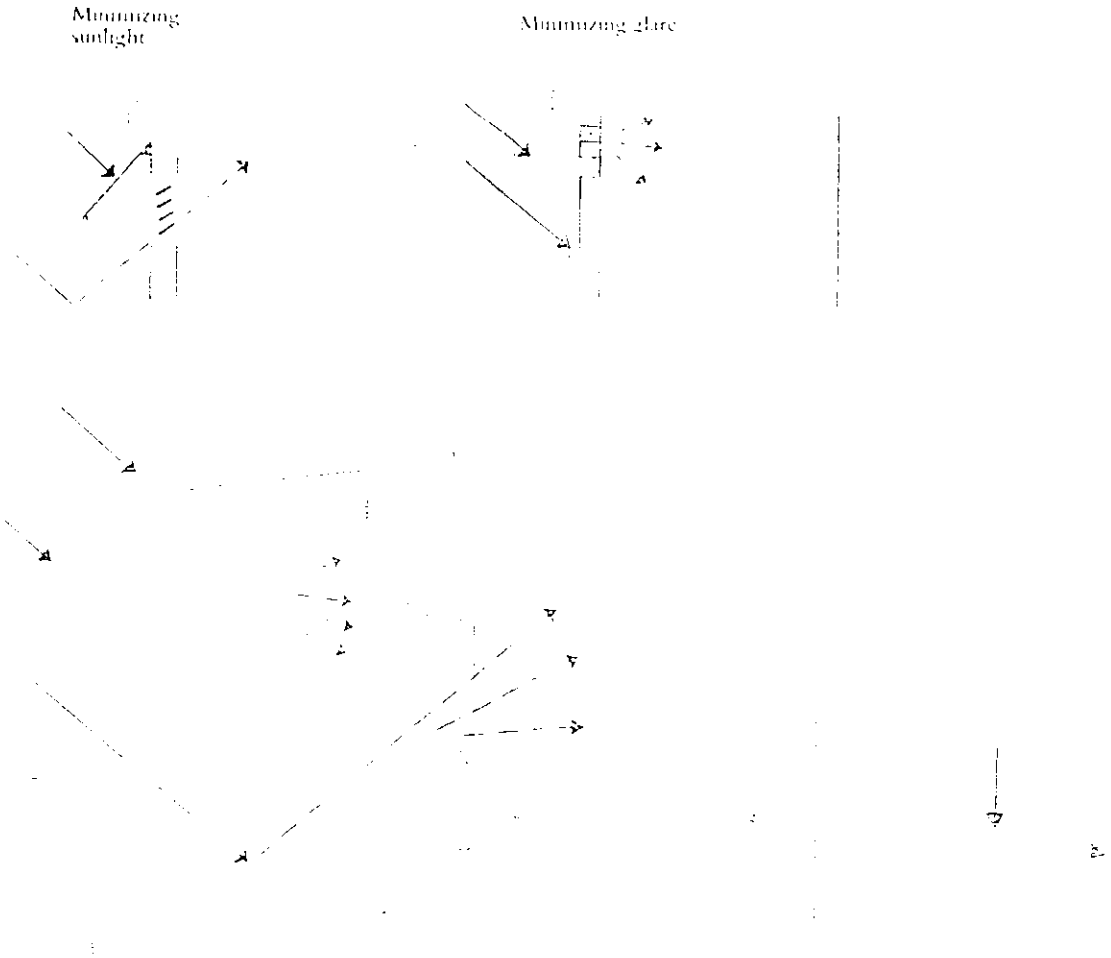

Fig 9: Introducing light

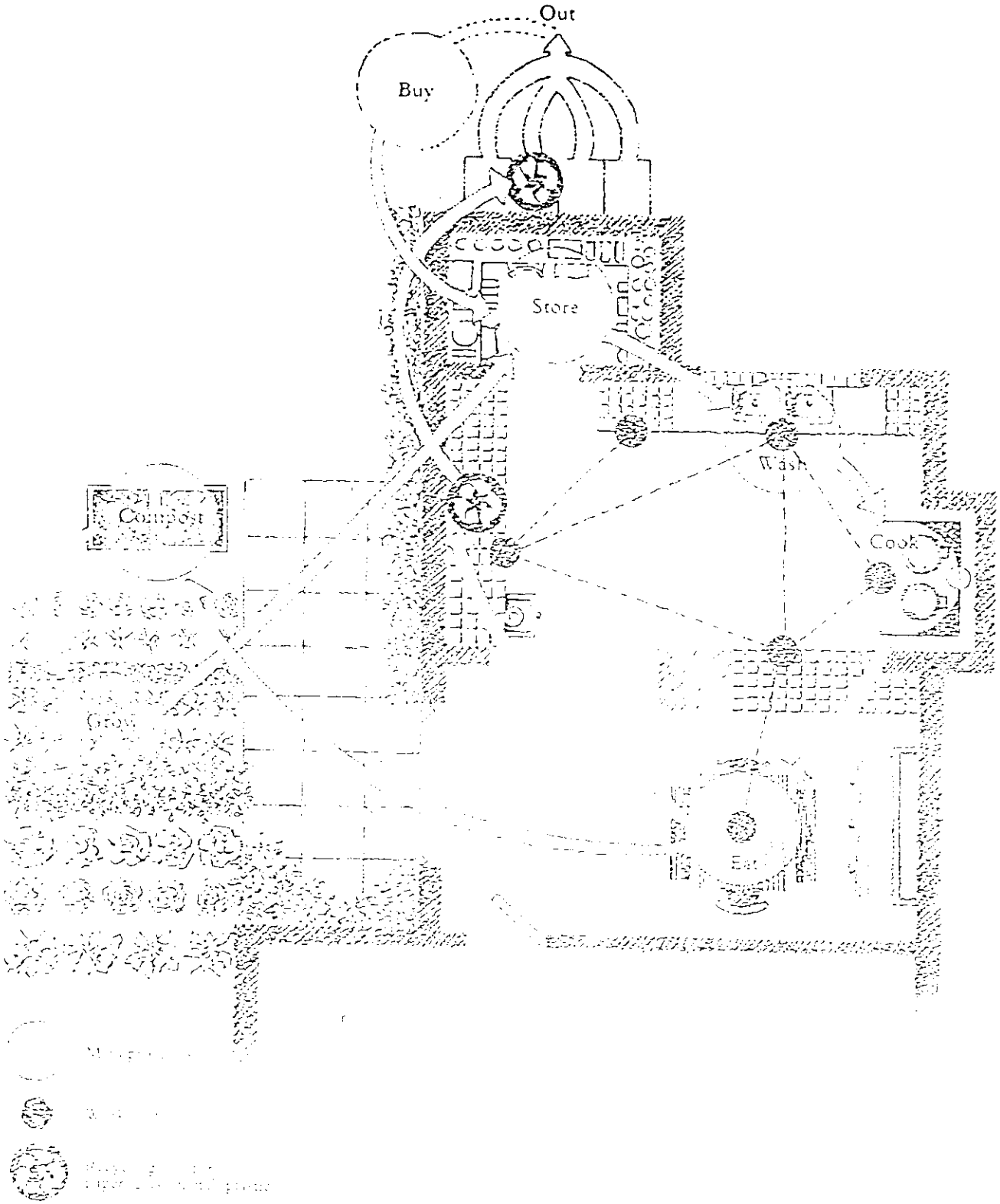

Fig 10: The New Kitchen

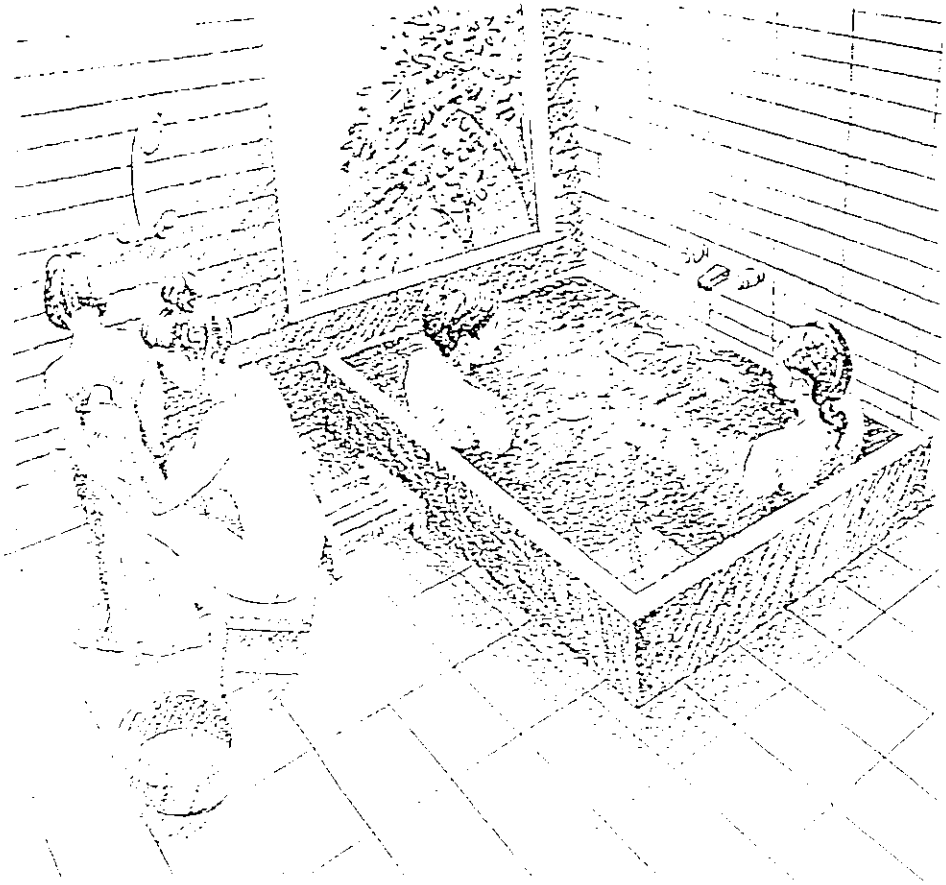

Fig 11: A Japanese Bathing Space

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