ARCHITECTURE AND THE CHALLENGES OF THE ENVIRONMENT: a case for organic architecture towards meeting the environmental challenges in the 21st century.

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Presented at

National Conference on Urban and Regional Planning in the Context of the Millennium Development Goals (MDGs)

DEPARTMENT OF URBAN AND REGIONAL PLANNING

SCHOOL OF ENVIRONMENTAL TECHNOLOGY

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

On 15th—17th November, 2006

Abstract

Perhaps no century in history has thrown up as much challenges to the architects and environmental managers as the twenty first century. In recent years therefore, environmental issues have become a matter of central concern for humanity. Consequently, environment issues and the natural environment became important guidelines for the realization of a healthy living through the built environment in the century. In the new millennium a more holistic approach to the realization of a healthy living through the built environment is emerging, and demanding new forms of expression that reflect the variety and creativity of nature itself. Organic architecture is being reincarnated today as a new international movement that combines a respect for nature with a celebration of natural forms, flows, and systems. Inspired by the non-linearity and creative forces of nature and biological organisms, organic architecture is environmentally aware—it embodies harmony of place, person and materials.This paper gives a brief overview of organic architecture—its origins and conceptualization. It highlights organic ideologies of natural forms and geometry; and how the environmental concerns could be resolved. The paper finally recommends that architects learn more about Mother Nature's secrets and apply them to our own mortal designs.

Key words: - Environment Harmony; Geometry; Natural Forms; Nature; and Organic Architecture.

1.0 Introduction

The impact on the environment has continued to effect dramatic changes with some threatening situations on the ability of man to survive if not controlled and maintained (Haruna, 2006). The industrial technology engenders high living standards, productivity and comfort, but also destroys biological capital like air, water and other parts of ecosystems that must support all and future generations. As science sees further into the microscopic world of matter and uncovers more about the remarkable structures of living things, nature continues to surprise us and teach us how we might build more cleverly, economically, subtly and ecologically.

Organic Architecture describes a way of thinking about design that transcends the common everyday buildings around us; that is, it describes environmental concerns, embodies the human spirit, and

transcending the mere act of shelter into something which shapes and enhances our lives. It promotes harmony between man and nature through design so well integrated with its site that building, furnishings, and surroundings become part of a unified interrelated composition.

The main features of organic architecture according to the great architect Frank Lloyd Wright (Farmer1996 and Mas'ud 2006), however, were—the close association of buildings to their sites by means of extended and emphasized planes parallel to the ground; the free flow of space unencumbered by box-like enclosures; harmony of all openings with each other and with human scale; the exploitation of the nature of a material, in both its surface manifestations and its structure; the incorporation of mechanical equipment and furniture as organic parts of the structure; and the elimination of applied decoration.

In architectural circles, organic has been seen to be synonymous with the buildings and writings of Frank Lloyd Wright in particular. Some connect it to others like Hans Scharoun whose

freer geometrical approach was just acceptable despite the developing consensus about modern architecture that produced the International style of the 1930s. To some the attitudes and subsequent buildings of Alvar Aalto who saw the need to reflect the imperatives of climate and tradition are organic Le Corbusier used biological analogies to explain that his buildings and city plans worked like the functional relationship between the parts of the human body, or like the development of tree and plants. Discussing buildings in such a way by organic or biological analogy had its origins back in the nineteenth century (Farmer, 1996).

However, Pearson (2001) and Hassan (1986) observed that organic architecture has a long and celebrated history, from Ancient Greece to Art Nouveau. Pearson sees organic architecture as one that is rooted in a passion for life, nature, and natural forms, and is full of the vitality of the natural world with its biological forms and processes. Emphasizing beauty and harmony, its free-flowing curve sand expressive forms are sympathetic to the human body, mind, and spirit.

The fact that the rectilinear, orthogonal mode came to dominate the 20th century is a reflection of materialist values of an industrially driven age. The post-industrial age is awakening to a new world, which also echoes an older and wiser vision. The re-emergence of organic design, represents a new

freedom of thought; an expression of hope for the future. This is affecting most fields of design from products and furniture, lighting and textile design to architecture, landscape architecture, and interior design.

In the new millennium, a more holistic and organic image of the universe is emerging, and demanding new forms of expression that reflect the variety and creativity of nature itself. Thus organic architecture is being reincarnated today as a new international movement that combines a respect for nature with a celebration of the beauty and harmony of natural forms, flows, and systems. Inspired by the non-linearity and creative forces of nature and biological organisms, organic architecture is visually poetic and environmentally aware, embodying harmony of place, person and materials.

2.0 Origins and Conceptualization

Primitive vernacular architecture was innately organic, based on natural forms and structures and simple, local materials (Pearson 2001and Hassan 1986). Egyptian and Ancient Greek civilizations studied natural forms and the human body and abstracted them as geometry. They use the circle, ellipse, triangle and rectangle to derive harmonious proportions for their shrines and temples and so promote harmony between themselves and their elemental gods and spirits of earth and cosmos.

Plato believed that all things flow and change in nature but are directed by eternal and immutable patterns, forms, or ideas that are the true reality. Aristotle, however, as a founder of the scientific approach, used observation to understand and classify nature. In architectural terms both contributed to key ideas and concepts that run through organic design.

The Roman, Vitruvius, agreed with his forebears that the human body, with its modular construction, is the ideal expression of nature's unity. His homo quadratus—the figure of a man, with extended arms and feet, fits neatly into what were considered the most perfect geometrical figures—the square and circle. The Romans moved on from philosophy to practice and to develop arches, vaults, and domes—structurally stronger and more economical of materials than earlier straight post and beam designs.

Towards the end of the Roman Empire theories of proportion lost their original divine significance and became a series of secular rules applied to any building of importance. Later, in the Byzantine Empire, Christian spirituality re-inspired architecture with ideas of divine proportion and the mystique of numbers, and developed the Roman form of the dome placed on a square to create the typical Byzantine cross-in-square church plan.

Divine geometry was also very much alive in the Islamic world. Here representation of the human and other animal forms was strictly prohibited. Mathematics and abstract geometry were the only appropriate expression of order and perfection created by Allah. Thus pure geometric shapes—circle, square, polygon, and star—were employed to produce the timeless Islamic architectural language of cupola, half dome, tunnel vault, horseshoe arch, stalactite pendentive, and rich ornamentation. Like Allah, the limitless one, building forms, spaces, and ornament seem to cascade into the distance without end.

Gothic architecture absorbed elements of both Greek geometry and pagan Celtic expression of the organic forms of the tree, plants, water, and earth. Master masons revitalized the sacred purpose of proportion and used plant forms for decoration. The circle was the basic controlling device for Gothic cathedral design. The whole structure derived from underlying star diagrams, subdivided by polygons (especially, pentagons and decagons), generated harmonious proportions. The pointed Gothic arch and vault shed structural loads more efficiently than the massive Roman semicircular arch. This innovation allowed unrivalled building heights to be reached with an apparent lightness and delicacy never before imagined possible in stone—a real flowering of the organic in architecture!

With the Renaissance came renewed interest in Classical theories of proportion based on human form. Michelangelo (Pearson, 2001.) held that knowledge of the human figure was vital to a comprehension of architecture. Alberti remarked that a building must appear whole like an organism and Leonardo da Vinci made his famous drawing of Vitruvius's homo quadratus. When Descartes stated "I have described the earth, and the entire visible world, as if it were a machine" (Pearson 2001.); he heralded the Age of Reason and gave birth to modern scientific method. With this new

age came a conviction that architecture was a science too, and that each part of a building, inside and out, had to be integrated into one system of mathematical ratios.

As a reaction to the dominance of this overly scientific view sprang the desire of the Gothic Revival for freedom from Classical rules and a return to what were seen as truer spiritual and holistic values. New architectural principles proposed by Ruskin, Pugin, and Violet-le-Duc drew inspiration from the forms and processes of nature and promoted medieval building traditions such as hierarchy of functions and forms, structural expression, truth to materials, craft skills, and rich polychromy and ornament.

Art for the people and by the people was the cry of William Morris , one of the founders of the Arts and Crafts Movement. And it was these social aims that underpinned the movement's concentration on creativity, naturalness, craft production, and co-operative effort to counter the spread of machine production and poor quality mass-produced goods. The rejection of 19th century stylistic imitations for a simpler, more abstract approach with natural continuous forms paved the way for the wider fantasies of Art Nouveau. But it was the deep, and sometimes near pantheistic or mystical, affinity with the natural world that was the universal source of inspiration. And inspired by the delicacy of such living forms as sinuous vine tendrils, flower stems, buds and insect wings, the line could be gentle and graceful or powerful and tense like a whiplash. In architecture, ornament and structure became fused into a free- flowing plastic, organic unity. Structures resembled sinuous vegetative growths, windows appeared as diaphanous membranes, and materials an exotic palette of brick, stone, terracotta, wrought and cast iron, stained glass, and wood veneers.

3.0 Roots in Geometry and Nature's Forms

3.1 Forms in Nature

Patterns and forms in nature, such as the spiral and fractal, are products of internal laws of growth and of the action of external forces such as sun, wind, and water (Pearson 2001.). Architects learn to use natural forms from observing living structures: trees, bones, shells, wings, webs, eyes, petals, scales, and microscopic creatures. They are the very forms of life and growth and have been key inspirations in organic architecture, whether for ornament, structure or metaphor.

Pioneering students of nature's forms (Farmer 1996 and Pearson 2001.), whose influences are still felt today, included Johann Wolfgang von Goethe (1749-1832), Ernst Haeckel (1834-1919), and D'Arcy Wentworth Thompson (1860-1948). Goethe studied natural forms. He also applied ideas of metamorphosis to art and architecture, the dynamics of form active in all living organisms, whereby an orderly and cyclic transformation can be traced in all plant forms from seed to calyx to blossom to fruit (and to seed again)—a concept central to the development of organic architecture.

Biologist and zoologist Ernst Haeckel studied Radiolaria (planktons) and was captivated by their exquisite geometrical forms and complex patterns. He is best known for his work Art Forms in nature with its magnificent illustrations that had an immediate impact on Art Nouveau and the work of Hermann Obrist, August Endell, and Louis Comfort Tiffany. Architect Rene Binet designed the monumental entrance gate to the 1900 Paris World Exposition, as a vast radiolarian. Haeckel himself used beautiful jellyfish forms as ceiling decoration in his former home, the "Villa Medusa". Zoologist D'Arcy Thomson also set out to define and classify form and studied an astounding range of natural forms from microscopic Radiolaria, to shells, insect wings to raindrops, snowflakes to the splash of a pebble in a pond. His thoughtful results summarized that in general no organic forms exist save such are in conformity with physical and mathematical laws.

3.2 Geometry

In modern architecture, geometry is manifest more in materials, structures, and new mathematics than in notions of proportions and symmetry. Some of the greatest 20^{th} century champions of non-rectilinear organic forms have been engineering pioneers such as Max Berg, Eugene Freyssinet, Robert Maillrt, Pier Luigi Nervi, Felix candela, and Buckminster fuller. They pushed new geometry and new materials, such as reinforced concrete, to their limit to create daring and beautiful structures. Their search for structures to span ever wider spaces with less material led to a light "floating" architecture that uses thin shells, frame, and tent constructions of audacious three-dimensional shapes using parabolic and hyperbolic curves, barrel vaults, folded slabs, and geodesic domes.

Today, detailed study of nature's forms, use of non-linear geometry, and computer modeling are exploring an exciting, and as yet, little-known world of new non-linear organic architecture. At a

time when nature is viewed as being a mercurial mixture of order and chaos pattern and accident, simplicity and complexity, it is not surprising that the creators of buildings should respond with new concepts. The lightweight timber grid shell, for example, is simple, economical, and strong, and uses sustainable materials. The thin wooden laths of the grid shell act like chains to take up optimum structural forms.

Boat design is also another example of an allied craft that employs specialist knowledge of complex double curved forms. Frank o. Gehry used naval architecture computer software to model the fractal shapes of the Guggenheim Museum, Bilbao, Spain.

3.2.1 Spirals—Patterns and forms in nature are products of internal laws of growth, such as the spiral and fractal, and external forces acting on them, such as sun, wind, and water. One of the most powerful and widespread natural laws is the Fibonacci Series, named after Leonardo Fibonacci, the medieval Italian mathematician. It governs phyllotaxis (the arrangement of leaves on a stem) to give optimum chlorophyll production (Pearson, 2001.). It also describes spiral growth patterns of objects as diverse as pine-apples, sunflowers, pine cones, seeds, tendrils of climbing plants, animal horns, and numerous shells, the most often cited being the nautilus.

3.2.2 Curves—The circle representing the path of the sun, moon, and stars, has been used since pre-historic times (Pearson, 2001.) for the henges and barrows of sacred sites. Domes, arches, and vaults were used in religious architecture because of their power to evoke the sublime. Even in secular use, curves can still retain a special emotional power. Curves may be gentle and graceful like the swan-neck, so prevalent in decorative designs using plant motifs, or they may be tense and explosive like a coiled spring. They may also be sleek and streamlined to respond to the energy and force of wind and water, or sensual and erotic in suggesting the beauty of living forms. Curves are very strong and can reach optimum structural shapes as parabolic and hyperbolic arches and shells.

3.2.3 Fractal—Fractal geometry describes natural shapes and rhythms such as snowflakes, leaves, tree branches, mountains, waves, and coastlines. Applied to architecture, rhythm and composition become fractal self-similar detail, often referred to as “textural progression”. From a fractal point of view, Modern Movement architecture lacks textural progression and harmony with its surroundings,

while the work of Frank Lloyd Wright, and other organic architects, show fine fractal cascades of detail from the large (plans and elevations) to the small (windows, doors, and decorative patterns). Fractal geometry opens up endless possibilities for designers interested in expressing the more complex underlying rhythms and random patterns of nature.

4.0 Organic Legacies and Metaphors

Frank Lloyd Wright is, for many, the true father of organic architecture. His mentor—Louis Sullivan had earlier, in his buildings combined a tough-minded functionalism with passionate feel for naturalistic ornament that seem to grip the building here and there with its twisting vital forms. "Outward appearances resemble inner purposes" was one way Louis Sullivan described his famous axiom that form follows function—a key concept for organic design. This was to influence Frank Lloyd Wright's later works greatly so much that organic architecture cannot be discussed without the mention of his contributions (Farmer, opcit.). Wright's talent for the sitting of a building and the innovative use of natural materials, and his inventive structural sense developed further the scope of organic ideas in architecture.

In Wright's masterworks (Farmer1996) like Falling Water and Taliesin West (his own house), buildings of the modern industrial age sit in an ancient landscape. Falling Water as its name implies is a house whose rooms are cantilevered out over a waterfall. The walls are natural stone, there is much glass to interconnect the woods and the waterfall with the interior, and the enormous cantilevers are of reinforced concrete; the effect is to transform the landscape around into a beautiful backdrop to the arresting building. In the more hostile desert landscape of Taliesin West, the building crouches on the desert floor, its form less dominant in the context of the open desert panorama. It appears to grow naturally out of the ground, its organized boulder walls petering out into the random boulders of the landscape. Wright wished his buildings to be part of nature and would often choose sites close to woods, rock formations, or even waterfalls as with Falling water, Pennsylvania. Like "a thing growing out of the nature of the thing", the concept of the building would emerge naturally out of the site. If nature was absent, he would provide ample space for plantings in and around the building or turn the building around and fill the centre, with trees and plants.

Alvar Aaltor brought Scandinavian clarity, simplicity, and lightness to organic design. He was excellent at handling asymmetrical massing of diverse volumes and gradually moved from earlier angular forms (Town Hall, Saynatsalo) to evolve vigorous curved forms (Finlandia Concert Hall, Helsinki). He could create a fluidity of space and quality of natural lighting and colour that were poetical, and use simple natural materials, particularly wood, in new and creative ways so as to allow the materials to express themselves.

Bruce Goff, whose work is often associated with that of Frank Lloyd Wright, also demonstrates his ability to absorb and reflect a genuine intent to allow his clients the opportunity to create an environment that was a natural expression of their values. He worked in what he called the "continuous present", his maxim being "beginning again and again". Goff described his approach "as a concept that grows from within outward". He liked to play with competing natural elements—earth, air, fire, and water. He superbly integrates many complex elements. The Bavinger House, Oklahoma designed in 1950, is a continuous logarithmic spiral of open-space platforms, suspended by cables from a central mast. The spaces seem to defy gravity and float over one another and the indoor pools below yet are rooted in the ground via the massive stone core.

A separate strand of the organic tradition has its roots in the Germanic cultural tradition. Rudolf Steiner was so impressed with the studies of John Wolfgang von Goethe into morphology and the metamorphosis of plants and animals, which had a deep impact on his later life and his anthroposophic architectural theories. Steiner developed a special intuitive process he termed organic structural thought to help comprehend the essence of an organic being. He never imitated natural forms, nor were his designs allegories or symbols for anything but themselves. "Man can only experience true harmony of soul where what his soul knows to be its most valuable thoughts, feelings and impulses are mirrored for his senses in the forms, colours and so on, of his surroundings" (Pearson, 2001). From this projection of bodily feelings into building forms, it follows that wee-designed buildings can exert a healing and spiritually supportive effect on both individuals and society. His two Goetheanums were a dramatic illustration of this new style of architecture that united spirit and matter with a living interaction between part and whole, the crucial link being the

metamorphosis between the small (seed) and the large(plant) whereby the new form is always, as in nature, prefigured in the previous form. In his later works, he evolved related concepts such as the "living wall", which "like an organism allows elevations and depressions to grow out of itself", and like bones, allows convex and concave double curves with torsion between them.

Another key Germanic influence was Hugo Haring. He expressed his belief that every place and task implies a form, and that it is the architect's job to discover it and let it unfold. Function, he felt, was derived from nature and life whereas expression came from the human intellect. He abhorred the trend in the 1920s, by such architects as Le Corbusier, to impose simplistic geometric forms from the outside and then justify them by their inherent beauty. Whereas a polished metal sphere may appeal to us intellectually, a flower, Haring felt, is an emotional experience and a higher order of expression. Haring's ideas had a strong influence on architects such as Alvar Aalto, Louis Kahn, and Hans Scharoun, who successfully translated Haring's concepts of organic functionalism into reality and went beyond this to develop new spatial experiences as well as forms, based on careful research into site, functional needs, and deeper social meanings.

4.1 Current Concepts—How Organic?

While strands of organic architecture (as mentioned earlier) continued to evolve, current approaches arose whose free-form products are sometimes confused with the organic tradition. Architects such as Frank O. Gehry, Peter Eisenman, Daniel Libeskind, Eric Miralles, Rem Koolhaas, Ben van Berkel, and Zaha Hadid have all set out, in their different ways, to display order, harmony, hierarchy, and orthogonal form. Although their works share some organic interests, such as the use of fractal geometry, it is driven by quite different imperatives. The contorted and fragmented forms of the buildings, full of sharp angles, dislocated spaces, and harsh, high-tech materials, all speak of a world of uncertainty and apprehension rather than one of organic holism, ecological design, and hope for humanity and the planet(Pearson, 2001).

But are these projects motivated by the spirit of organic design? Geometry and science are, once again, prime movers. The intellectual attraction of new science and the purity of geometric forms are stimulating their use for their own sake. They are being applied as design imposed from the outside

rather than organic design created, like life and nature, from within. Even fractal geometry, a deeper representation of natural relationships, is being applied externally, divorced from the internal functions of the building. The use of geometry and science, alone, does not produce organic design.

Green or sustainable architecture is evolving fast, too, but there is a danger that, instead of being the vanguard for a new, holistic architecture, it is engrossed in high-tech and energy-saving issues. Few green or sustainable architecture projects go beyond these parameters to explore the deeper world of spiritual expression and organic form where the wonder and sensual beauty of the natural world are combined with essential practical needs of economy, efficiency, and conservation. What is now desired is an architecture that expresses the union of organic inspiration and truly sustainable design.

4.2 Environmental Challenges and Design Approaches

4.2.1 Environmental Issues.

In architecture, environmental harmony was known to the Chinese, the Indians, the Greeks, and others (Hassan1986 and Pearson 2001). It produced the temples of Karnack, the great mosques of Islam, and the cathedral of Chartres in France. With the advent of the industrial revolution, the inherited techniques and perfected knowledge of creating, using handmade tools, were lost and are now forgotten. Energy-intensive mechanized tools have diminished man's personal, cellular contribution to the fabrication of objects, the building of structures, and the growing of food. The resulting economic and political disturbances are visible today. The negative consequences of the industrial revolution have disturbed the natural organization of the divine concept for humanity. Profoundly affected is the mass of the population, which is pressured to consume industrially produced goods. The result is cultural, psychological, moral, and material havoc. Yet it is this population that has an intimate knowledge of how to live in harmony with the local environment.

Interactions between people, sun, and climate can be enhanced by environmentally responsible design and development that responds to the dynamic forces of nature. The abundance of sunlight is not only good for our garden but good for ourselves. Natural daylight can enhance our feeling of well being both physiologically as well as emotionally. Through building placement, massing and solar orientation, we can use this energy for daylight in buildings as well as to heat, cool and produce

electricity. By understanding the change in sun angles over the year we can precisely control the amount of sunlight that enters a building, blocking it out in hot seasons, letting it in during the cold weather.

Rectilinear buildings are not ideal environmentally responsive buildings (Pearson, 2001). While buildings are mostly still linear, the physical laws governing the dynamics of fluids, heat, light, sound, and force are mostly non-linear. The processes of growth and decay occur, not in straight lines, but in curves and cycles. Yet we continue to design and build rectilinear straight buildings that constrain and block natural energy flows. Curvilinear buildings, on the other hand, work with nature and allow optimum shapes and forms to be developed that are more efficient, economic, and appropriate to local climate and environmental conditions.

It is well known that wind flows, for instance, are best responded to with curved aerodynamic forms that reduce “drag” as seen in the smooth curving profiles of modern cars and planes. Passive ventilation, to avoid or reduce energy- hungry air-conditioning, is also enhanced by aerodynamic shapes.

The sun moves in a semicircular path across the sky and yet most buildings are rectangular—their orientation, layout, and straight facades limiting the full benefits of natural lighting and passive solar gain. For cooler climates, however, a curving sun-facing façade, which catches the sun throughout the day and the seasons, seems the obvious solution. If feasible, it would be even better if rooms, or even entire buildings, could slowly revolve, ecologically powered, to track the sun or shade according to the climate or season.

Temperature flows also behave better in curvilinear interiors. Heat is more evenly distributed avoiding corner hot and cold spots. Heat is most efficiently conserved within a compact form, the sphere being the most efficient. Ventilation flows are more easily controlled bringing an altogether more equitable and comfortable indoor climate. In harsh climates, semi-underground earth-sheltered structures can produce zero-energy buildings—ideally suited to organic design.

The shapes and forms of internal space affect our feelings. Maybe because natural forms have many positive associations, they evoke feelings of harmony and wellbeing. Curvilinear structures and forms are said to produce different subtle energy resonances.

4.2.2 Design Approaches

Architecture must be responsive to human needs without sacrificing the needs of future generations by respecting our natural resources (Harry, 2006). Environmentally responsive design is a process of making informed choices to create healthy, comfortable buildings that are in harmony with the environment and ourselves. There are numerous design models from the past, as well as modern technological advances that enable us to build in this manner:-

(a) Environmental Sustainable Architecture: - Sustainable architecture involves a combination of values: aesthetic, environmental, social, political, and moral. It's about using one's imagination and technical knowledge to engage in a central aspect of the practice -- designing and building in harmony with our environment. The architect thinks rationally about a combination of issues including sustainability, durability, longevity, appropriate materials, and sense of place. The challenge is finding the balance between environmental considerations and economic constraints. Consideration must be given to the needs of our communities and the ecosystem that supports them.

Sam (2006) outlined the Principles of Sustainable Design to include: -

- *Understanding Place* - Sustainable design begins with an intimate understanding of place. If we are sensitive to the nuances of place, we can inhabit without destroying it. Understanding place helps determine design practices such as solar orientation of a building on the site, preservation of the natural environment, and access to public transportation.
- *Connecting with Nature* - Whether the design site is a building in the inner city or in a more natural setting, connecting with nature brings the designed environment back to life. Effective design helps inform us of our place within nature.
- *Understanding Natural Processes* - In nature there is not waste. The byproduct of one organism becomes the food for another. In other words, natural systems are made of closed loops. By working with living processes, we respect the needs of all species. Engaging processes that regenerate rather

than deplete, we become more alive. Making natural cycles and processes visible brings the designed environment back to life.

- *Understanding Environmental Impact* - Sustainable design attempts to have an understanding of the environmental impact of the design by evaluating the site, the embodied energy and toxicity of the materials, and the energy efficiency of design, materials and construction techniques. Negative environmental impact can be mitigated through use of sustainably harvested building materials and finishes, materials with low toxicity in manufacturing and installation, and recycling building materials while on the job site.
- *Embracing Co-creative Design Processes* - Sustainable designers are finding it is important to listen to every voice. Collaboration with systems consultants, engineers and other experts happens early in the design process, instead of an afterthought. Designers are also listening to the voices of local communities. Design charettes for the end user (neighbourhood residents or office employers) are becoming a standard practice.
- *Understanding People* - Sustainable design must take into consideration the wide range of cultures, races, religions and habits of the people who are going to be using and inhabiting the built environment. This requires sensitivity and empathy on the needs of the people and the community.

(b) Sustainable Construction: - Sustainable construction is defined as the creation and responsible management of a healthy built environment based on resource efficient and ecological principles. Sustainably designed buildings aim to lessen their impact on our environment through energy and resource efficiency. It includes the following principles— minimizing non-renewable resource consumption; enhancing the natural environment; and eliminating or minimizing the use of toxins

Sustainable buildings are those buildings that have minimum adverse impacts on the built and natural environment, in terms of the buildings themselves, their immediate surroundings and the broader regional and global setting. It entails building practices, which strive for integral quality (including economic, social and environmental performance) in a very broad way. Thus, the rational use of natural resources and appropriate management of the building stock will contribute to saving scarce

resources, reducing energy consumption (energy conservation), and improving environmental quality. Sustainable building involves considering the entire life cycle of buildings, taking environmental quality, functional quality and future values into account.

(c) Biophilia: - Is the study of the human response (Haruna 2006 and Mas'ud 2006) to the natural environment and the relationship between humans and natural systems, which is, in its simplest form, a sense of place. It is the innately emotional affiliation of human beings to other living organisms. Biophilic design attributes (Griffin 2006) include:-the use of dynamic and diffuse daylight; the ability to have frequent, spontaneous and repeated contact with nature throughout and between buildings; the use of local, natural materials; a connection between interior and exterior surfaces; natural ventilation; a direct physical connection to nature from interior spaces, and direct visual access to nature from interior spaces.

(d) Ecological Building: - A movement in contemporary architecture which aims at creating environmentally friendly, energy-efficient buildings and developments by effectively managing natural resources. This entails passively and actively harnessing solar energy and using materials which, in their manufacture, application, and disposal, do the least possible damage to the so-called 'free resources' water, ground, and air.

(e) Green Building: - Producing green buildings involves resolving many conflicting issues and requirements. Measures for green buildings can be divided into four areas— reducing energy in use; minimising external pollution and environmental damage; reducing embodied energy and resource depletion; and minimising internal pollution and damage to health

A green building places a high priority on health, environmental and resource conservation performance over its life-cycle. These new priorities expand and complement the classical building design concerns: economy, utility, durability, and delight. Green design emphasizes a number of new environmental, resource and occupant health concerns— reduce human exposure to noxious materials; conserve non-renewable energy and scarce materials; minimize life-cycle ecological impact of energy and materials used; use renewable energy and materials that are sustainably

harvested; protect and restore local air, water, soils, flora and fauna; and support pedestrians, bicycles, mass transit and other alternatives to fossil-fueled vehicles.

4.3 Conclusion: - Today, the technology and knowledge exists to create a building that touches the earth lightly during both construction and day-to-day operations. Taking this a step further, organic architecture embodies creating of places of great user satisfaction while respecting the web of life. Occupants of built environments don't want simply to work, play, eat, or sleep in a functional building. They want to be inspired, invigorated, comforted, and reassured by their surroundings. They want spaces that will make them more productive and healthy, and they want spaces in which they love to be—spaces that create delight when entered, pleasure when occupied, and regret when departed.

Organic Architecture describes a way of thinking about design that transcends the common everyday buildings around us; that is, it describes environmental concerns, embodies the human spirit, and transcending the mere act of shelter into something which shapes and enhances our lives. It promotes harmony between man and nature through design so well integrated with its site that building, furnishings, and surroundings become part of a unified interrelated composition. We have to come full circle to consider the future of organic architecture and design as proposed by David Pearson (2001) that organic design should—(i) Be inspired by nature and be sustainable, healthy, conserving, and diverse; (ii) Unfold, like an organism, from the seed within; (iii) Exist in the "continuous present" and "begin again and again"; (iv) Follow the flows and be flexible and adaptable; (v) Satisfy social, physical, and spiritual needs; (vi) "Grow out of the site" and be unique; (vii) Celebrate the spirit of youth, play and surprise; (viii) Express the rhythm of music and the power of dance.

The use of geometry and science, alone, does not produce organic design. Organic principles explore the deeper world of spiritual expression and organic form where the wonder and sensual beauty of the natural world are combined with essential practical needs of economy, efficiency, and conservation. Organic architecture is rooted in a passion for life, nature, and natural forms, and is full of the vitality of the natural world with its biological forms and processes.

4.4 Recommendations:- As science sees further into the microscopic world of matter and uncovers more about the remarkable structures of living things, nature continues to surprise us and teach us how we might build more cleverly, economically, subtly and ecologically. Towards meeting stringent environmental issues in this millennium, architects have to step up efforts at collaborating with chemists, biologists, ecologists, and psychologists to learn Mother Nature's secrets and apply them to our own mortal designs. They have to become more adept at applying technologies that deplete fewer precious resources, generate less toxicity, and threaten fewer habitats with combination of Nature –whose designs are inherently efficient, effective, and beautiful, thereby offering us models of abundant, healthy production.

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