Form, Function and Structure studies in Nature and Architecture

Design Research Seminar

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Submitted in partial fulfillment of the requirements

of the degree of

Master of Design

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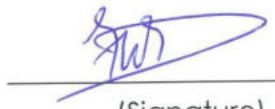
Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.



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Approval sheet

This Design Research Seminar entitled "Form, Function and Structure studies in Nature and Architecture" by Tu'umay Allene, Roll Number 126132002, is approved in partial fulfillment for the degree of Master of design in product design at Industrial Design Center, (IDC) Indian Institute of Technology, Bombay.

Project Guide _____

(Prof. Ravi Hazra)

Date 5 June 14

Place IDC, IIT-B.

Acknowledgement

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Secondly I would also like to thank my classmates who helped me a lot in finalizing this project within the given time frame. It also gives me great pleasure to thank especially Tareke Tekia, PHD student in mechanical engineering at IIT B and all Ethiopian students in IIT Bombay for their support and help in different phases of the project.

Last but not least, I would like to Appreciate Indian and Ethiopian governments who gave me this great chance to study in IITB . I should also appreciate the long last relation among the two countries.

Contents

I. Preface

Form and function are two argumentative principles of design. Structure is the mediator to survive form as its organic shape and function to fulfill its ultimate purpose. Architecture gives them a spatial order to do their utopia. Nature is a universal donor for form, function, structure and architecture.

'Form, Function and Structural Studies in Nature and Architecture' have been chosen as a design research seminar for two reasons.

1. My curiosity in this topic is result of the realization that in nature everything in nature is functional to the extent that everything is efficient, optimum and elegant.
2. I believe that Architecture is quality of life, if we feel it. We live with nature and it gives us a clue to solve design problems when we feel it. Shelter is one of the basic needs for human being but doing a shelter may not be architecture. Architecture is needed to create things beyond the need. Thus, Architecture learns much from nature to acquire design solutions.

This report, design research seminar will give some insights on how those basic design elements of good design in Architecture, "Form, Function and Structure" works in architecture inspired from nature.

II. Scope of the project

The scope of this project is to manifest how **FORM, FUNCTION** and **STRUCTURE** work in architecture and nature. This helps in the field of architecture and design to show how things are copied from nature and applied to solve design problems. It also gives a clear understanding on how designers, Architects and engineers are inspired by nature to solving design problems with innovative ideas and solutions.

This project proves that nature is material provider, and very thing in nature has made for purpose. Great design solutions have inspired from nature directly or indirectly.

Nature provides material, architecture gives clear meaning (language) aesthetically, functionally and the structure of it. Thus, Architecture plays a great role in functional and structural of an object related to nature by using a process called design in order to achieve the final goal.

This project achieves it goal by relating man-made things with nature and how architects, designers and engineers use those elements from nature and process it to give a meaning. This could be achieved by mimicking nature and make them functional to give a solution of a given problem in human need.

III. Introduction

The essence of architecture is articulation of spaces to serve specific functions in a specific

way. Form is the result of how the physical elements such as walls, floors, roof etc are articulated through construction and material with the help of structural system. This manifests in the form which also articulate the meaning.

The **FUNCTION** here also includes aesthetic function. A building must look interesting and convey a meaning. Ever since man set his foot on the planet he has been encountering nature. **NATURE** in this context is all the phenomena and products of nature animate, inanimate as well as phenomenon such as climate, wind, sunlight, rain, storm etc this encounters has taught man. Through analogies from nature, man's problem can be solved optimally.

Architects study art, science, and religion in order to understand the basic workings of nature, and then applied what they learned to solve the problems of the day. Over time, the quantity and complexity of accumulated knowledge led to increased specialization among Architects, and breadth of knowledge has increasingly traded for depth of knowledge. This trend continues today.

An Architect interested in learning about other areas of specialization like biology, art science, agriculture, mathematics, physics and so on in order to have clear knowledge how to solve problems of the current day. In short 'Architecture is something about everything'. This implies Architects would have to study the following challenges.

1. Contexts from many different disciplines and determine the contexts in each discipline

2. Specialization on the terminologies of the contexts of the disciplines.

These all needs effort and extended beyond the brief and excursions into unfamiliar areas to research specific problems.

The aim of this study is

1. To understand the relation between nature and architecture as well as the architecture with other man made physical elements.

2. Understand how architects are inspired by nature to solve design problems creatively.

3. Study the thought on future trends in Architectural design

In general the study on form, function and structure in architecture is the fundamental purpose. Establishing such principles increase the probability that design Would be successful and increase the cross-disciplinary knowledge with nature as material provider.

1. Learn from nature

As we are surrounded by nature, it is a bit easy to observe and adopt things happening in nature. Since pre historic times, nature has inspired human beings to adopt many thing by coping nature. Our great parents have started building mud house by observing MUD Architecture of insects and waving of cloths is inspired after looking at phenomenal waving experts from nature waving birds.

Ancient Egyptian settlement was inspired by the directional flow of Blue Nile. Nile flows from Ethiopian highlands to the north through Egypt to Mediterranean Sea and the sun rising from east and setting in to the west. These bearings are represented in to hieroglyph (symbol) for the world. The Artificial Mountains (Pyramids) are constructed parallel to the river Nile and the settlement of the people starts along the river basin.

From this we can understand how planning and architecture were employed to complete and articulate the natural structure of the country. In this Egypt's simple geographical structure provide for symbolizing basic external meaning in the physical environment. ((Schulz 1980)

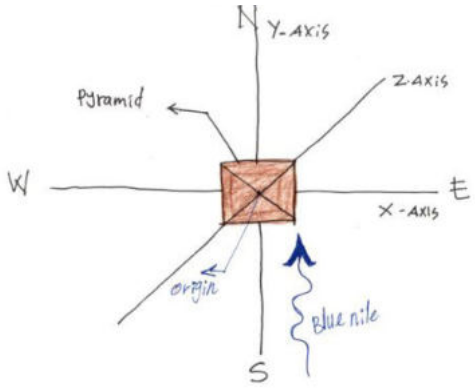
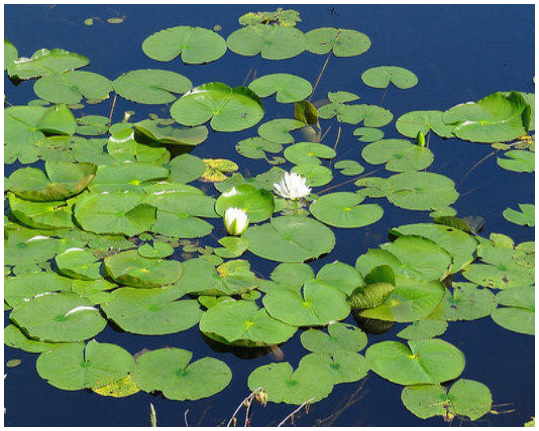


Figure 1 Flow direction of Blue Nile and Egyptian pyramid

There are many classic examples represented in architectural applications like "Upturned leaf of royal water lily, showing the conspicuous ribbed veins that inspired the design of crystal palace which was built in London during 1859 for first industrial exhibition.

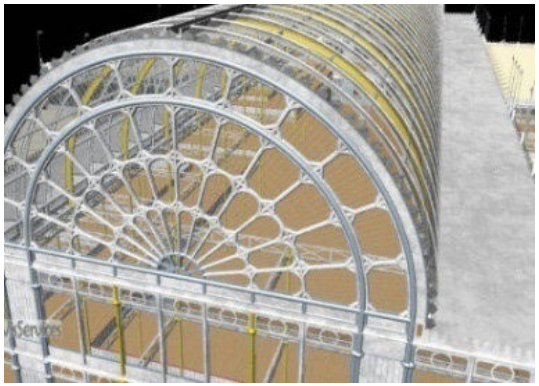
Another similar example is the Eiffel tower of Paris based on the structural details of human femur bone.



A

B

Royal water lily (A and B) (austinbotany.wordpress.com, 2/5/ 2014)



C. Royal water lily (austinbotany.wordpress.com, 2/5/ 2014)

Figure 2 Window Frame inspired from natural water lily

In general we can learn from nature in three ways. These are Bionic, Biomimicry and Phenomena.

1.1 Bionic (functional/mechanical factors)

The word bionic was coined by Jack E. Steele in 1958, possibly originating from the technical term 'bion' (pronounced bee-on) from Ancient Greek: meaning 'unit of life' and the suffix '-ic' meaning 'like' or 'in the manner of', hence 'like life'. Some scholars, however, explain bionic as being formed as a portmanteau (combination) from biology + electronics. Boinic deals with technological conversation of the working principle of construction, processing, development and growth found in living things of nature.

In short bionic is the study and the construction of systems that function like (parts of) living beings. The study of functions, characteristics and phenomena Introduction to Bionics observed in the living beings, in order to apply such knowledge in the conception of new techniques and in the creation of new devices and machines.

Bionic means the use of biological prototypes for the design of man-made system.

After bionic principle in nature are studied, these principles are applied to solve architectural design problems. In bionic bedroom house is a bedroom, living room - living room, kitchen - the kitchen. (By Anzhela Zakharchuk n.d.)

Today bionic is concerned not so much with the form of parts of the shape of things but rather with the possibilities of examines how nature makes things happen, the interrelation of parts, and the existence of system.

An interesting example of natural phenomena applied to bionic concept is how bats find their way in the dark through an echo location method. Bats emit a high pitched sound that bounced off objects in their path, is picked up by their sensitive ear and thus established an unencumbered flight path for them. Much as same principle is used in radar and sonar.

Sonar used audible sound wave and radar uses ultra high frequency waves.

Another similar bionic example is how dolphin uses a radar and sonar like navigational system that does not depend on hearing. In common in Wales, it rip-

ples its external skin surface utilizing the effects for navigation and increase swimming speed. (Hudson 2009)

The basic structural arrangements, functional system and mechanisms for body movements and transmission of signals can be used as clues for evolving artificial system.

Bionic approach restricts itself in finding solutions based on principles found in plants and animals. Those metaphorical activity draws inspiration from vast pool of adoptive devices and mechanisms used by animal and insects as a mean of protection, communication, transportation etc. Interestingly whatever we see around us today is, time tested by nature from millions of years and more than ten millions species are awaiting your attentions to be used as metaphors in problem solving.

Cybernetics is another specialized area of bionic. It deals with communication and control systems of living organism involving self organizing –sensors – neurons. The resulting systems invariably display the typical characteristic of living things, such as self-adaptation, self learning and self correction of mistakes. This approach can lead to design and development of mechanics, vehicles and control system having greater reliabilities, sensitivities, strength and speed with minimal size, weight and power input required, performing the designated task in varied environmental conditions.

Examples of bionic architecture

1. The columns of Gothic sacral architecture which inspires from stretched umbrella plant structure, and their capitals decorated with specific plants: the umbrella itself is derived from mushroom. This shows how nature transforms to give some solutions and /or design ideas.

A. Magic-mushroom (www.usa-today.com, 19/12/2013)

B. Umbrella (real-self-defense.com,19/12/20 13)

C. Eur-erco-catedral (www.erco.com, 19/12/2013)
Figure 3 Bionic from mushroom to umbrella and building structure

2. Organic architecture is another best example of bionic how Frank Lloyd Wright create harmony combining architecture and nature on his famous bionic building named Falling water in Pennsylvania which is placed almost on the edge of waterfall. He relates nature and architecture as one. The building looks part of the nature (like as nature). The carpet/Rug on the floor of the leaving room looks natural.

A. Exterior of Fallingwater ...

B. Interior of Fallingwater
Figure 4 Fallingwater (pittsburgh.about.com(A and B), 19/12/2013)

3. Guggenheim museum in New York by Frank Lloyd Wright is also bionical creation which inspired from snails form and associates with natural organic forms.

A. Source (powertrip-berkeley.com, 19/12/2013)

B. Snail (www.snail-world.com, 19/12/2013)
Figure 5 Guggenheim-museum New-York and snail shell

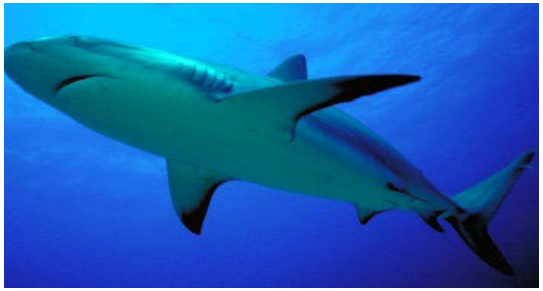
4. Air plane is designed to fly as bird or to floats as a fish. This example can also use as simile. But airplane's character is more similar to the flying bird or float-

ing gray-fish. In here the character is applied on the design. So it is more metaphoric design solution.

A. Bird (www.wall-save.com, 16/12/2013)

B. Airplanes (www.wall-ng.com, 25/12/ 2013)

C. Flying bird (Source unknown)



D.Caribbean Reef Shark (www.jigzone.com, accessed on 25/12/2013)

E. Airplanes (www.wallng.com, 25/12/2013)

Figure 6 Metaphor in industrial design in designing airplanes

5. The wings of many large – winged insects such as butterflies and many plant surfaces remain dirt free without chemical detergents, simply by their complex surfaces topography that interacts with the physical of water molecules. The lotus plant is a symbol of cleanliness and purity in some Eastern religions, which makes sense considering that the plant essentially cleans itself. Lotusan exterior coating uses the same micro structural principles to regain its cleanliness automatically after the mere rinse of rain shower.

A.Lotus leaf (www.paintpro.ne/ Articles. 2/5/2014)

B. Lotusan exterior (www.ps-mag.com, 2/5/2014)

Figure 7 The Sto Corporation's self cleaning lotusan exterior paint uses the paint's micro-structural qualities.

A.Butterfly, www.imgion.com, 2.5.2014

B. Chromaflair (www.pinterest.com, 2/5/2014)

Figure 8 Chromaflair pigment-free auto paint inspired by butterfly wing scales that doesn't fade and comes in

1.2 Biomimicry

The terms biomimicry and biomimetics come from the Greek words "bios" meaning life, and "mimesis" meaning to imitate. So "Biomimicry" is a design tool based on emulating the strategies used by living things.

Biomimicry is not a new idea but humans have been looking at nature for answers to both complex and simple problems throughout existence. Many Architects, designers and engineers use nature for the purpose of solving complex human problems.

Nature has solved many of today's engineering problems. Over the last 3.8 billion years, nature has gone through a process of trial and error to refine the living organisms, processes, and materials on Earth. The emerging field of biomimetics has given rise to new technologies created from biologically inspired engineering at both the macro scale and nano-scale levels.

An American natural sciences writer, innovation consultant, and author Janine M. Benyus elaborates Biomimicry (innovation inspired by nature) study in an approach how nature helps in solving human problems by mimicking and/or inspired in it. According to her study "in Biomimcry – innovation inspired by nature" Janine M. Benyus dis-

cussed how nature tried and tested processes for 3.8 billion years can be used to develop man made system. (Benyus 1997)

A. Nature as model: - Here nature is the model and then imitate, get inspiration and process it to solve human problem. As you can see in figure 9. Urbanization and forestation have similar characters in some ways. Both urban development and forestation follow river basin.

Ancient development of urbanization in an Egyptian (river Nile) and Mesopotamia (rivers Tigris and Euphrates) was settled in same way.

Urbanization is forestation of buildings. Buildings are ground up like trees vertically growing and horizontally expanded.

Forestation is a place for wild animals and urban area is for human

Forestation is natural but urbanization is man made. We can understand that nature is a model to man in such a way that people can live together in particular area like we call it now as city/town.

A. Amazon forestation

B. New York city(www.neponline.org, 18/12/13)

Figure 9 Urbanization and forestation

B. Nature as measure: - this is an ecological stand to judge "rightness" of the innovation. How life has sustained on earth for the past 3.85 billion years: what works what suitable and lasts.

Plants make their food (Glucose) out of carbon dioxide (CO_2) with the help of sun light in their chlorophyll through the process called photosynthesis. And human beings used this sun light (heat energy)as source of energy using thermal collector. This is how human uses nature as measure with the character of the plant in making their foods. And human used this solar energy to cook food.

A. Leaf (hqworld.net,15/12/13)

B. Solar panel (www.greennet-blog.com, 15/12/13)
Figure 10 Mimicing leave to solar system

C. Nature as mentor: - "Biomimicry is a new way of viewing and valuing nature, based not on what we can extract from the natural world, but on what we can learn from it.

A. High scraper buildings (www.artflakes.com, 18/12/2013)

B. Trees (www.shutterstock.com 18/12/13)
Figure 11 Skyscraper with trees

Janine M. Benyus has raised three questions in her talk on talk TED talk in July 2009. (ted-talks) These are;

- How does life make things?
- How does life make the most of things?
- How does life make 'Things' disappear in systems?

Those are basic questions which needs profound researches in the field of biology.

1.2.1 Biomimicry approaches

Micheal Paqlyn , on the back cover of his book called "biomimicry in Architecture" wrote his thought and importance of biomimicry that " between now and 2050, Biomimicry is going to be one of the main tool that will facilitate the transition from the industrial age to the ecological age of mankind." (Pawlyn 2011). According to Janine M. Benyus, there are six approaches of biomimicry

A. Interpretation: - Understanding of the principles and working of nature and employing

B. Simulation: - Feigning (copying an approach from nature

C. Emulation (Advanced biomimicry):- Modeling natural process to the degree of self assembly and self repairing

D. Replication (elementary biomimicry):- Can you imagine a seed what kind of flower does it gives?

E. Replication: - it is not by coping or interpreting specific

solution, such as form, geometry, structure, function but by approaching it as a cohesive whole (attains the integrated functionality absorbing in nature.

F. Integration: - Tectonic derived formation in nature along with efficient system ((Ramaswamy 2007)

Designers, Architects and Engineers use biomimicry stimulated by nature to solve problems coping nature and natural elements and apply to a particular problem in creative way by:

1) Imitating their models, or
2) Valorizing their knowledge, or
3) Changing the paradigm of just extracting (by learning from nature or by doing the things in the way that nature does).

1.2.2 Nature as a design solution

Biomimicry, innovation Inspiration by nature, gives an idea to solve a design problem. Inspired by nature to solve design problem is a technique to apply either the idea of nature as a concept, metaphor, symbolism or smile.

A. Concepts

Concepts are ideas identified by the designer as a foundation for giving form to space, building and /or site.

Concepts are drawn from variety of sources the designer is an important source of ideas and act as interpret throughout the gestation of a design.

The main source of concepts is the society. This may be the way of living life, use of equipments, culture, history, weather…)

Samples for conceptual design:

Hotel: - Recreation, resting (rehabilitation), happy, relaxation, specialty/VIP, buying special things for special person

City center: - Active movement, view toward streets, flow, noise,

Hospital: - Helping, treating, saving, life, In metaphysics, and especially ontology, a concept is a fundamental category of existence. In contemporary philosophy, there are at least three prevailing ways to understand what a concept is? Those are:

A. **Concepts as mental representations:** - where concepts are entities that exist in the brain.

B. **Concepts as abilities:** - where concepts are abilities peculiar to cognitive agents.

C. **Concepts as abstract objects: -** where objects are the constituents of propositions that mediate between thought, language, and referents. (yourdictionaty)

B. Metaphor

The prominent Greek philosopher Aristotle defined metaphor as: 'the act of giving a thing a name that belongs to something else."A metaphor is a figure of speech/meaning that describes a subject by asserting that it is, on some point of comparison, the same as another otherwise unrelated object. Metaphor is

a type of analogy and is closely related to other rhetorical figures of speech that achieve their effects via association, comparison or resemblance including allegory, hyperbole, and simile. In simpler terms, a metaphor compares two objects/things without using the words "like" or "as". Metaphors are supposed to paint a vivid picture, or become a profound statement or saying.

A common definition of a metaphor can be described as a comparison that shows how two things that are not alike in most ways are similar in another important way. The term metaphor is also used for the following terms that are not a part of rhetoric:

A .Cognitive metaphor is the association of object to an experience outside the object's environment

B. Conceptual metaphor is an underlying association that is systematic in both language and thought.

C. Root metaphor is the underlying world-view that shapes an individual's understanding of a situation

D. Nonlinguistic metaphor is an association between two nonlinguistic realms of experience

E. Visual metaphor uses an image to create the link between different ideas. Metaphors can also be implied and extended throughout pieces of literature.

Designers, Architects and engineers can apply their concept of design in designing with Metaphors using the function of sense organs (Michael Hendrix)

Figure 12 Metaphor and sense organs

The beehive metaphor by Spanish Architect, Antoni Gaudí who belonged to the Catalan/vernacular Modernism and a Swiss French Architect, Le Corbusier belong to modern architecture inspired by beehives and used in their designs as a metaphor. Those Architects have explained their inspiring in different ways as in the Table 1 below.

Table 1Different vision of beehive by Antoni Gaudí and Le Corbusier

	Antoni Gaudí	Le Corbusier
Different vision of beehives	Anarchic	Formal
	Traditional	Modernist
	"There are no straight lines or sharp corners in nature. Therefore, buildings must have no straight lines or sharp corners."	Box-shaped forms of the modern apiary.
	Most famous architectural invention was the parabolic arch,	'The house is a machine for living in´
	Same as that made by the bees when they build a natural honeycomb	He was excited about the beehive of its cleanliness and efficiency,

C. Simile

A simile is a rhetorical figure expressing comparison or likeness that directly compares two things. It is highlights the similarities between two concepts, ideas, people, things and entities to describe something. When you say, 'Dead as a dodo' or 'loud like a trumpet', This is actually making use of the figure of speech, and we refer to as a simile. Through our imaginative powers and the rare gift of the human intellect to identify similarities between different patterns, similarities and therefore similes, naturally arise. The following words are using to describe/ connect objects in simile such as 'as', 'like', 'such as', 'so' and 'than' and verbs like resembles to connect with the concept. (metaphor-examples.html n.d.)

In Architecture we can copy elements from nature. But those elements are not similar or we can transform them in to our function, form and/or regardless of our individual thinking, but still the element is like the natural object. This is simile (coping elements from nature).

Note that: -

'Simile' is very close to 'Metaphor'. The prime difference between a Simile and a Metaphor is that, while Simile compares the similarities between two entities and Metaphor is as to equate two similar ideas. Simile uses the physical appearance of the object while metaphor uses the behavioral/abstract entities of an object.

In the sentence 'He was like a lion in the field' is an example of a simile, but the same sentence

when composed as 'He was a lion in the field' becomes a metaphor.

Examples:

A. Lotus Temple, located in New Delhi, India, also called "Bahai Temple" or the Bahai House of worship, designed by an Iranian-American "Bahá'í" architect, Fairborn Sahba, is an important landmark in the city of Delhi. This place of worship of the Bahai sect is literally constructed in the shape of a large, white lotus flower. An architectural feat in itself, this beautiful temple is flocked by people from all religions, a living example of the openness and equality promoted by Bahai laws. (ixigo.com n.d.)

A. Lotus Temple (sketchfab.com, 18/3/2014)

B. Lotus flower (www.wallpea.com, 18/3/2014)

Figure 13 lotus temple and lotus flower

B. Finger print office building in Thailand which is directly mimicked from finger print.

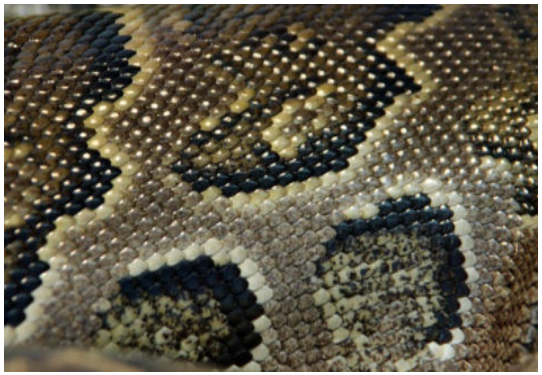
A. Larson-jewelers-finger-print-engraving-ring

B. Finger print office building Thailand (www.architectweekly.Com, 24/12/2013)

Figure 14 Finger print office building Vs finger print

C. The Vitra head Quarters

In Basel, Switzerland, and the Guggenheim museum in Bilbao, Spain, by Canadian-American Architect, Frank Owen Gehry, shows that the skin of snake which is clearly the complexity, self similarity and analogy with the nature is fascinating.



A. Snake skin (www.torange.us Invoice,18/3/2014)

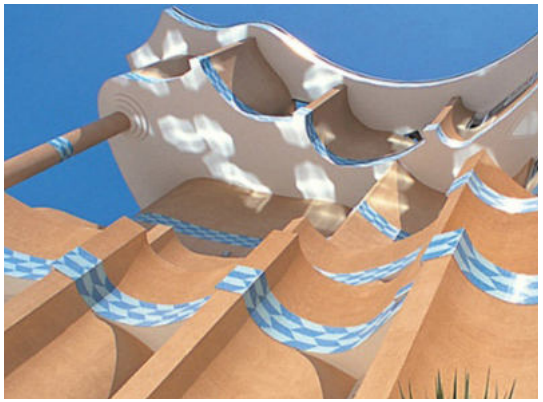
B. Guggenheim Museum(wikimedia.org,13/3/14)

C. Vitra-Headquarters (wherewedesign.com, 8/3/2014)

Figure 15 Frank O. Gehry self similarity to realize the skin of snake

D. Paolo Portogesi, Italian Architect, inspired by the chaotic movements connected to the gas liquid motion, has released in the hotel Savoia, Italy that contains the smoothed surface inspired by the wave motion as a metaphor of the sea,

A . Wave of the sea (physics.ucsd.edu,13/3/2014)



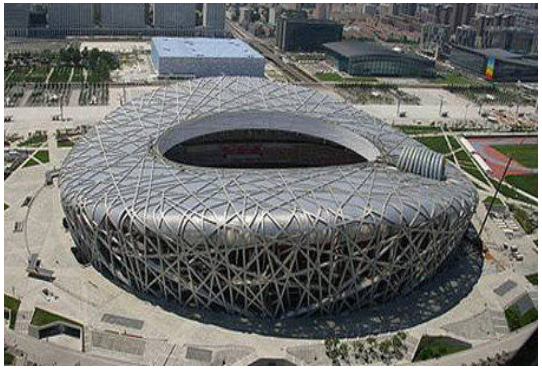
B.Hotel Savoia, Italy (www.gecos-spa.it, 13/3/2014)

Figure 16 sea wave and Savoia Hotel

E. Bird's Nest stadium, In Beijing, China, designed by Swiss architects Jacques Herzog and Pierre de Meuron and Chinese architect Li Xinggang and the others, is situated in Olympic Green Village, "Chaoyang" District. It was designed as the main stadium of 2008 Beijing Olympic Games. The Olympic events of track and field, football, gave lock; weight throw and discus were held there. Since October, 2008, after the Olympics ended, it has been opened as a tourist attraction. (travelchinaguide.com, n.d.). As its name indicat-

ed the stadium was designed like as birds nest as shown in the figure17.

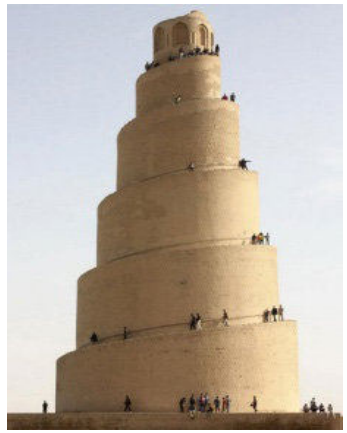
A . Bird's nest (www.back-yardchirper.com, 23/3/2014)



B. The bird's nest stadium in Beijing (www.standard.co.uk, 8/2/2014)

Figure 17 Bird's nest as simile

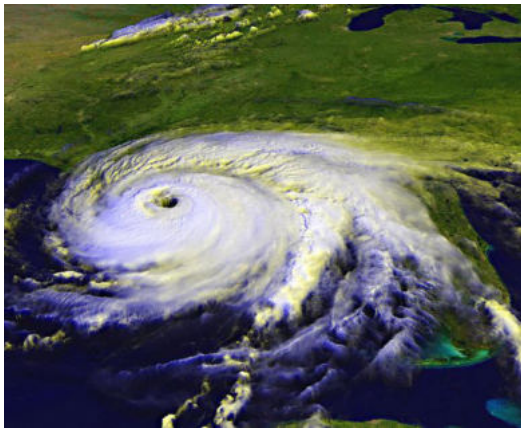
F. Spiraling up from the ground, the remaining minaret of the Great Mosque of Samarra is the most prominent of the remaining structures of a mosque that was once the largest in the world. It also Known as the "malwiya" or the snail shell minaret, this 180 foot tower was the main focal point of the mosque, that covered 42 acres at its peak. In the mid-9th century, the great work was commissioned by the Abbasid caliph Al-Mutawakkil who allegedly rode a white donkey up the spiraling paths to the top. (Great-mosque-of-samarra n.d.)This minaret has the Fibonacci spiral proportion sequence such as hurricane, galaxy, and snail shall and the climb trees' leave like ivy.



A . Minaret at the Great Mosque of Samarra (donaldsweblog. blogspot.com, 23/3/2014)

B. climb tree (www.ru-dyrucker.com, 23/3/2014)

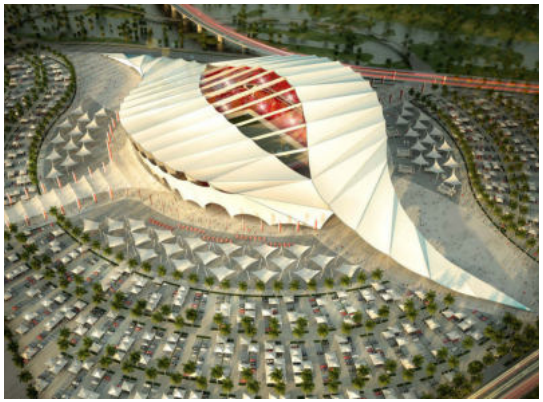
C. NASA spiral galaxy (ww.nasa.gov, 23/3/2014)



D. Hurricane-ivan, environment (nationalgeographic.com, 23/4/2014)

Figure 18 Minaret at the Great Mosque of Samarra

G. The Al-Khor Stadium in Al Khor, Qatar, will take on an asymmetrical seashell motif, providing covered seating for all spectators. Connected to a number of transportation systems, the on-site parking will be able to hold 6,000 cars, 350 buses and the coming and going of 150 public buses/shuttles, as well as 1,000 taxis and water taxis.



A. Al-Khor-Stadium (www. qatar.to, 21/5/2014)

B. Seashell (imgarcade.com, 21/5/ 2014)

Figure 19 Al-Khor-Stadium with seashell

D. Symbolism

Each major building has characteristics symbolic concepts that can be associated with potential forms.

Example: An air port may evoke words like movement, travel, speed and technology. Library may bring words to mind like teaching learning wisdom, knowledge, security and information. This can be applied by listing all the symbolic adjectives, nouns, and images identified by the client and the designer/architect bearing on the project. It is also possible to choose any number of symbols to use in the search for translation to form.

Example: - if the design problem is to design a library, the architect can use a honey comb as a symbol. Since the form in honey comb is hexagonal the designer defines the concept of honey with library as follow in the table.

Table 2 Sample of symbols how to apply conceptual design.

Library	Honey-comb
Source of knowledge	Resembling of good test (sweet)
Reading and read-ing	Working and work-ing
Silence, grace	King, grace
Library has bass	Bees have king
Students/ people went to library to collect books, knowledge	Bees went somewhere to find the nectar and pollen (the important ingredient to make honey)
Design look like hexag-onal	Final shape of honey is hexagonal in nature

1. 3 Phenomena

Nature Observatory is a place to feel and experience nature. Wind, water, sound, swaying tree tops, aurora borealis, midnight sun and scents of the forest are among many others the natural phenomena's we can feel through this architecture.

We all have the necessity to "find our secret spot". Longing for nature is common in today's high speed society when the city residents are looking for calmness. It's not only the calmness in nature we want to experience but also the phenomena's it has to offer.

I have created a space next to nature, in harmony with it. It is a space that invites visitors to experience the sites natural topography. A building with blurred boundaries between nature and architecture, between inside and outside. All year round with all the different seasons a place next to the Arctic Circle has to offer. Frosty Winter, Crusted Snow, Ice Break-up, Midnight sun, Harvest, Colorful Autumn, the First Snowfall. (Malmström n.d.)

2. Elements of physical expression in Architecture

Architecture

The word Architecture is derived from Greek word "Arkhitekton" which is a composite of two words "Arkhi" to mean "chief" and "Tekton" which means "builder, carpenter, and mason"

Some scholars also defined Architecture as combination of two words "Arch" concave construction of stones or other building material and "Tecture" is the technique for providing support to arch to transfer incumbent weight of the arch.

Architecture as Building design can also be define as the ART and SCIENCE of designing and constructing. It is the style or fashion of buildings, especially one that refers typical period of history or a particular time.

So Architecture is the art and science of designing and con-

structing buildings and other structure for human use and shelter which reflects style (aesthetic) and functional aspects in highest quality of design. It is a passion, vocation, as well as a science and a business.

The great American Architect, Frank Lloyd Wright who develops organic architecture says about Architecture by asking question "What is architecture anyway? Is it the vast collection of the various buildings which have been built to please the varying taste of the various lords of mankind? I think not. "No, I know that architecture is life; or at least it is life itself taking form and therefore it is the truest record of life as it was lived in the world yesterday, as it is lived today or ever will be lived. So architecture I know to be a Great Spirit...." According Frank Lloyd Wright "Architecture is a great living creative spirit which from generation to generation, from age to age, proceeds, persists, creates, according to the nature of man, and his circumstances as they change. (architecture)

Bernard Rudofsky an Moravian-born American writer, architect, collector, teacher, designer, and social historian, Searched vernacular architecture ('Architecture without Architects') he attempts to break down our limited idea of this field and briefly introduce the reader to the vast and wise world of ' non pedigreed architecture '(vernacular, indigenous, and often anonymous). The lessons taught in this world are highly useful to mankind, especially relating to the environmental crisis the world now faces.

Chirstian Noberg- Schultz states written on the preface of his book called "Meaning in western architecture" tells that Architecture something is more than practical need and economy, it concerned with existential meaning. Those meanings are derived from nature, human and spatial phenomena and are experienced. Architecture changes those meanings to spatial form (place, path and domain). (christian Norberg-Schuil 1974)

In general Architecture deals with existential meaning of elements to make interning and meaningful. Those elements which Architecture deals with are function (space), form, texture, color (light) and structure which is the back bone of all the elements.

2.1 Form

In Art, design and Architecture we often used the term **"FORM"** to denote structure of work, the manner of arranging and coordinating elements and parts of composition so as to produce a coherent image. From suggests referring mainly in design and architecture to both internal structure, external outline and the principle that give unity to a whole. We see and record form

because of the color. It is just as we perceive taste when we eat, our taste buds sense four attributes: sweet, salty, sour and bitter. Similarly, when we look at a scene, our visual nerves register color in terms of the attributes of color: the amount of green-or-red; the amount of blue-or-yellow; and the brightness. (Color vision Art n.d.). Color is the most memorable of all design elements. It can morph or mutate from one light source to another. In day light you are awash in color displaying variation of the hue (the color itself), saturation (intensity), and value (lightness of tint or darkness of shade). One of the ways we most commonly see colors is through pigment or a color changed by wavelength- selective absorption, such as freckled skin or the printed image. Color can also be visualized in ways beside pigment: structurally (butterfly wings, soap bubbles, iridescent feathers), dyes and stains (bodily fluids such as squid ink or blood), chemically induced bioluminescence (fireflies, marine animals such as jellyfish), as suspended particles (silt in water that creates different hues), and transparency (found in deep water animals). Color signal may different thing in nature, including, warming, receptivity, mimicry, camouflage, and transparency (which mimics its source of clear light at ocean depth where color is less relevant). (Macnab 2012)

According to Mitchell Beazely, on his book called "COLORS" stated that color influences mood and feeling and make things cold or warm, provocative or sympathetic, exciting or tranquil and in general color enriches the world and our perception to it. ((Beazley 1980)

There is confusion between **Form and Shape**. Form includes a sense of three dimensional, massive or volume and shape refers more specifically to the essential aspects of form that gives its appearance. Form is one of the elements of visual perception because of the color. It has visual proportion of size, color, texture and has relational properties which govern the pattern and composition of elements position, orientation, and visual inertia. (Ching 1996)

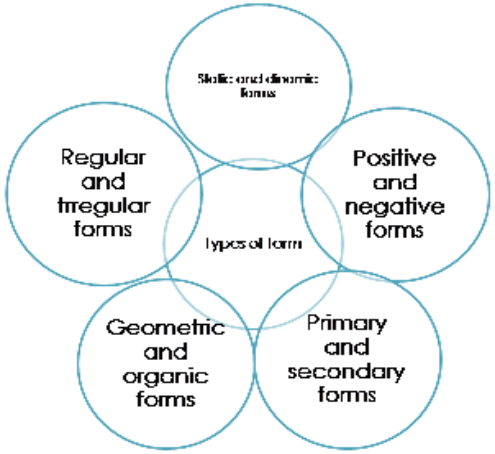


Figure 20 Types of forms

A Spanish Architect Antoni Gaudí who belonged to the Modernism (Art Nouveau) movement and was famous for his unique style and highly individualistic designs. His designs are remarkable for their

range of form, texture and polychrome for the free expressive way in which these elements of his art seem to be composed. The complex geometries of Goudi's design are coincided with its architectural structure that the whole, including its surface, gives the appearance of being a natural object in complete conformity with nature's laws. (britannica)

The combination of original design, interesting shaped stonework, and vibrant colors in Gaudí's work give the viewer a truly breathtaking visual experience.

Another example of Gaudi's work is Casa Josep Batlló, which is shown in figure 21. The shape of the building was made using concrete which looks like a rocky and inorganic form as structural elements that gives hardness, strangeness and stability of the form and the building as a whole.

A

B

Figure 21 Casa Josep Batlló by Gaudi, Spain(www.travelling-daddy.com/barcelona-designed-by-antonia-gaudi , 21/12/ 2013)

2.2 Function

Function is the principle that architects should follow to design a building based on the purpose of that building. In art and architecture, an aesthetic doctrine developed in the early 20th century. Out of Louis Henry Sullivan's aphorism that form ever follows function. Functionalist architects and artists design utilitarian structures in which the interior program dictates the outward form, without regard to such traditional devices as axial symmetry and classical proportions. After World War I, the German Bauhaus produced a number of influential architects and designers, notably Walter Gropius and Ludwig Mies van der Rohe, who worked within this aesthetic. (Press, The Columbia Electronic Encyclopedia 2012)

Mies van der Rohe, Ludwig, German-American architect and a pioneer of modern architecture,is one of the most influential figures. He is famous for his minimalist architectural dictum "less is more." In Germany, another German-American architect,

Gropius Walter, who is one of the leaders of modern functional architecture in Germany his Fagus factory buildings (1910–11) at Alfeld, with their glass walls, metal spandrels, and discerning use of purely industrial features, were among the most advanced works in Europe. (Press, The Columbia Electronic Encyclopedia, 6th ed. 2012)

Figure 22 Fagus shoe factory, sample of modern functional architectural building in Germany Fagus shoe factory (www.dieselpunks.org, 21/3 /2014)

Man uses stone, wood, and concrete to construct a building and these materials given from nature are called construction materials. Suddenly those materials used creatively and looking good. Someone may get them beautiful and touch his/her heart because of that. This process is design/Architecture/art which makes it beautiful. But those all things have been made for some purpose, it may be house for living in or something for protection from man made and natural disasters. From this we have three things to relate. These are **Function, Construction** and **Architecture**. As you can see in the chart those three things are core elements to erect a structure. But the structure has to be erected because of some purpose. That is need which follows by function then evaluation of the need. Need needs a process, in this case construction. Construction can be learnt from nature applied in the nature or in a processed manner. Those processes are languages or meanings of how the entire process works and function well. This process is architecture.

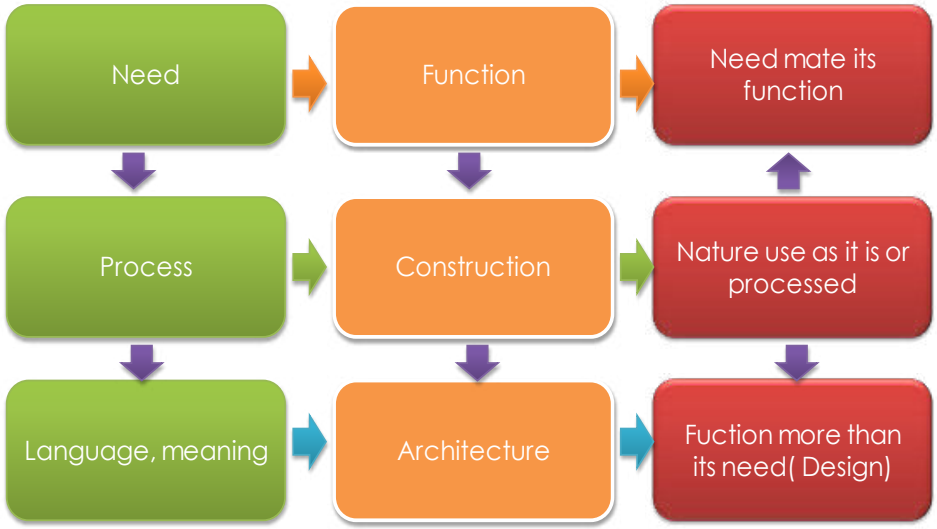


Figure 23 functional processing in Architecture

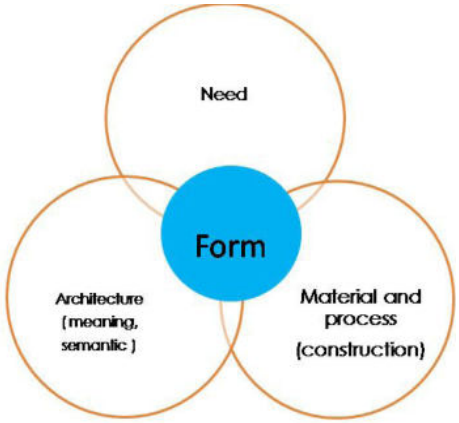


Figure 24 Process from need to form

Everything in nature is made based on its function aspect and it plays a great role in giving different materials to man. Man may use those materials directly and/or after being processed to solve his problems.

Humans and all their associated artifacts are an immutable fact in nature. On our current consumptive trajectory, we are on a collision course with the environment. If we accept the definition of sustainability as "the triple bottom line" (i.e., the three E's of "economy, ecology, equity" OR the three P's of "people, planet, profit"), at its practical root, sustainable *architecture* is about how we come to terms with our place in nature. We might also overlay onto our sustainability definition the Vitruvian Virtues of Architecture (components of Architectural values)by Maxims Vitruvius' "Utilitas (Function, commodity, utility), Firmitas (solidity, materiality) and Venustas(Beauty, delight, desire)" to remind ourselves of the timelessness and applicability of these lessons). Faced with increasingly diminishing resources, creating appropriate architectural environments is beyond choice: it is essential. Designers no longer have the luxury to ignore the effects of their architectural creations on the global environment and its inhabitants. Buildings are the mediator between man and nature; the Architect is the artistic intermediary charged with creating a responsive, responsible architecture. (Re think Architecture+-Nature n.d.)

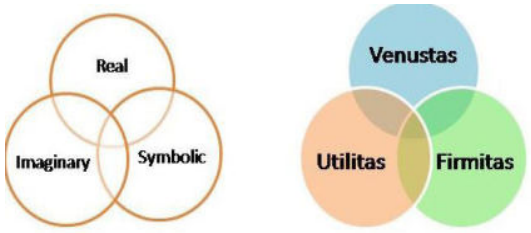


Figure 25 the Vitruvian Virtues of Architecture

These Latin words "Utilitas, Venustas, Firmitas" simply mean "utility, attractiveness, stability" respectively.

Vitruvius pretty was well covered the whole range of architectural concerns when he coined this phrase.

Utility refers the planning for convenience and comfort of users. Attractiveness naturally involves the aesthetics or artistic aspect. Stability refers to soundness of construction, not merely to assure that the building stands up, but keeps out hostile weather and endures without excessive maintenance.

There were genuine architects practicing in Egypt before these

myths were created, probably. Imhotep (an ancient Egyptian architect, physician, and court official) meaning "the one who comes in peace, is with peace" the first architect recorded historically, was designing buildings six thousand years ago. (utilitas, firmitas venustas)

2.3 Structure

The term structural design refers to the art and science of creating structural system in nature or in the artificial world. The term Architecture relates mainly to the design of the built environment. The term structural design in nature relates mainly to the way nature builds itself. (Mosseri 2004)

From the very beginning man has a tendency to discover and learn from his environment. In his observation/learning designing process he has experienced, adaptation and developed skill to provide his need by imitating, interpreting and using the opportunities of nature. This effect of nature can be seen in many architectural examples from simple shelter to Gothic cathedral and today's high technology building. The study of the interaction between nature and architecture can easily be seen the intervention between what architectural design and what nature has, are very complicated range from material to construction techniques, from structural system to aesthetics. (Sorguc 2004)

System in living things, which can be animals, human being and Botanic entities have rigid skeleton (exoskeleton/external and endoskeleton (internal)

Structural system inanimate entities or hydraulic skeleton (fluid, gas or other materials under pressure covered with an envelope (cell, bladder, lung, heart, fruit…).

2.3.1 Rigid skeleton can be:

A. Animated entities: - (movable objects) structured produced by animals like sea shell, birds feather, and fly wing radiolarian.

B. Inanimate:- (Fixed objects) clouds, mountains, stones, stars, liquid, air bubbles, water streams, moisture drops, chemical liquids … all those go under a design process and change of forms. Inanimate structures have extremely long life span when compared to with any animate form's life span and animate nature is absolutely diverse, mobile, and mutable and is miscellaneous compared to inanimate nature.

This system can also be classified in to rigid skeleton or hydro-skeleton

Structural system in Architecture

This is one of the most important architecture and structural components which include: industrial products, like furniture, cars, ships...

Structural components/elements are shells, membranes, muscles, tendons… in architecture those elements can

be beams, columns, members, slabs, domes, arches, barrel vaults, cables, fabrics…

The structural components in nature and architecture can be classified as

1. Pointed elements
2. Linear elements
3. Surface elements
4. Spatial elements

Another important category of the structure in nature is related with their load bearing capacities as in the case of man-made structure.

A. One dimensional: they are usually lightweight elements such as tension –stressed fiber, hairs, sinews, muscles, intestines

B. Two dimensional: characters that are able to transmit forces through their surfaces, structures composed of tension and compression stressed elements such as the wing of insects, bats, bird are two dimensional. On the other hand membranes of cells, skins, intestines, and spider webs can be considered as two dimensional.

C. Three dimensional: - It includes particularly tension – stressed cells organs, structures such as vertical bones and all mollusks. Many compression and pressure stressed structures such as vertical bones, and compression and bending resistant skeleton system of trees and bushes , the spongiosa in side bone and the three dimensional skeleton of radiolarian are also included in this category. The bodies of many animals consisting of tension, compression, and bending resistant elements are also three dimensional (Sorguc 2004)

Structural relation between structural elements may be influenced by degree of freedom, static determinacy, deformation, stability, stress,

The total Architectural creation consists of thousand of billions of cells, when each cell will have a specific role. The entire process will be an outcome of the plan which will be made with the help of ADNA (Architectural DNA) (Mosseri 2004)

2.3.2 Five main categories of structure in nature (Sorguc 2004)

A. Tree like structure: - The observation of tree like structure, led man to learn both new constructional methods. These tree like structure can be first observed in the rib of Gothic style. One of the pioneer examples of tree like structure is Eddy stone lighthouse by John Smeaton which was constructed in south west of Plymouth in 1759. This was done based on the English Oak tree. The roof of the Stuttgart airport passenger terminal in Germany designed by Meinhard Von Gerkan is contemporary example of tree like structure.

Figure 26 Tree like in Stuttgart Airport Interior, Stuttgart Airport Interior,(commons.wikimedia.org ,3/5/ 2014)

B. Web like structure: - spider silk appear to be stronger and more elastic than Kavlar, which is the strongest man-made fiber. Web like structures exhibited membrane characteristic in their load bearing features. The load carry capacity is extremely high and yet the structure itself is a lightweight. Tents are examples of this web like structure. Feri Otto, In a recent year is the pioneer architect who studied similarities in tent and web like structure.

Figure 27 Feri Otto's web like structure Roof for Munich Olympics Arena, Munich, Germany (www.sbp.de, 3/5/2014)

C. Shell like structure:- they are most efficient structural elements because of their high resistance, minimum material, large span, and sheltering character. Some examples of shell like structure are eggs, seashells, turtles, skull, nuts, and the nest of some birds and insects. Architecture has been profoundly influenced by the symmetry of those "natural wonders" Created by snails, clams, scallops and other marine mollusks.

These type of structures are more reflected in Zaha Hadid's design

Figure 29 Shell like Pavilion by Zaha Hadid (badatsports.com, 3/ 5/2014)

D. Skeleton like structure: - in nature the spine and rib work in conjunction with one another to provide support and protection. This idea seem plausible for the buildings as well. The Architect of the Eiffel tower was inspired by Femur, the lightest and strongest bone of the human body with self ventilation property due to the porosity of the bone material. Antonio Gaudi showed natural and organic form which was no longer ornamented superimposed building constituted essential structural element as in case of bone-shaped column. Santiago Ca-

latrava has also used features of an animal shape and skeletal structures in the design of his bridge and building projects.

A. Turning Torso by Santiago Calatrava: (www.panoramio.com ,3/5/2014)

B. Hearst-tower by Norman foste(agencyofinterdependency/wordpress.com. 2/5/2014)

Figure 30 skeleton like structure

E. Pneumatic structure: - pneumatic structures which occur in inanimate and animate nature. They can easily be found in variety of forms of animate nature plants, animals and human beings. The principle of "PNEU" which is a system in which a tension –resistant, flexible envelope surrounded a filling. Pneumatic constructions and their use of air as a supporting medium has become part of architectural language, Pneumatic technology is by no means, a newly established science. Those pneumatic constructions in architecture are called air halls. They are pre-stressed structural systems. Allianz Arena Pahu studuma, Germany, is a contemporary example of this type of structure.

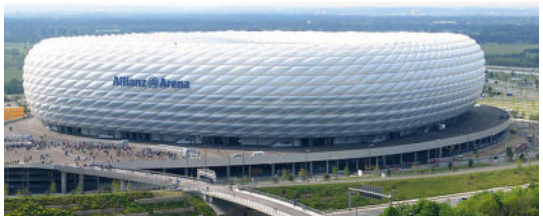


Figure 31 Allianz Arena Pahu (www.blsciblogs.baruch.cuny.edu, 14/3/2014)

2.3.3 Examples of man-made structures mimicked from nature

Some well known architects and engineers, who were inspiring by nature to form a structure like Antonio Gaudi (Spanish Architect), were using nature as a provider of form and other architects and engineers have transformed natural forms to their design solutions. According to Antonio Gaudi an arch for him is a parabolic (elliptical curve rather than circular curve) which is freely suspended chain or a flexible cable which assumes a curve under the action of uniformly distributed weight. These freely suspended shapes are called Catenaries. (See Antonio Guadi's design)

A. Feri Otto (Germany Architect and structural engineer):- A spider web is applied to form a structure in his design at Munich Olympiastadion Munich, Germany.

A. Spider-web (www.firsthdwall-papers.com, 21/12/2013)

B. Munich Olympiastadion Munich, Germany (architecturehabitat.blogspot.com, 21/12/2013)

Figure 32 transforming of spider web to structure

B. Buckminster Fuller (American architect) :-The term geodesic, which is from the Latin and its meaning is ``earth dividing. A geodesic dome is a type of structure shaped like a piece of a sphere or a ball. This structure is comprised of a complex network of triangles that form a roughly spherical surface. By using triangles of various sizes, a sphere can be symmetrically divided by thirty-one great circles. A great circle is the largest circle that can be drawn around a sphere, like the lines of latitude around the earth, or the equator. Each of these lines divides the sphere into two halves. The dome is a structure with the highest ratio of enclosed area to external surface area, and in which all structural members are equal contributors to the whole. (Fuller n.d.) The geodesics intersect to form triangular elements that have local triangular rigidity and also distribute the stress across the structure. When completed to form a complete sphere, it is a geodesic sphere.

A.Glob(pl.123rf.com), 21/12/2013)

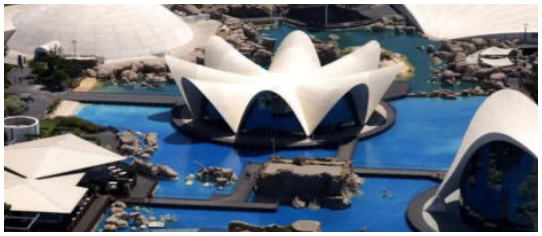
B. Geodesic-dome-at-epcot-carl-purcell , 21/12/2013

C. Geodesic- dome structure (insidethefactory.typepad.com 16/3/2014)

Figure 33 Fuller Geodesic dome with glob

C. Felix Candela (Spanish Architect), in his design, Oceanographic is a marine park situated in the east city of Valencia, Spain, where different marine habitats are represented. It is integrated inside the cultural complex known as the City of Arts and Sciences. They got a thin sheet made in concrete with steel fibers in only 6 cm. Thick to cover a 40 m. Span as shown in Figure34.

A



B

Figure 34 Oceanografilo cubierta acabada (www.cmdingenieros.com) 24/12/2013

D. Eero Saaneinen (Finnish American architect and industrial designer) designs the Gateway Arch which 630-foot (192 m) high monument in St. Louis, in the U.S. state of Missouri. Clad in stainless steel and built in the form of a flattened catenaries arch and as a monument to the westward expansion of the United States. It is the centerpiece of the Jefferson National Expansion Memorial and has become an internationally famous symbol of St. Louis.

A. Rainbow (www.listofimages.com, 20/ 3 /2014)

B. St. Louis Gateway Arch (blog.thebuttonmonger.com, 28/12/2013)

Figure 35 Rainbow and St. Louis Gateway Arch

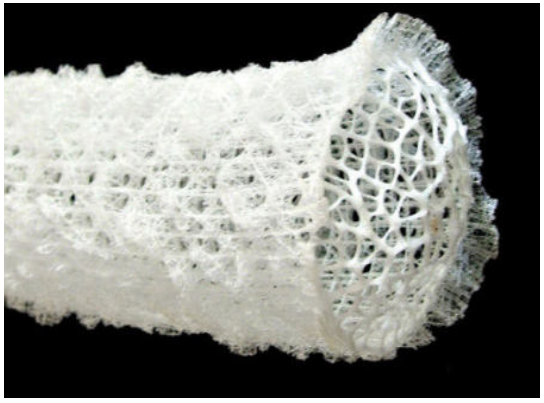
E. Robert Maillart, was a Swiss civil engineer who revolutionized the use of structural reinforced concrete bridge (as shown in figure 36 a 133 m long and 13 m height) with such designs as the three-hinged arch and the deck-stiffened arch for bridges, and the beam-less floor slab and mushroom ceiling for industrial buildings.

Figure 36 Salginatobel Bridge by Robert Maillart in Schiers/ Switzerland (www.worldmonument.ch, 28/12/2103)

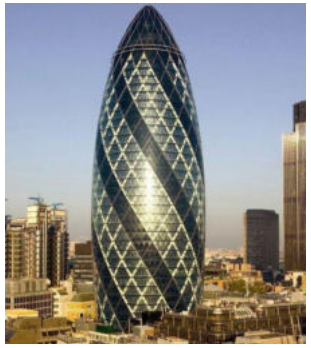
In general the remarkablyrapid development of biology and unprecedented success compared to the previous period, building techniques like invention of steel concrete and the beginning of glass and metal structures usage require special attention to the appearance of such an important trend in architecture as "organic architecture".

F. Norman foster (British architect) has designed 30-st-mary-axe an iconic building in United Kingdom. This Building was designed as sustainable architecture, High-tech architecture, Structural Expressionism. This building has a character of structural out line in nature with nature. Does Norman Foster have inspired pineapple, corn or sea sponge?

A. pineapple B. Corn



C. Sea sponge (io9.com, 23/12/2013)



D. 30-st-mary-axe (www.urbika.com, 20/12/13)

Figure 37 30-st-mary-axe with sea sponge and corn

G. Greek columns look ram's horn

The Greek temple Ionic columns is the is copied from the ram's horn

A. Ram (www.nwf.org ,17/12/2013)

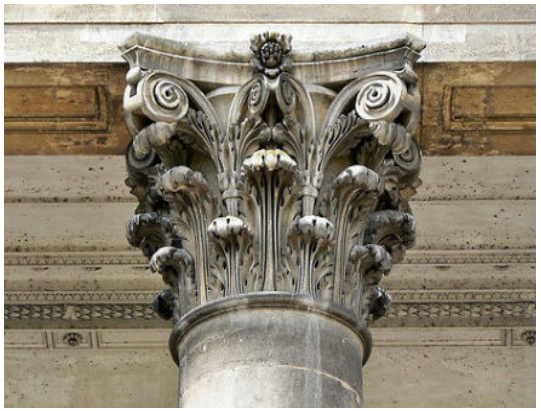
B. Greek column Ionic capital (eu.fotolia.com, 24/12/2013)

Figure 38 Greek column Ionic capital and horns of ram

H. Ancient Egyptian, Greek and roman Corinthian capitals

The simulacra of the slow movement of growing plants or trees attached to structural members of building like the palm leaves or scallops of the Philae capitals of Egypt, the acanthus on the Corinthian capital of Greek and roman antiquity are inspired by the growing of palm tree and apply on the capitals.((Ramaswamy 2007). This shows how growing of the palm tree is applied to the structural elements of those capitals.

A. Roman Corinthian Capitals (www.royalacademyprints.com,25/12/2013)



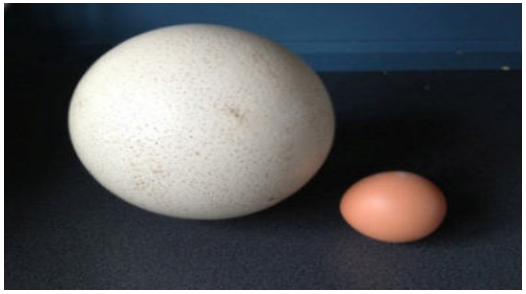
B. Greek Corinthian capitals (www.sasgreekart.pbworks.com, 25/12 /2013)

C. Egypt-Aswan-Philae-capital (www.traveladdicts.net,25/12/2013)

D. Natural palm tree (corcol.blogspot.com, 25/12 /2013)

Figure 39 using of palm tree in different ages and places

2.3.4 Examples of nature which helps as an idea for making a structure



A. Egg (openthedoortob4.blog-spot.com, 23/3/2014)

B. Crap(uglycricket.com, 23/3/20)

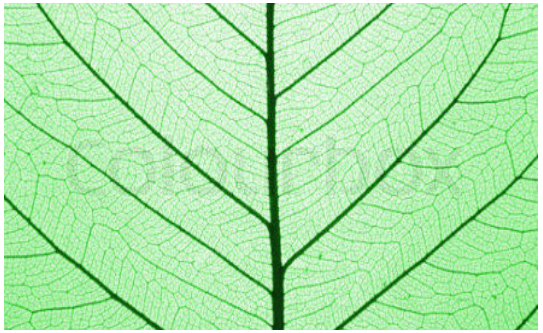
C. Double helix (www.pdt.com, 23/ 3 /2014)

D. Armadillo-leprosy(technora-ti.com, 23/ 3 /2014)

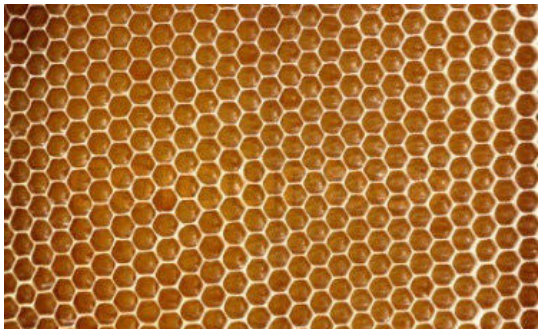
E.Spider net(Wallpapers.free-re-view.net, 23/3/2014)

F. Climb tree

G. Hermann's tortoise shutter stock (www.petinfoclub.com, 23/3/2014)



H. Green-leaf-structure (www.colourbox.com, 23/3/2014)



I. Honey comb(www.colourbox.com 23/3/2014)

Figure 40 Natural elements as concepts for structure

3. What does Architecture deals with?

3.1. Creating enclosed spaces for human use

Architecture was born out of man's need to create enclosed space for various functions and give this enclosure an expression.

Architecture creates interesting spaces for human considering functional, environmental, structural, economical, politically aspects and human behavior.

3.2 Technology of construction for better performance

One of the greatest structural engineer and architects of the 20th Century, **Pier Luigi Nervi** (1891-1979), extraordinary success in combining the art and the science of building, produced some of contemporary architecture's finest works. Nervi's concept of structure is similar to that of the Classical period, when the architect inspired and was involved in every part of the process, although, of course, he employed completely different methods. In the majority of his projects Nervi remained faithful to conventional reinforced concrete "a material that can be easily molded and is resistant to both compression and tension" while limiting the use of pre-stressed concrete. On the other hand, he made use of the extraordinary freedom offered by prefabrication of structural components.(CHIORINO n.d.)

3.3 Natural Phenomena (climatic factors: comfort, conditions, natural lighting)

Everything in nature has specific function. The form which we can see in nature has been formed because of its function. It looks very interesting because of its form.

Nature by itself is balanced and stable. Thus, functionality and structure are perfectly done.

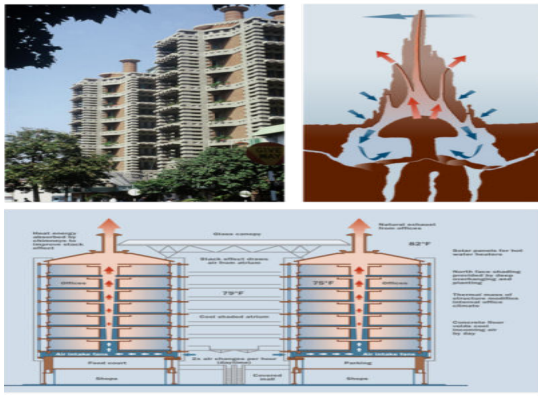
According to W**illiam M c. Donough and Michael Braungart, Cradle-to-Cradle,** "Nature doesn't have a design problem. People do Instead of using nature as a mere tool for human purposes; we can strive to become tools of nature who serve its agenda too. What would it mean to become, once again, native to this place, the Earth - the home of all our relations?"

Examples of some building which have used natural phenomena for cooling

A. East gate Centre in Harare, Zimbabwe, typifies the best of green architecture and ecologically sensitive adaptation. The country's largest office and shopping complex is an architectural marvel in its use of biomimicry principles. The mid-rise building, designed by architect Mick Pearce in conjunction with engineers at Arup Associates, has no conventional air-conditioning or heating,

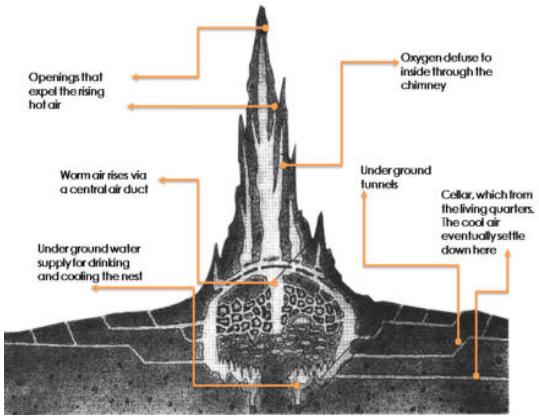
yet stays regulated year round with dramatically less energy consumption using design methods inspired by indigenous Zimbabwean masonry and the self-cooling mounds of African termites. (The east gate center n.d.)

A



B

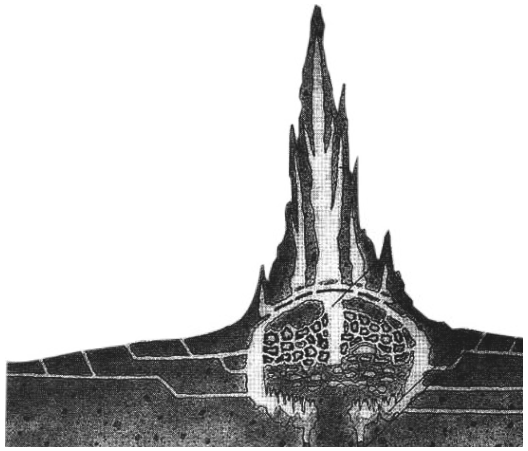
Sectional Elevation and 3D of East gate building(A and B) (ehp.niehs.nih.gov, 15/3/2014)



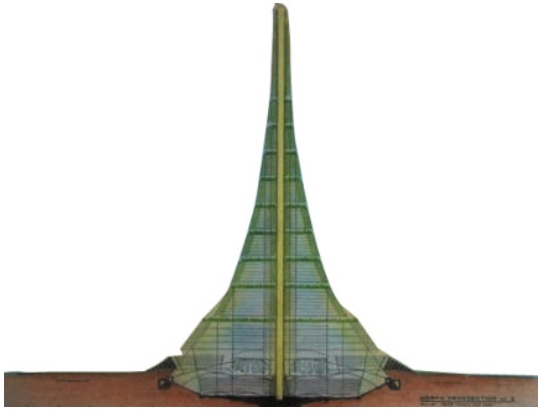
Termite nest, (www.arch.mcgill.ca,15/3/2014)

Figure 41 Cooling system inspire from termite nest

B. Two-miles high termite nest proposed to counter the population challenge, the Ultima Tower is a hypothetical super-mall skyscraper, designed by American architect Eugene Tsui in 1991. With a total height of 3,218.7 metros (10,560 ft), the tower would be 2 miles tall, and comprise 500 stories if built Tsui proposed that the tower would be home to 1 million people, and the design is exactly inspired by termite nest which is a home for a millions of termites. . (Blain 2008)



A. Termite nest(www.arch.mcgill.ca,15/3/2014)



B. Ultima-tower (www.gizmag.com , 15 /3 /2014)

Figure 42 Termite nest and Ultima-tower

C. Heat is transferred in four ways: radiation, evaporation, conduction and convection. Many organisms that can live in hot regions go to great length to

avoid picking up heat. Some of them avoided radiative gain by staying out of the sun altogether or skipping across the sand rapidly to minimize absorbing heat through conduction. Applying the same logic to architecture would lead to the conclusion that avoiding heat gain should be the first priority when trying to keep a building cool.

The world water headquarters situated in the Namibia desert designed as a competition entry by exploration with Charlie Paton proposed two methods of keeping cool. The first one is through the evaporation of sea water at the front of the building (as the sea water greenhouse) and the second one is through a more extreme version of fog-basking beetle's(an insect that can harvest water from the air in the Namibian desert) radiative cooling.

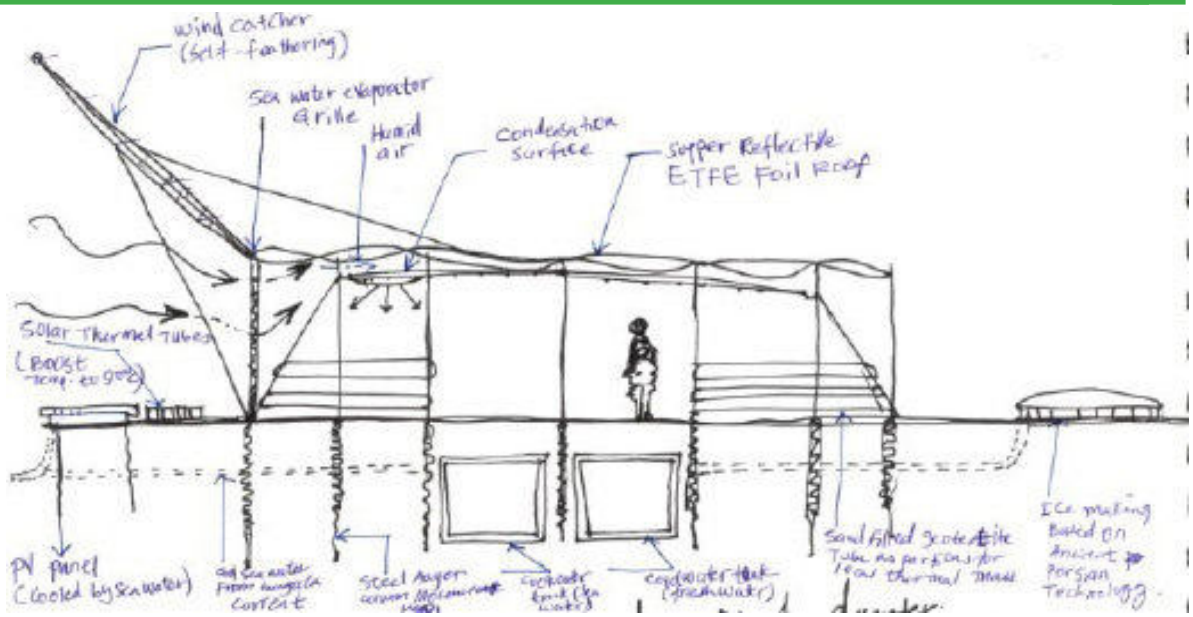


Figure 43 world water Headquarter

D. La Sagrada Familia (large Roman Catholic Church) is one of Gaudí's most famous works in Barcelona (Figure 44). This giant Basilica has been under construction since 1882 and is not expected to be completed for between 30 to 80 years and currently under construction.

A

B

Figure 44 Sagrada Familia by Goudi (Spain),(www.panoramio.com, 21/12/ 2013)

It is clearly influenced by forms of nature which reflected by the use of curved construction stones, twisted iron sculptures.

E. Japan's Architect, Tadao Ando intended to design an architecture that is totally cut off from the world outside, to create a silent space within. At the same time, natural light from outside is meaningful in term of religious. Believe; to admire in nature as Shinto religion does. Nevertheless, an opening void is not practical in term of temperature control in building; Moreover, in winter, a climate in Japan is frosted so its vent was closed by glass panel in order to preserve an original concept of natural light and prevent users from cold. (Sibunruang 2012)

A

B

Figure 45 Tadao Ando Church of Light

Tadaoando.wikia.com as of 16/3/2014

F. Reichstag parliament Building in Germany by Foster and partners is gorgeous glass cupola brings plenty of natural light and ventilation down to the parliament floors and into its own entrance, reflected by its mirrored-core. Helical ramps allow people to ascend to the cupola's top, get a rest and enjoy a 360-degree view of the city while symbolically standing above the heads of their elected representatives in the chamber below. A large sun shield tracks the movement of the sun electronically and blocks direct sunlight to avoid excess heat and uncomfortable glaze. (Alperovich 2012)

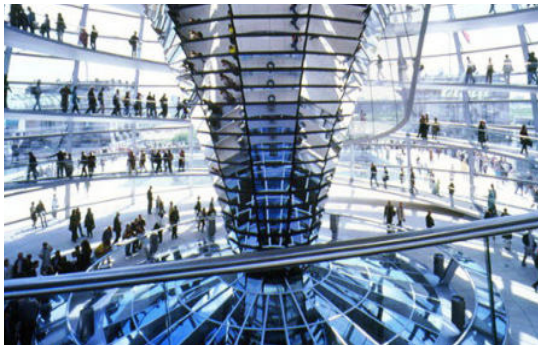


Figure 46 Reichstag-Interior (www.telegraph.co.uk,15/3/2014)

4. Semantics

Semantic in Architecture focuses on the relation between *signifies'* signs, symbols, and what they stand for, their denotation. Linguistic semantics is the study of meaning that is used for understanding human expression through language.

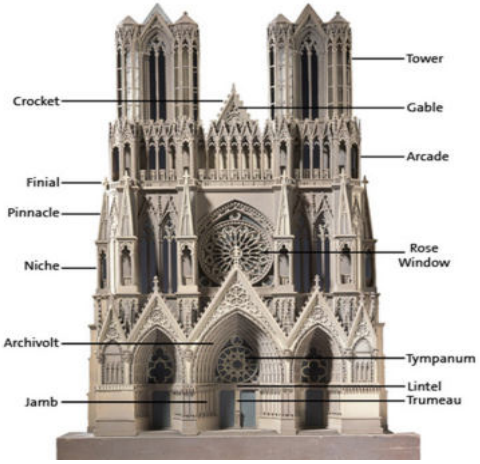
Semantics in Architecture is the meaning of forms, shapes and how functionality fulfills its goal. Thus making architecture descriptions true assets.

The goals of the semantic architecture are

- To define a formal semantic way of representing architecture intended to be both human and machine readable
- To describe a system architecture at a high level of abstraction
- To permit analysis of architectural quality attributes

Example: Gothic architecture is most familiar as the architecture of many of the great cathedrals, abbeys and churches of Europe. It is also the architecture of many castles, palaces, town halls, guild halls, universities and to a less prominent extent, private dwellings. Its characteristics include the pointed arch, the ribbed vault and the flying buttress gives the semantic/ meaning of the building either the building is Church or palace of the Gothic architecture.

The concept of semantics on Form, Function and Structure play a great role in Architecture in such a way that the meaning of the deign reveals. Form in architecture is what the building looks like (aesthetically), function refers to usability (purpose) of the building and structure in architecture is the overall stability of the building.



A

B

Figure 47 Gothic Architecture exterior and interior ((www.vam.ac.uk/content/articles/g/gothic-architecture ,10/5/2016)

The technique we use in Bionic and biomimicry are best examples of semantic approach in design.

Example:-Take any natural element, visualize and read the things which you can understand from that element and translate it to source of design solution. So, nature donates idea for architecture and Architecture is universal receiver of the ideas from nature in the form of function(How it works, materiality, durability, usability and construction) and gives the meaning of the object nature to apply in Architecture (aesthetically, in terms of form and shape) functionally and the entire bones.

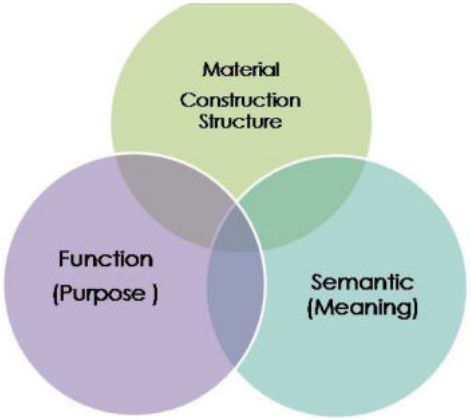


Figure 44 Relationship of how to give meaning in design

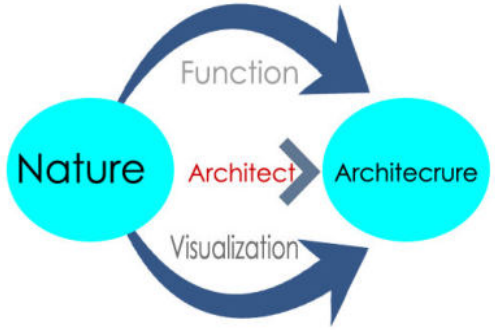


Figure 45 Architecture and nature

4.1 Thought on future trends in architectural design inspired by nature

The cultures of prehistoric humans are known mostly through The excavation/curving of stone tools and other relatively imperishable artifacts. This early tool making tradition refers to the Paleolithic (Old Stone Age). The Oldowan and Acheulian are the first simplest technologies which human being used. As a result they lumped together in to lower Paleolithic stage of cultural development.

Sometime 100,000 years ago or somewhat earlier, Neandertal and some other late archaic humans achieved a major leap forward in tool making with the development of the Mousterian tool tradition (named for the site of *le Moustier* in France).This new technology was revolutionary enough to warrant being considered a distinct Paleolithic phase the Middle Paleolithic. Mousterian-like tool industries were employed at that time also by early modern *Homo sapiens* in some areas of Africa and Southwest Asia (prezi) (palomar).

This shows everything man made things are changed (evolved) through time. We can also see how communication system changes through time. This time it is possible to communicate with a person at any distance because of the new technology. We can call this as the transformation of information and communication technology (ICT). We can carry TV

set in our pocket. We can move anywhere as far as we want using car, ship, and airplane. We can call it as revolution of transportation. May be in the future man can invent a wing to fly by himself and those transportation systems which man uses them in current time may not be used in the future.

When we come to Architecture, shelters changed from trees to cave then hut, settlement, urbanism, growing of buildings (vertical and horizontal).

4.2 What will be the future building?

We can predict the future building depending up on how man gradually change himself from time to time and how man reaches the current technology. Man invents instruments before inventing his shelter. For him shelter was not a big deal compare to getting his food and protecting him self and his family from possible traits.

He first invented instruments used for hunting animals. After long time he realized that, it was very critical to have a shelter to deal with the adversaries of nature. Then he invented caves by chiseling and drilling rocks for inhabitation. When he carved the rocks he has followed simple proportion in order to stabilize them. But that was not enough to live in caves because of population become increased. So he invented huts and formed kind of settlement called village. This new settlement was around river basins and improved new life with new technology. The population become increased, and built many houses and formulate urbanization. This urbanization was horizontal expansion and some of the residents become far from the river basin, so he has to invent another way that he can stay near the river basin that was vertical growing that is multistory building system. When man invented those multistory buildings he became worried in stability, durability, function and mathematical (proportion) system how to erect them. This was done simply without any scientific methods rather than functional bases.

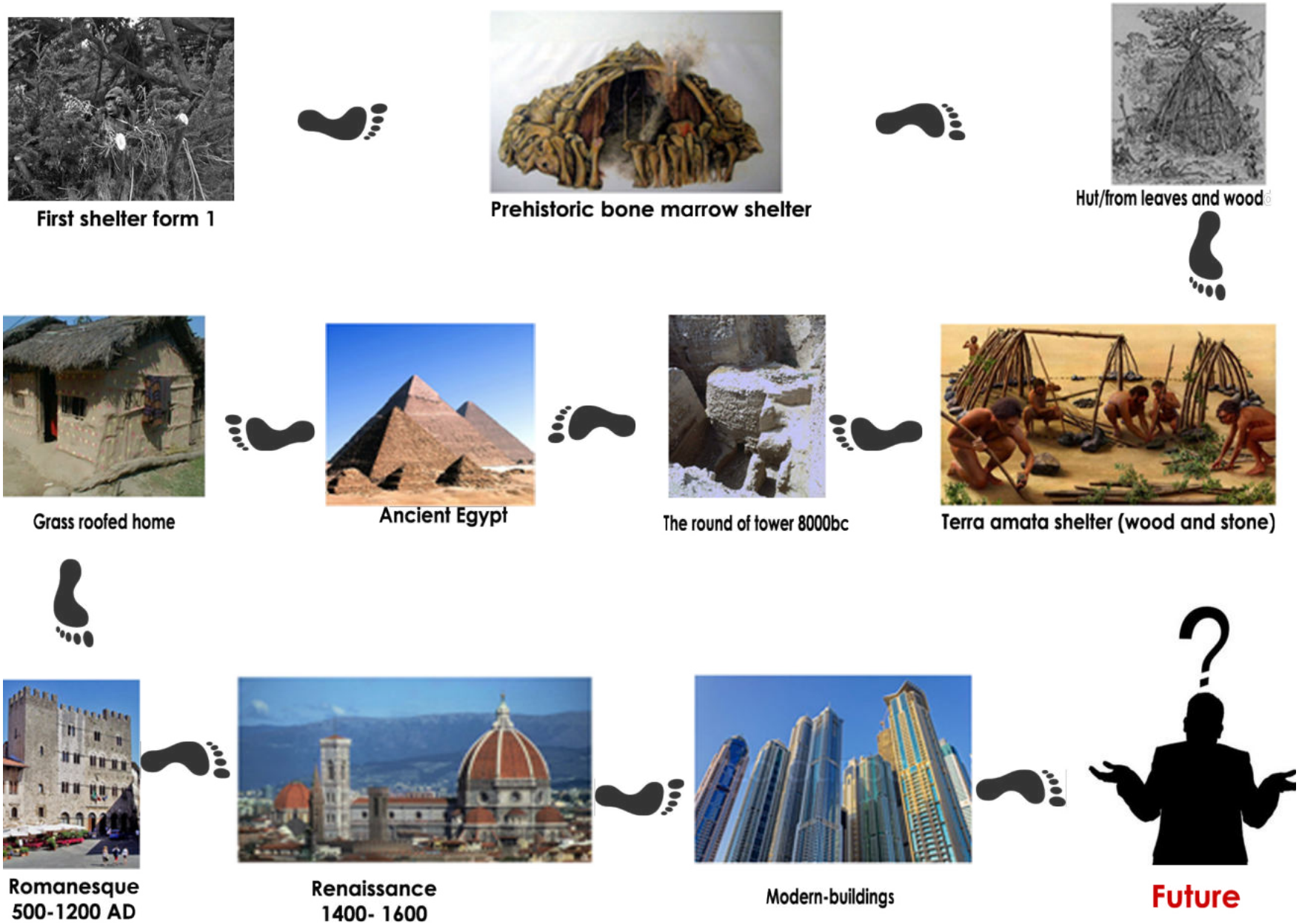


Figure 46 Revolutions of shelter in human life

5. Conclusion

The idea of mimicking nature has existed ever since man moved out of the architecture of nature where he lived in a cave and trees to escape harsh natural conditions. He started building his shelter when he started moving from place to place in search of food and water. But it was difficult for him to adapt the forces in nature. So man instigated to make his first shelter which could act as his second skin. Since the natural conditions forced him to spend most of his time indoors.

He realized that these thing is comfortable for him and learnt to create a comfortable shelter with materials which were available for him. Man defined his boundaries and adopts a model of leaving which defined culture. Indigenous culture understood the pattern and cycles of nature and derived to living which was in harmony with nature. Thus vernacular architecture developed in various parts of the world was responsive to the climate, topography, vegetation and source of water. (Ramaswamy 2007)

For example:-Architecture is created by man to create beautiful or interesting, functional building that has more than practical need.

From this we can understand that how human being changes his shelter to counter natural phenomena like rain and snow and to protect him self from wildlife attack.

What natural forces and disasters currently Affect human?

Earthquake, deficiency of land to construct a building, storm surge (hurricane flooding, typhoon Haiyan, Cyclone Nargis and so on) which can occur because of the green house effect are some of the major problems. In our time (21centuray) appropriate technology is available to avoid some of the problems. These include not only the technology used in the design process but also in construction, operation, and maintenance.

We have enough technologies but still those natural deserters are still beyond the technology. All the above natural disasters are mostly affecting to human by de-constructed his shelter.

Having the above premises as a base, the next building may be constructed in air or over a sea. We may see flying or floating building in the future. Or the building itself moves from place to place as the owners need.

Currently there is a huge disaster in melting of ice and ¾ part of the earth is water. The population is increases very fast. So a lot of buildings are fall down and eroded by flood, but they are not floating.

It is known that human need is endless. Man invents new technologies to fulfill his need.

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