

FORMULATING ANALOGOUS SOLUTIONS AS A CONCEPT TOOL IN INNOVATIVE INTERIOR DESIGN APPLICATIONS

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ABSTRACT: Design-by-analogy and Metaphor is a powerful part of the design process across the wide variety of modalities used by designers such as linguistic descriptions, sketches and diagrams. Many tools are needed to support people's ability to find and use analogies, and a deeper understanding of the cognitive mechanisms underlying design and analogy is a crucial step in developing these tools. This paper explores the effects of representation within the modality of sketching, the effects of functional models, and the retrieval and use of analogies. The level of abstraction for the representation of prior knowledge and the representation of a current design problem both affect people's ability to retrieve and use analogous solutions. A general semantic description in memory facilitates retrieval of that prior knowledge. The ability to find and use an analogy is also facilitated by having an appropriate functional model of the problem. This paper approaches analogy and metaphor from design aspects and its application in design quality in fields related to creativity and the conceptual content of signs and symbols within the various design contexts. To achieve its objectives, the paper covers theoretical background which is related to existing studies with specific reference to analogy and metaphor. The second step, covers a number of studies from which a hypothesis to build up a framework that addresses the research problem with some emphasis on symbols. These studies have a number of implications for the development of tools to support design-by-analogy and metaphor solutions. The paper aims to present an adopted design model of analogy in the design process and presents a set of conclusions, primly, related to this topic and its impact on design and designers.

KEY WORDS: Analogy, Innovation, Psychology of design, Idea generation, Cognitive models.

1. INTRODUCTION

Analogy is to manage an objective in correspondence to a source (base) in like manner to the similarities between them while thinking about the distinctions in the meantime. Similarity is the procedure of relationship between circumstances from one space (source) to another (objective) made conceivable through the foundation of relations or representations (Gentner, 1983). Designs are analogous if they share at least one function or behavior, but not necessarily similar structures (Gero, 1996; Visser, 1996). Analogy association forms advance new derivations and issue understanding. Analogical association and recovery in human insight depend on how a problem is represented, where past research demonstrates that different representations encourage analogical thinking through the recovery of powerful and novel analogies put away in originators' long haul memory (Vattam, Helms, and Goel, 2008).

The National Academy of Engineering (NAE) as of late discharged two reports on the Engineer of 2020, that recognize the 'flat world', abilities required by engineers in the twenty-first century. These reports underline the requirement for architects and creators without bounds to create abilities in useful resourcefulness and inventiveness to separate them from low wage builds on the global market. This paper approaches this objective through understanding the use of metaphors and analogies in the design

procedure and supplements different ways to deal with encouraging inventiveness. In this unique situation, the term analogy is characterized as outline of a thought by methods for another commonplace thought that is comparable or parallel to it in some critical highlights. The term metaphor is for the most part characterized as a non-literal articulation which deciphers a thing or activity through an inferred examination with something different; an image (Literary Oxford Dictionary).

2. Analogy

2.1 Philosophy of Analogy

Thinking, considering, and going to a recognition is between two elements (source or base, and an objective) where achieving a level and managing an objective as the base or source. Analogy is considered as a sort of abnormal state recognition, where one circumstance is seen as (regarding) another (Hofstadter 1995). Definition: The New Oxford Dictionary of English (2001) characterizes analogy as takes after: An examination between a certain something and another, ordinarily with the end goal of clarification or elucidation a correspondence or incomplete similitude. A thing which is or is spoken to as being practically identical to something unique in huge regards. A process of arguing from similarity in known respects to similarity in other respects. The Cambridge International Dictionary of English (1995) expressed that to contrast is with "Analyze Differences "and in the meantime "Consider Similarities" in analogy as yet discussing similitudes however not disregarding the distinctions which will control how profound is the connection between the objective and source and in this manner recognizing the quality of the similarity (Gentner D. 1983). It is likewise expressed is a very refined intellectual process in which two conceptualizations - a source and an objective - are investigated for normal auxiliary examples (Gentner D. (1989). Higgins and James M, (1994) concurred that a "analogy" or "drawing analogies" or "analogical reasoning" is an examination of two things that are basically different yet are appeared through the similarity to have some similitude.

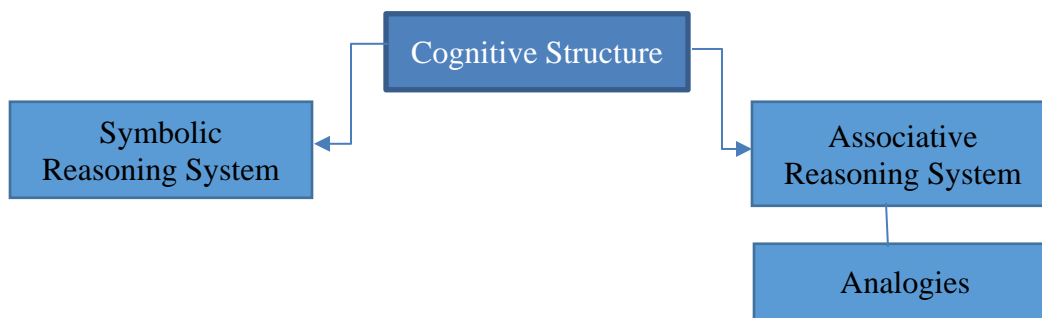
	Similarity		Function
Contiguity	BIRD	FISH	
	wings	fins	→ locomotion
	lungs	gills	→ getting oxygen
	feathers	scales	→ protection

Source: Itkonen E., 2005, *Analogy as Structure and Process: Approaches in Linguistic, Cognitive*, John Benjamins publishing company

Fig. [1] Prototypical Analogy

2.2. Analogical Reasoning

Two frameworks have been estimated to exist inside a man's intellectual structure: (a) the symbolic framework, and (b) the associative reasoning framework, as appeared in Figure 1. Schemata can be seen as being put away and used in both of these intellectual frameworks. The emblematic or run based reasoning framework is the place theoretical true issues are contemplated about and unraveled through emblematic representations and standards. The associative, similarity-based reasoning framework is the place issues are contemplated about through affiliations or similitudes with other known data. In spite of the fact that scientists differ as to which framework is overwhelming, this second framework is noteworthy in light of the fact that associative reasoning is seen to be a central piece of master outline insight (Akin, O. 2001).



Source: Done by the researchers

Fig. [2] Graphic representation of the cognitive structure for reasoning through analogies.

Analogical reasoning is a component of the associative, similarity-based reasoning framework, as appeared in Figure [2]. This sort of reasoning is a technique for initiating put away outline in view of the distinguishing proof of associations, parallels, or similitudes between, what are regularly seen as different things. Analogies fill in as a type of framework, where new data is tied down to existing schemata. Analogical thinking is in this manner the utilization of diagram analogs, or information from past encounters, to encourage learning in another circumstance (Ball, L. J., Ormerod, T. C., and Morely, N. J. 2004). Analogies empower a person's representative capacity or "the capacity to choose designs, to distinguish repeats of these examples in spite of variety in the components that make them, to frame ideas that conceptual and reify these examples, and to express these ideas in dialect" (Holyoak, K.J., Gentner, D., and Kokinov, B. N. 2001). Specialists have found that analogical reasoning is regularly a principal subjective instrument for plan critical thinking. Accessible assets as of now put away in the brain as schemata are enlisted to invigorate the scan for critical thinking techniques through analogies (Goldschmidt, G. (2001).

Back to the Source/Target idea of Analogy, if two circumstances or articles are known to be comparable in a few perspectives, it is likely that they will be comparative in others (Luger and Stubblefield 1998). While Holyoak clarified it as a social thinking among terms relying upon understanding these terms. It decided how terms and the connection between terms are connected together. AR is pondering two elements (a source or a base and an objective) through analogy between them by discovering similarities, to manage one (focus) in regard with the way you manage another (source or base) (Holyoak K., 2001).

2.3 Analogical Types in Interior Design

2.3.1 Based on Similarity Nature

Broadbent G. (1973) considers analogical design as the most powerful source of creative ideas in the architectural design. He distinguished 3 categories of Analogy:

2.3.1.1 Visual analogies

In such Analogy, designers refer to existing structures, frames from the nature, artwork. They obtain and allude to what they outwardly observe around them whether it is different structures or nature or even artistic creations, anything their eye sees and their psyche envisions it and envision it in a building. This type is concerned about the visual introduction of designers, and how the figurative and analogical graphical and calculated reasoning influences the outline. The part of images and semiotics in the visual referenced analogical thoughts in configuration has been stressed. (Broadbent G. 1973)

2.3.1.2 Structural analogies

Foreseeing from its title, the similarities attracted this analogy depends on structure. As Broadbent expressed, where forces of pressure in the human body are alluded to sometimes alluding to it as how profound is the analogy between the source and the objective, or the idea of the similarities taken in the analogy procedure, how profound are these similarities identifying with the source and the objective also. Gentner (1989) contended that despite the fact that these "surface" kinds of analogies are anything but difficult to make, under ordinary conditions they couldn't ensure the exchange of auxiliary relations amongst source and target. This profound or basic analogy is of a more elevated amount, higher request relations in view of profound properties, which no uncertainty considering an issue all the more profoundly drove dependably to better outcomes, that is better arrangement among the objective and source. (Gentner, D.,1989)

2.3.1.3 Philosophical analogies

It the sort of analogy that relies upon methods of insight or as Broadbent (1980) expressed it with references to standards of material science, science and so forth., Accordingly Organic analogy in light of zoology and art of plants is viewed as philosophical relationship too.

2.3.2 Based on Knowledge Nature

In light of the idea of the information exchanged from past understanding to the new issue, the analogical reasoning approach was characterized by Carbonell (1982,1983, 1986) in Maher M.L. also, Gero J. S. (2006) into two classes: transformational analogy and derivational analogy.

2.3.2.1 Transformational Analogy

It adjusts the answers for the past issues for the new issue. It changes the arrangement of the past issue in an approach to fit the new issue.

2.3.2.2 Derivational Analogy

It applies the past problem solving processes or methods to solve the new problem.

2.3.3 Based on Source Type

Wayne O. Attoe (1979) recorded numerous sorts of analogies found through the nineteenth and the twentieth century that was said in Routi P. (2007) paper about topical hypotheses of architecture. These sorts are named after their source compose. The rundown of Wayne O. Attoe is:

2.3.3.1 Mathematical Analogies

Based on Geometrical shapes and proportions.

2.3.3.2 Biological Analogies

Charles Jencks could be the first who anticipated that science would turn into the real illustration for the 1990s and the hotspot for critical structural development this century i.e. biomorphic school. (Jencks C., Architecture 2000: forecasts and strategies, Studio Vista 1971).

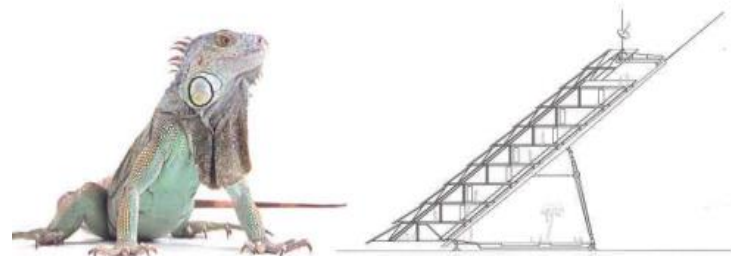
Analogy in Design	Meaning
Organic Analogy	where by designs composes are arranged by strategies taken from botany and zoology.
Anatomical Analogy	Building structure of configuration is contrasted and the skeleton of the creature.
Ecological Analogy	Perspectives the suitability of designed items for their functional purposes as being equivalent to the wellness of creatures and plants for their condition.

Source: Done by the Researchers.

Table (1): Biological AR types in design by Philip Steadman.



Source: Horden R., Fuchs U., Franke B., 2008, *Micro Architecture : with 680 Illustrations*, Thames and Hudson Ltd., London , UK
Fig. [3] Bridge (Munich 2002).



Source: Horden R., Fuchs U., and Franke B., 2008, *Micro Architecture: with 680 Illustrations*, Thames and Hudson Ltd., London, UK
Fig. [4] Habitation (Munich 2007)

2.3.3.3 Mechanical Analogies

Building as a machine.



Source: Mathews K., 1998-2008, *Great Buildings architecture*, Retrieved: February 19, 2009, from www.greatbuildings.com
Fig. [5] Lloyds Building

2.3.4 Other types of Analogy

2.3.4.1 Symbolic Analogies

Surmising from its title what it suggests to, it resounds imagery among the AR procedure. Symbolic Analogy is for the most part Visual Analogy, as a connection between the image and the principle component to be symbolized. However, this Symbol won't not relate outwardly to the primary component like in mathematic images.

2.3.4.2 Proportional Analogies (Aristotle)

The most broadly known speculations of similarity presented by Aristotle, in which analogies are spoken to regarding extents A: B: C: D, or "A is to B as C to D" in plain English.

2.3.4.3 Surface Analogy

Casakin H. (2002) characterized it to identify with effortlessly available and shallow ideas of protest properties. While Gentner and Toupin, (1986); Medin and Ortony, (1989); Ross, (1989); Smith E. E. (1989) considered it to be a perceptual or surface similarity is generally notable and simple to perceive. Accordingly, it is regularly a helpful record of more profound theoretical or basic similarity and can give access to more unpredictable relations. Case A rectangle is to a square as an oval is to a circle.

2.4. Forms of Analogical Reasoning

Researchers have presumed that analogical thinking can be sorted into two distinct structures. To begin with, analogical reasoning can be utilized to comprehend the task of another gadget. Pattern, or put away learning, of how a gadget works is utilized to reason about how an analogous device may work or seeing how to work a gadget can be surmised from knowing how the bigger framework functions. Second, analogical reasoning utilizes pattern, or learning as of now put away, to reason about, derive, as well as foresee data to take care of an issue. As it were, simple schemata are utilized to think about what is now put away as schemata, to another space of learning.

2.5. Analogies and Creativity

Another vital segment of analogical reasoning in outline issues is inventiveness. As Perkins (1997) verbalized, similarity is "the animal that conveys individuals' intellectual limits over the abandon of unworkable potential outcomes from the natural to genuine developments". In particular, analogies can assume a vital part in applied change, which is a vital part of inventiveness. Four analogical procedures can be utilized to goad applied change: (a) highlighting, (b) projection of candidate inferences, (c) re-representation, and (d) restructuring. Analogies concentrate consideration on particular parts of the base and target areas, featuring important data. By anticipating surmisings, analogies help in the improvement of learning inside the objective area. Re-representing either or both the base or target area to enhance the similarity can additionally build up theoretical change. At long last, analogies can goad the rebuilding of components of the objective area to shape another clarification.

3. Metaphor

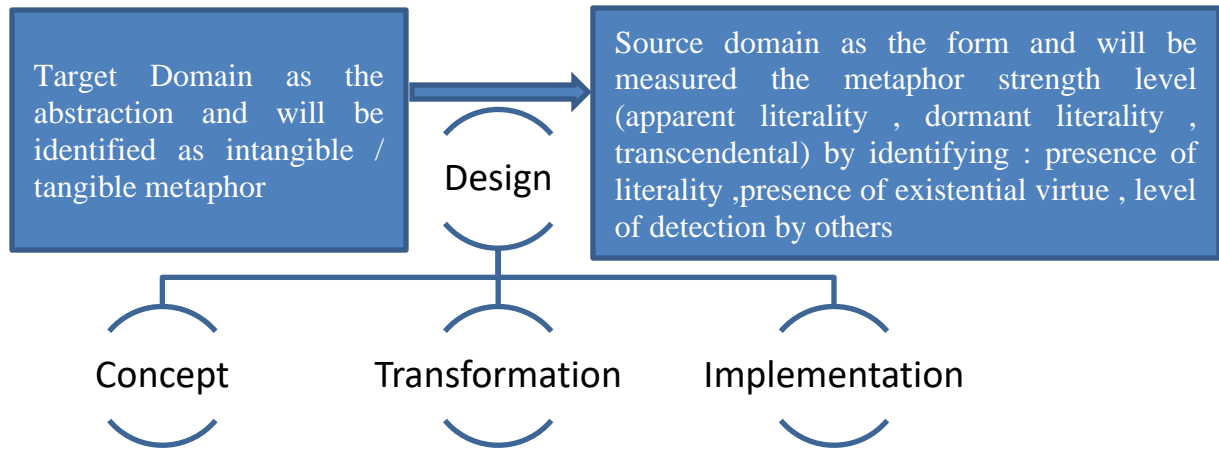
The main thorough dialog about Metaphor likely got from Aristotle Poetics. Metaphor utilized as analogy or delegate from something that we needed to portray. It is utilized from unimportant disentanglement to idyllic utilized or even to develop meaning. In its broadest sense each type of trade, personality transference or phrasing transposition could be inside the normal for allegorical. In this way, metaphor isn't just barely a semantic shape yet a central character of human etymological connection with the world. There are no less than three distinctive thought of Metaphor got from Aristotle clarification: (1) as substitution for a literal condition (2) as borrower from its original context (3) as deviation from usual using. Accordingly metaphor for the most part have certain implying that ought to be perused all the more painstakingly as it isn't simply speaking to truly of what is really appeared.

Lakoff and Johnson in Metaphor we live by contended that metaphor was really shape normally in human personalities and getting to be potential based for their entire theoretical framework, along these lines will impact everything from the way they are thinking to (at last) what they are doing. In this way Lakoff and Johnson trusted that metaphor was something other than an arrangement of wonderful dialect, however it is simply the dialect as there was not a solitary word that was not a metaphor, as each word really speaks to something that we need to depict. Assist more Lakoff and Johnson called their arrangement of metaphor as reasonable development, which they isolate into two fundamental viewpoints: (1) Source domain as the metaphor itself, or the representation of the thing itself, simply put as the concrete form; and (2) Target domain as something that worked and should be understood behind the metaphor, simply put as the

abstraction. Along these lines, metaphor is a deliberation that is speak to through solid frame, in this way at whatever point there is association between source area and target space, illustration will exist.

3.2 Metaphor Identifier

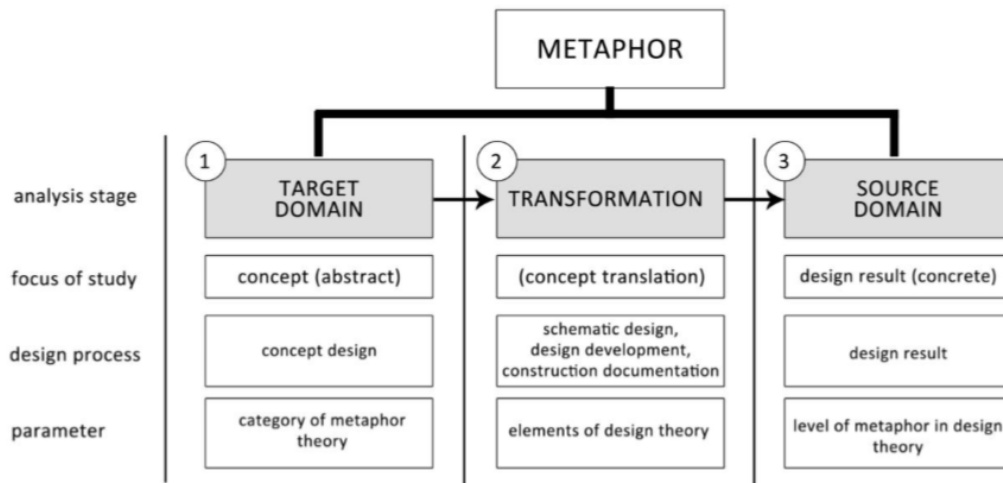
With all the argumentation above, we endeavored to make a procedure to recognizing metaphor and estimating its quality level in inside outline ventures:



Source: Done by the Researchers.

Fig. [3]: Theory translation towards composing tools for identifying metaphor and measuring its strength level in interior design projects

As an apparatus joined and utilized as a part of assessing interior design projects, we embedded the change procedure as an extension of interpretation and data from idea to usage. The change stage will be estimated through interior design basic elements: (1) form, a three dimensional surface shaping the whole interior (2) texture, determining the surface quality and (3) color, integrate the whole ambiance. In this manner Metaphor Identifier will take a shot at recognizing metaphor and estimating its quality level in interior design projects as demonstrated as follows:



Source: Madsen, K., (1994). A Guide to Metaphorical Design, Communications of the ACM, 37(12), pp. 62.

FIG. [4] Metaphor Identifier work flow

3.3 Categories of Metaphor

There is a major likeness between the classifications of Metaphor and those of Analogy. The two words by one means or another are connected together. Along these lines, numerous got confounded of utilizing the two words to allude to a similar idea. Antoniades A. C. (1992) distinguishes three board classifications for metaphor: 1. Tangible. 2. Intangible. 3. Combined.

-Tangible Metaphors

In which the figurative flight stems entirely from some visual or material character (a house as a stronghold, the top of a sanctuary as the sky) This one is all the more near visual similarity, in which the wellspring of the analogy is whether another building, frames from nature, or canvases. Tangible Metaphors looks like so much the classification of analogy in light of source nature, as calling the 'tangible metaphor' with 'Iconic Analogy'.

- Intangible Metaphors

In which the metaphorical departure for the creation is an idea, a thought, a human condition: or a specific quality (Individuality, naturalness, Community, Tradition, and Culture) Example Sustainability in design obtained shut cycle keeping in mind the end goal to accomplish biological system adjust.

- Combined Metaphors

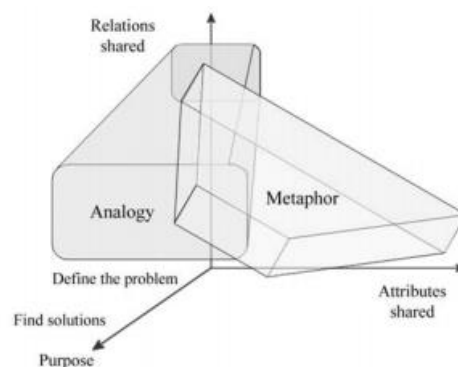
It is the conceptual and the visual cover as elements of the purpose of takeoff. The visual is reason to identify the ethics, the characteristics, and the basics of the specific visual holder.

3.4. Metaphor in design

Designer knows better in the light of this, as designer dependably inventively made something from deliberation to its genuine usage. We know it as idea or thought. Antoniades in Poetic of Architecture contended that this idea or thoughts normally based from three classifications of metaphors: Intangible Metaphor, Tangible Metaphor and Combined Metaphor. The first could be comprehended as an idea, a thought, a human condition or a specific quality. The second related entirely from some visual or material character, while the last was the point at which the theoretical and the visual cover or compared with each other. Much of the time substantial illustration alludes to a thing as it is near strict articulation and intangible metaphor alludes to a descriptive word as it is near understanding.

3.5 Metaphor and Analogy

Metaphors frame assist the designers in defining the design problem. Metaphors are normally used to outline's understanding, exercises and responses to an item. They enable understand client needs or physical traits from the wellspring of motivation. Metaphors' excellent correspondence capacity gives significance to to a design situation; a cafeteria when seen as a desert spring for its guests turns into a better place altogether.



Source: Gentner, D., (1983) *Structure Mapping: A Theoretical Framework*, *Cognitive Science*, 7, 1983, pp. 155..
Fig [5]. Definition and relationship between analogy and metaphor as used within design.

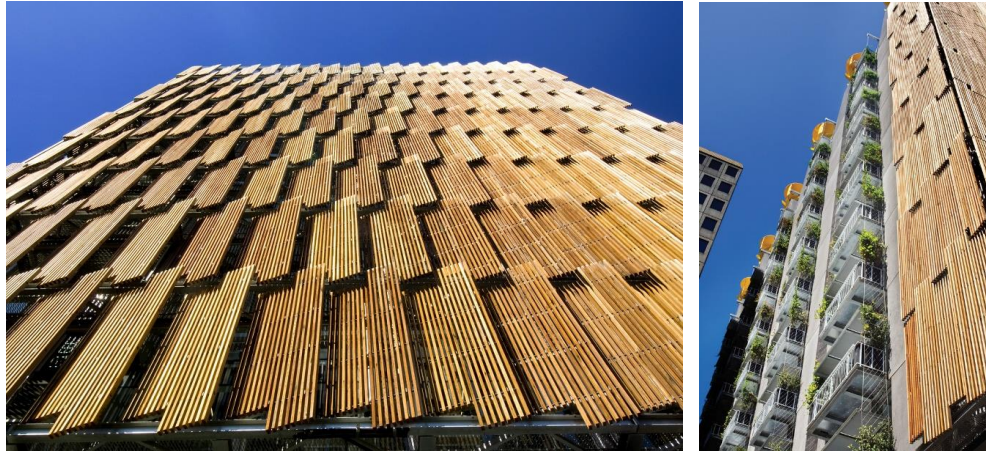
3.6. Metaphors, Literal Similarities, and Types of Analogies

An essential qualification ought to be made between metaphors, exacting similarities, and kinds of analogies. As indicated by Gentner and Jeziorski (1993), metaphor can be seen as a general classification enveloping analogies. Notwithstanding, Miller (1993) contended that comprehensively, "any outflow of likeness or similarity can be called a analogy ". An approach to recognize the two is to sort metaphors as things analyzed from an indistinguishable class and analogies from things thought about from various classifications. The "reason for an analogy, along these lines, can be planned as relations of comparability that can be communicated as examination explanations". Analogy is maybe a more inventive examination of less comparative relations. An analogy is a method for adjusting and concentrating on social shared traits autonomously of the articles in which those relations are inserted". Gentner and Gentner (1983) illuminated the refinement between exacting similarities and analogies by alluding to how the things are organized as diagram. Things are truly comparative when the specific attributes of the things are the same. Things are closely resembling when the social structures are comparable, however the specific attributes of every thing are not the same. Two distinct kinds of analogies can be recognized, surface component analogies and generative analogies. Goldschmidt (2001) called attention to that analogies can have either basic or surface component shared traits that are persisted to new things or circumstances. Things that are closely resembling in view of their surface highlights, nonetheless, may not be practically equivalent to fundamentally or thoughtfully. For instance, dialect or analogical terms can be obtained from one area as a helpful method for discussing another space. Generative analogies are the sort of analogies that give the capacity to make derivations from the base space to the objective area. These deductions can be made in light of the fact that the closely resembling connection between the base and target area depends on more than the surface highlights of each. The structure of every area is sufficiently comparative reasonably to produce derivations from what is thought about the base space. Inferences, as well as forecasts can be made in view of analogies. At the end of the day, analogies enable a man to go past the natural and reason about the new. Goldschmidt (2001) brought up that inductions and expectations with generative analogies can be made on the grounds that they are frequently not simply recognized but rather imagined. People can envision or "run" activities in their psyches, for example, causality, in light of what is thought about the base area.

4. CASE STUDIES OF ENERGY CONSERVING BUILDINGS UTILIZING

4.1 Council House 2 Building (CH2), Australia (Biological Analogy/ Organic)

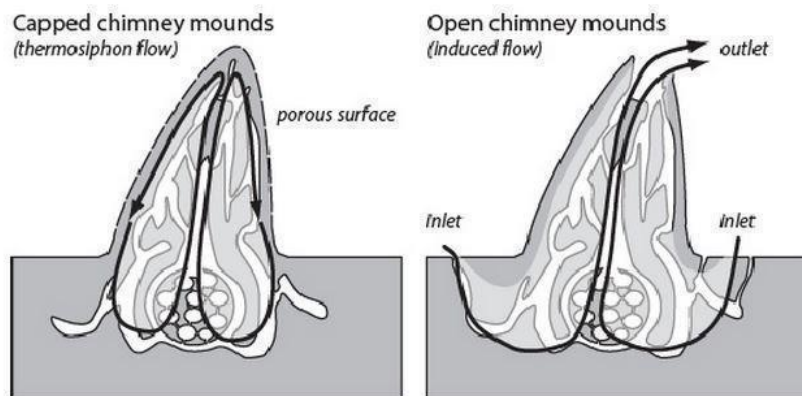
CH2 is an expansion for an effectively existing office working in Australia planned by a compositional firm called Designinc. It is a 10 stories building and it "a six star rating from the Green Building Council of Australia. (Dominque, H., 2007)." The building was intended to be a standout amongst the most vitality proficient structures "to make a compelling working for the staff and a building that would be a beacon venture locally, broadly and globally for natural development". One of the design objectives is to achieve the goal of zero ozone harming substance emanations. Numerous strategies to accomplish manageability could be discovered reused timber louvers, photovoltaic cells controlling the louvers, chilled roofs and Black water sewage reusing framework. They are endeavoring to accomplish an independent building that leaves no waste like a working constructed environment. The warming and cooling arrangement of the building is propelled by Termite hills. One of the termites' practices inside its assembled condition is directing the temperature of its hill. There are two procedures by which termites manage inward hill temperature as indicated by the opening over the hill. In the event that the highest point of the hill is shut then a procedure known as the thermo-siphon stream which may be "warm light air, driven by metabolic warmth exchange, is expelled from the home by means of a system of passages and ousted through the permeable surface of the hill. Here it is supplanted with cooler, denser air that plunges once more into the home (Bezemer, V., 2009).



Source: <http://www.inhabitat.com/ch2-australias-greenest-building/> (Accessed On 11/2/2018)

Fig [6] the different elevation treatments of the CH2 elevations according to orientation.

On the off chance that the best is opened then the aloof framework utilized is known as Induced stream and furthermore known as venturi impact "they are reliant on twist speed to evacuate warm air, which thusly attracts cool, thick air in through the base of the hill" (Bezemer, V., 2009). These strategies help the termites to settle the temperature inside the hill paying little respect to the temperature of the hill. The dirt stores the cool and the vents and pores in the hill dispose of the warm air on the off chance that it isn't required. The termites always make and open new vents while shutting old ones with a specific end goal to control the temperature.

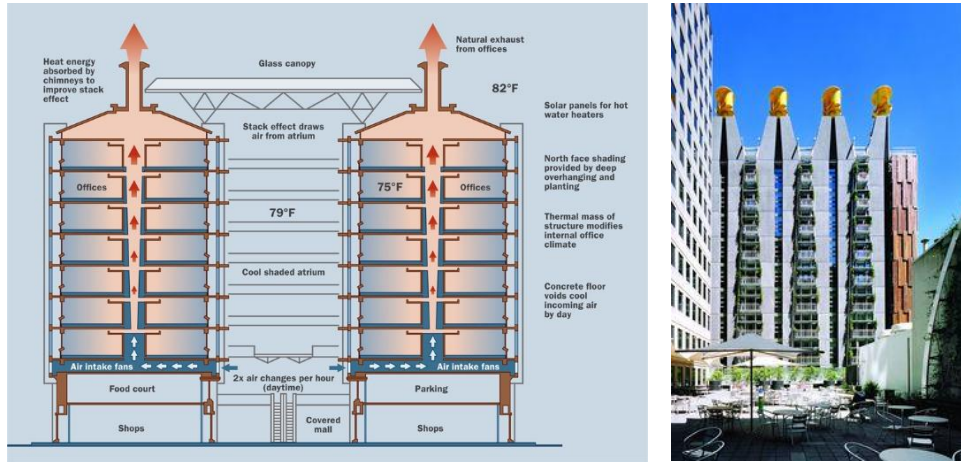


Source: <http://www.mero-structures.com> (Accessed on 11/2/2018)

Fig [7] The image shows the two different techniques of how the temperature of the mound is regulated.

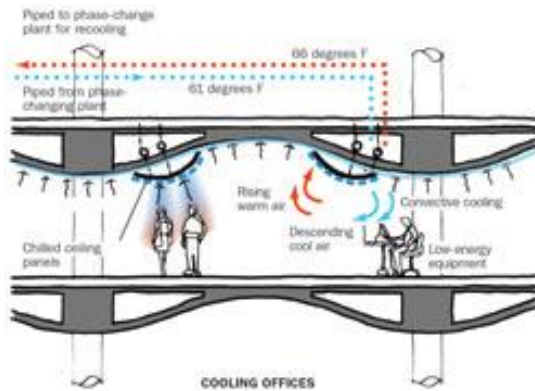
A similar idea was connected in the building to apply aloof cooling and warming to limit the utilization of HVAC frameworks that devour vitality and add to the outflow of Green House Gases. This framework was translated in the CH2 building by means of a progression of ventilation stacks in the north and south veneers (vents), controlled window openings (pores) and precast wavy solid roof (soil). The ventilation stacks were deliberately set on the northern façade in light of the fact that it is the most presented to the sun and the southern façade in light of the fact that it is slightest façade presented to the sun and this is because of its area in Australia. The hotter the air gets in the northern vents the simpler it ascends out and gets supplanted by cool air from the southern vents. To additionally improve this procedure the vents on the northern façade are painted dark to assimilate more warmth similar to a trombe divider impact and the vents on the southern façade is painted with a light shading to reflect warm (Bezemer, V., 2009).

The solid wavy roof has a comparative capacity to that of soil in termite hills which is putting away warm mass. The roof is wavy to "expand the surface zone and the warm mass limit." during the evening the solid replaces the hot warm mass put away in it for the duration of the day by the cool night air; Moreover there are channels that gather the warmed air and expel it out through the ventilation stack.



Source: Dominique Hes, Design Snap Shot 07, pg.1

Fig [8] Sections showing how the passive cooling techniques work in the building and the termite mound paints

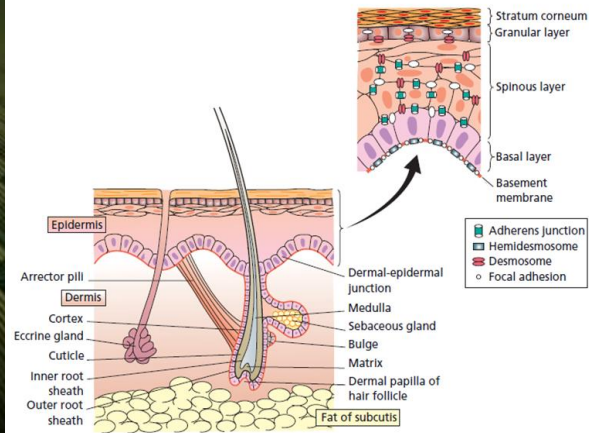


Source: Dominique Hes, Design Snap Shot 07, pg.1

Fig [9]. The wavy ceiling that has the same function of soil in Termites mound.



This type of impersonation of nature isn't depended on totally there are more strategies and frameworks utilized as a part of the CH2 working to upgrade the result and it is as yet not 100% without human mediation anyway it is motivated from the conduct of termites and how they utilize accessible normal assets to make their encompassing condition agreeable and it is an approach to handle aloof warming and cooling to limit vitality use and harming the earth. The building envelope is enlivened from mammalian skin. The idea is that there is an external layer that arrangements with the outer condition (epidermis) and the internal layer secures within components and states of the CH2 building (dermis). The outside layer is porous and the internal layer is shut and opened by require.



Source: <http://www.mero-structures.com> (Accessed on 11/2/2018)

Fig [10] The double skin the epidermis (wood panels) and the dermis (curtain wall)

4.2 Esplanade art center Singapore (Visual analogy - Biological/ Ecological)

This building shading framework was propelled by two components of nature the durian organic product a neighborhood organic product in Singapore that is otherwise called the ruler of natural products; and the polar bear which is an outsider to this piece of land. The durian plant has thistle like projections everywhere on its semi inflexible skin to shield the seeds inside it from warm and coordinate sun beams. The thistles are the shading gadgets that are imitated from the durian plant. The polar bear is known for its white hide which really comprises of straightforward hair follicles and dark skin. The straightforward hair when upright enable the light to infiltrate and be consumed by the dark skin at whatever point there is sun and come back to ordinary position generally. This movement by identifying daylight is what was copied from the polar bear in light of the fact that dissimilar to the polar bear in this building the warmth isn't needed. Designed by architects Michael Wilford and specialists Atelier one. It is a social focus that comprises of two immense theater structures, open air stages, workplaces and lofts. The plan idea depends on the building envelope for capacity and stylish characteristics. The principle capacity of the building envelope is to give the inside space an outer shading framework for the duration of the day permitting common sunlight and negligible warmth.



Source: <http://www.mero-structures.com> (Accessed on 15/2/2018)

Fig [11] Images of the art center.

This building shading framework was propelled by two components of nature the durian organic product a neighborhood organic product in Singapore that is otherwise called the lord of natural products; and the polar bear which is an outsider to this piece of land. The durian plant has thistle like bulges everywhere on its semi inflexible skin to shield the seeds inside it from warm and coordinate sun beams. The thistles are the shading gadgets that are impersonated from the durian plant. The polar bear is known for its white hide which really comprises of straightforward hair follicles and dark skin. The straightforward hair when upright enable the light to infiltrate and be consumed by the dark skin at whatever point there is sun and come back to typical position generally. This movement by identifying daylight is what was mirrored from the polar bear on the grounds that not at all like the polar bear in this building the warmth isn't needed (.www.biomimeticarchitecture.com)

Source :
www.biomimeticarchitecture.com
(Accessed on 16/2/2018)

Fig [12] The first image is of the Durian fruit and the second image is of the polar bear skin and fur



The latent procedure for shading and controlling the inside space temperature and light enlivened from durian plant and polar bear is connected in the twofold bended building envelope. The aluminum shading gadgets take after the durian natural products thistles distending to give shade and they move like the polar bears hair as indicated by sun area and light power through photovoltaic sensors along these lines securing the inward space of the craftsmanship focus.



Source V. Bezemer, *sustainable buildings by imitating nature cooling techniques*, November 2009

Fig [13] the protrusions resembling the durian fruits thorns and they move via photovoltaic sensors like the polar bears hair response to the sun that create a well-lit interior and prevents over heating of the space

4.3 Minister of Municipal Affairs & Agriculture building in Doha, Qatar (Visual analogy – Form and Function/ Surface Analogy)

Because of betray condition the whole building structure and capacity was motivated from the prickly plant a plant indigenous to the leave as appeared in figure. The principle goal of the outline was to make a building that is exceedingly vitality effective. The building shading framework is enlivened from the prickly plant capacity to shade itself to abstain from losing water in the dry spell climate it exists in. one of the desert flora procedures to abstain from losing dampness is utilizing its spines or thistle like structures to trap air close to the surface skin to keep the surface cool and furthermore they give shade from the sun.

An office building intended for the service of metropolitan issues in Doha which is known for its to a great degree sweltering climate and the extreme leave sun. The building is composed by a design firm known as Esthetics Architects Go Group. Because of forsake condition the whole building structure and capacity was motivated from the prickly plant a plant indigenous to the betray as appeared in figure (). The primary goal of the plan was to make a building that is exceptionally vitality effective. The building shading framework is propelled from the desert plant capacity to shade itself to abstain from losing water in the dry season climate it exists in. one of the desert plant methods to abstain from losing dampness is utilizing its spines or thistle like structures to trap air close to the surface skin to keep the surface cool and furthermore they give shade from the sun.



Source <http://www.robaid.com/bionics/green-architecture-qatar-cacti-biomimicry.htm> (Accessed on 18/2/2018)

Fig [14] Images of cactus and how its curves help it shade itself better and the spines that protect and shade it.

The building is secured through and through with shades that impersonate the spines of the desert plant and play out a similar capacity of shading the surface of the working as appeared in figure (15). As indicated by the sun power the shading gadgets open and close amid day time this is an understanding to the desert plant transpiration which happens as per sun force. Additionally another element in this building is utilizing distinctive environmental frameworks to clean filthy water. Each natural framework softens toxins up water as per the supplements it encourages and what it needs to flourish from the water. Those environmental frameworks rely upon "The utilization of accommodating microscopic organisms, growths, plants, snails, mollusks and fish that flourish by separating and processing contaminations". On the off chance that this building is executed it would be one of only a handful couple of structures utilizing biomimetic strategies that did not simply copy a life form or a conduct but rather an environmental framework that disposes of its squanders normally (www.biomimeticarchitecture.com).

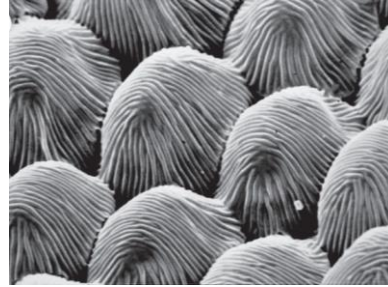


Source <http://www.robaid.com/bionics/green-architecture-qatar-cacti-biomimicry.htm> (Accessed on 18/2/2018)
Fig [15] It is obvious in the image the building resembles the cactus in form and function.

4.4 Hydrological center for the University of Namibia (Biological – Anatomical Analogy)

The Namibian leaf scarab can separate drinking water from the haze and dew beads in air. The scarab raises its behind legs around 45 degrees and appearances the blowing wind or mist and the hard shell gathers the water beads as they consolidate on it and this is on the grounds that it is intended for this reason by means of the "hydrophobic knocks and hydrophilic valleys that stream down into the Beetles mouth". This motivated the modeler to make a similar method in the working through a tremendous haze catcher that is the height confronting the blowing winds. The nylon work mist catcher gets water beads and by means of gravity the consolidated water drops into a tank that is found underground. This water is added to another tank with desalinated water utilizing photovoltaic boards and afterward it goes ahead to sustain the building. The draftsmen's perception of nature and impersonating a straightforward life form like the creepy crawly brought about a basic latent way that conveyed water to a somewhat droughty locale and may take care of an issue that most districts will undoubtedly confront which is the absence of water.

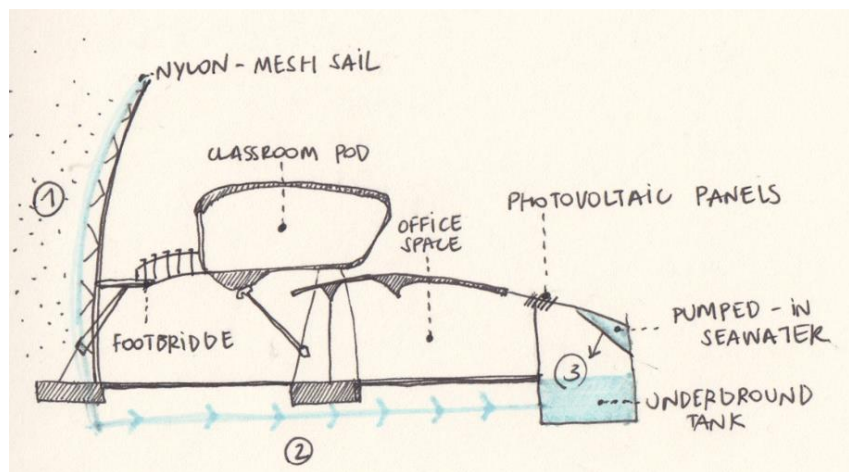
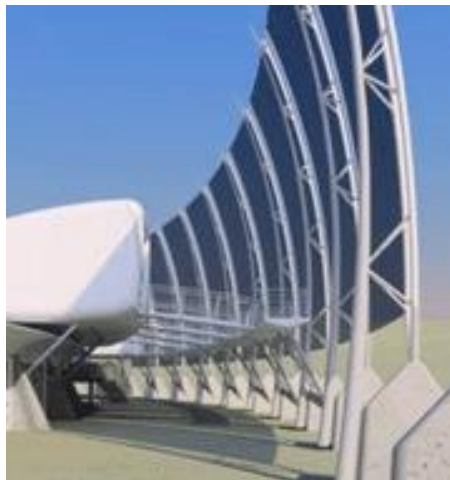
This a proposed task to include a hydrological place for the University of Namibia; the outline of the building was proposed by designer Mathew Parkes of KSS planners. Because of the way that there is a noteworthy water issue in Namibia as a result of the dry season and negligible presence of water body a hydrological focus was of significance since it will give a "logical investigation of the properties, circulation, and impacts of water on the world's surface, in the dirt and fundamental rocks, and in the environment." This will help inquire about effective approaches to take care of the water issues. The Namibian abandon creepy crawly can separate drinking water from the mist and dew beads in air. The scarab raises its behind legs around 45 degrees and appearances the blowing wind or haze and the hard shell gathers the water beads as they consolidate on it and this is on the grounds that it is intended for this reason through the " hydrophobic knocks and hydrophilic valleys that stream down into the bugs mouth" (Magali ,B.,).



Source: <http://www.metropolismag.com> (Accessed on 23/2/2018)

Fig [16]. The beetle when it raises its behind legs facing the wind or fog, a microscopic image showing the hydrophobic bumps and hydrophilic valleys found on the Beetles shell.

This propelled the engineer to make a similar strategy in the working through an enormous haze catcher that is the rise confronting the blowing twists as appeared in figure (17). The nylon work haze catcher gets water beads and by means of gravity the dense water drops into a tank that is found underground. This water is added to another tank with desalinated water utilizing photovoltaic boards and after that it goes ahead to sustain the building. The engineers' perception of nature and mirroring a basic life form like the scarab brought about a straightforward latent way that conveyed water to a fairly droughty locale and may take care of an issue that most districts will undoubtedly confront which is the absence of water (www.metropolismag.com).



Source: <http://www.metropolismag.com> (Accessed on 23/2/2018)

Fig [16] The fog catcher and the route of the water after it condenses on the nylon mesh.

5. Conclusion

- This paper encourages future designers to comprehend the parts of analogy and metaphor in creative design. It explains analogy definition as a significant problem solving technique, a noteworthy critical thinking procedure and a logical reasoning strategy. It is drawing similarities and contrasts between a source and an objective to exchange a specific arrangement or matter from the source to the objective. It helps in presenting analogy as a method or means of comparison between Similar and differentiated properties of objects. It also sheds up light on the principle purposes of analogical thinking which includes:

1) Problem solving and Critical thinking. 2) Explain to others. 3) Recognize and Identify problems. Additionally, it presents metaphor as an etymological phenomenon, a more interesting methods of expression to allude to two items not actually comparative but rather accepting they are, through

symbolism and abstraction. It is the interpretation of one thing in type of another. Eventually, the paper clears up the qualification amongst metaphor and analogy in the outline procedure. Results from hypothetical and test information demonstrate that designers utilize both analogy and metaphor inside the plan procedure unwittingly. All the more fundamentally, the outcomes recommend that metaphor use is primarily employed in the early problem framing stages of design to enhance understanding of a design situation. Analogy is generally utilized as a part of the idea age period of configuration to delineate causal structure between a source thought in one space to the objective outline issue being explained. The paper additionally discusses the impact of metaphor on comprehension of the design itself. The consequences of these discoveries prompt a general philosophy to all the more viably utilize metaphors and analogies in design or innovation forms. This methodology might be adjusted for use inside specific classrooms, educational outline processes, or modern improvement forms.

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