

**Predictive Perspective for Assessing Visual Perception of
Existing Libraries Architectural Forms by Generative
Redesign**

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Abstract:

The preferences of both architects and users over time, and on occasion, major upkeep and repairs are required. There is no assurance that a building's original compositions will always be appreciated, nor that it will preserve its excellent standing. Once a structure has been constructed, there is no assurance that it will continue to be in good standing once it has been completed. Despite this, a building's reputation can be maintained despite the state in which it is currently located. The building will undergo certain extensions as a direct result of the necessary alterations. It is occasionally necessary to alter the structure's present shape or composition—some extensions being done to create additional space. The professionals assigned a relative weight to the essential components of the visual perception appreciation process, those components underwent reprioritization after their ranks were determined, and the experiment on regeneration adhered to the priorities that the specialists had specified. By using delphi techniques, in which experts were asked to evaluate the quality of the regenerated design, it was possible to validate and narrow down the options for the numerous forms generated from data and reduce the number of alternatives.

Because of this, the options built by artificial intelligence software to regenerate the forms using the priorities from

experts' evaluation, which highlighted the order of interventions.

Key Words:

Architectural forms, regenerative design, libraries form, perception, visual design, form validation.

Introduction

Numerous studies have cataloged the wide range of visual features that either convey the architect's aesthetic vision or affect the aesthetic sacrifices made in the project. Some redesigns make inappropriate alterations to older buildings that cause not only specialists to reject the design but also locals to move out of the area because they have lost the mental image of the building. In other cases, trials fail because the new design isn't good enough due to disrespect for the visual factors of good architectural design and this is the research problem, as concluded in previous research. Please see the figures from 1:8



Figures 1 and 2 show a building that had been unsuitably redesigned



Figures 3 and 8 sets of buildings unsuitably redesigned concerning shape, colors and materials

One way to think of aesthetics as the art of beautiful thinking, another as the art of sensory cognition, and yet another as a lower theory of cognitive processing. As a result of the widespread documentation of the fact that all visual properties have the potential to be aesthetically experienced or to affect aesthetic visual preferences.

2. Architectural Visual preferences

the twenty-first century is concerned with bespoke architectural creations, which are primarily linked with individual design experts, rather than with mass-produced building types, as were their predecessors. This shift in emphasis can be attributed to the fact that the twenty-first century has seen a widespread increase in the number of people interested in documenting that all visual properties have the potential. As a result of this culture's preference for experimenting, which has led to a preponderance of form over content in architectural design, there have been many changes in how we view the beauty of buildings.

This has led to a predominance of form over substance in architectural design. The following is a list of the visual aspects that can be appreciated for their aesthetic value:

- Visual Complexity, Because of the size discrepancy between the building's numerous parts and its overall condition.
- Colour, It's established knowledge that colour is the fastest-recognized visual signal and has a major impact on people's taste judgements.
- Symmetry is typically preferred over asymmetry, even in complex abstract forms, because the human eye more easily recognizes it.
- Familiarity, Because of your consistent visits, you will develop a stronger attachment to the building and its architectural form.
- Knowledge and experience: The architect's aesthetic judgements may be influenced by their training and experience in design and construction.
- The shape describes the building's aesthetic, the arrangement of the building's architectural elements that give rise to its complex forms.
- Materials, The materials used in constructing a building or object give it a certain look and feel and hint at its age and style.
- Functional character is the interior's expected functional quality (depending on the category of the building or the building to be selected for the survey).

3. Research materials and methods

The chosen research methodology consists of preliminarily listing some outstanding criteria deducted from the previous study highlighted on international and national libraries cases of study to measure the quality of redesigning libraries' existing buildings; in addition, to perform regenerative design experiments to introduce proper architectural solutions for buildings redesigns applied on one building, an action plan resulting from this research to applied in Egyptian libraries building tested on a case of study as a pilot experiment, and validated by specialists by an online questionnaire adopted to collect the required data of evaluating the quality of form regeneration based on using the prioritized factors which ranked by experts and named as responsible of the visual perception.

4. What is a regenerative design development

To ensure that all crucial design parts are subject to singular, irreversible variables, creating a geometric model capable of outlining a succession of shaping possibilities is necessary. The algorithm's capacity to independently govern each feature of the design while searching for optimal combinations for the repeated design possibilities relies on the uniqueness of each shape metric .

All values must be continuous since the algorithm should optimize the settings based on anticipated future results based on the past patterns of the current structure.

The search algorithm in a generative design technique needs to be able to read all performance measures for the hypothetical design system as a numerical code, which can be limiting .

Since the architect's intended performance parameters for the algorithm are the visual perception factors, it is crucial that all outcomes of the design solutions can be reliably estimated and analyzed using these factors.

Once a generative model is complete, an algorithmic investigation can be carried out to develop high-performing designs. Optimization techniques often involve searching for the ideal settings for the input values of a requirement to maximize the value of one or more preferred outputs.

Regenerative design typically starts with a collection of foundational designs that are selected randomly or in some proportion. Either random parameter swapping (called "cross-breeding") between two successful designs yields a third (or "generation") that outperforms its predecessors, or direct optimization of design performances based on the previous generation's results yields "generations" that outperform their predecessors (elitism).

The basic input values of each new design can be subtly altered through a mutation process before being introduced to the population. This process is continued for an extended period, up to the maximum number of generations or until no further performance improvements can be achieved .

5. Using Generative Design in existing buildings enhancements



The broad strokes of the regeneration plan are sketched out, with the comprehensive restoration of the structure as its bedrock. All the requirements for integrating the building with nature, especially those about the need to apply sustainability, have been met because the removal of certain components and the installation of others ones resulted in the new form of the existing building. The requirement to use sustainable practices is to credit for this. Improvements in comfort and efficiency in using nonrenewable energy sources and scarce materials are the results of a recent renovation that was carried out whether or not the building was created sustainably in mind: precipitation collection, improved natural light and air exposure, and other advantages .







Instead of calling for a change in approach, regenerative design and development focus on adopting a different frame of mind.

To put focus on this regenerative worldview, the company Regenesi has developed a regenerative methodology that provides a collection of guiding ideas and concepts. The three stages of implementing this technique are finding the right link to the environment, planning for harmony and co-evolution, and finally, putting it together. By highlighting the relevance of having a sense of community and belonging through an appreciation of location, harmonious design is offered, and co-evolution ensures the continuing integration of human and natural systems in a mutually beneficial way.

6. Cases of study analysis based on the visual factors


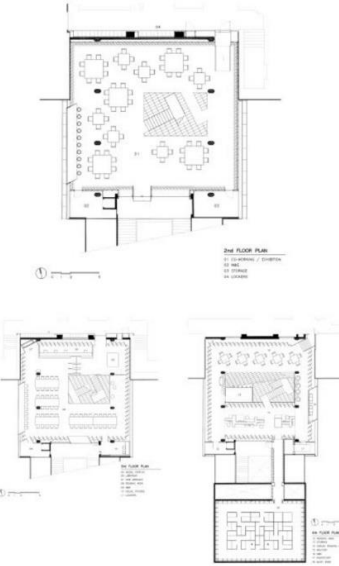
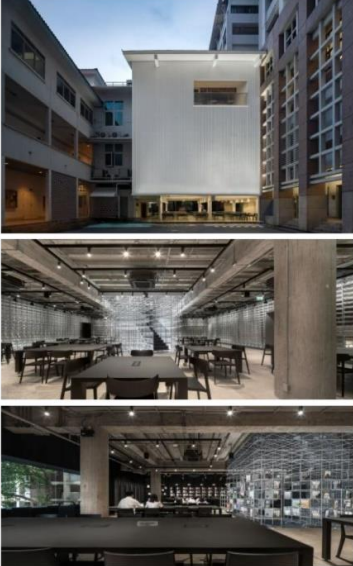
Eight international library buildings were chosen in addition to eight Egyptian public libraries highlighting the visual factors analyzed by the authors under the criteria of being a standalone building with clear masses composition to give relative weights after reviewing the understanding of those factors in relation to architectural forms, the given weight done by delphi technique as detailed after the cases analysis.

Analytical Study of the building (Alaska State Library)		
Building history	Building analysis	Illustrative
<p>Architects: Hacker Architects</p> <p>Area : 120000 ft²</p> <p>Year : 2016</p> <p>Photographs :Lara Swimmer</p> <p>Manufacturers : Terrazzo & Marble, Zone Display Cases, Argeton, Delta</p> <p>Designs Civil Engineer : R&M</p> <p>Engineering Landscape Architect : Walker Macy</p> <p>Structural Engineer : Schneider & Associates Mechanical</p>		







Architectural and aesthetic form analysis			
Visual Complexity	interior color	Symmetry	Expertise
<p>The facade consists of a main block, which is a rectangle covering the glass, and next to it another prominent block for the closed reading part</p> 	<p>There is a harmony in the interior colors of the spaces through the combination resulting from the similarity of the colors of the raw materials between wood and marble</p> 	<p>There is no symmetry</p> 	<p>Hacker Architects Architecture Office· Portland, United States</p> <p>Hacker Architects has 4 projects published: Cultural architecture, Residential architecture</p>
<p>The shape that defines the image of building</p>  <p>Use the shape of the rectangle at the destinations while trying to shape it and change its size in the different blocks forming the facade</p>	<p>There is a harmony between the materials in the interior design and in the exterior destinations in terms of marble, glass and wood</p> 	<p>The main function of the building is to be used as a library for reading as well as a large lecture hall, while the rest of the spaces are services and spaces for employees</p>	<p>There is a harmony in the colors of the main facade of the building, where the combination between the color of white, the color of brown wood and the color of blue-tinted glass</p> 

data of reference analyzed by the authors with respect to the previously mentioned visual factors¹

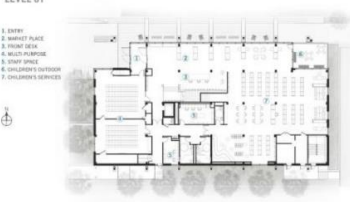
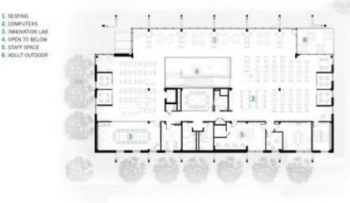



Analytical Study of the building (Architecture library Chulalongkorn)

Building history	Building analysis	Illustrative images
<p>Architects : Department of Architecture</p> <p>Area : 1260 m</p> <p>Year : 2019</p> <p>Photographs : W Workspace</p> <p>Lead Architects : Twitee Vajrabhaya , Chaiyapat Mirasena</p> 		




Architectural and aesthetic form analysis




Visual Complexity	interior color	Symmetry	Expertise
 <p>The building is a rectangular block with three window openings in the middle</p>	 <p>There is a combination in the colors of the interior design between dark brown and lead, which led to the use of many lights to allow people to see well</p>	 <p>There is a symmetry in the main facade</p>	<p>They designed 14 different buildings and these are some of their designs: Sala Bang Pa-In Hotel / Department of ARCHITECTURE - The Commons Saladaeng / Department of ARCHITECTURE- Architecture Library Chulalongkorn University - Little Shelter Hotel / Department of Architecture -Mist Hot-spring Hotel / Department of Architecture -Thailand Creative and Design Center / Department of Architecture -</p>
<p>The shape that defines the image of building</p>  <p>The dominant geometric shape of the building is the shape of a rectangle</p>	 <p>The entire facade was painted white with glass window openings</p>	<p>The ground floor of the building was used for activities and the first floor was used for reading and the surface is divided into two parts, an open part and a closed part</p>	 <p>The interface was characterized by a white color with the addition of some lights</p>

data of reference analyzed by the authors with respect to the previously mentioned visual factors²

Analytical Study of the building (DCPL Southwest Neighborhood Library)		
Building history	Building analysis	Illustrative images
<p>Architects: Perkins and Will</p> <p>Area : 6705 m² Year : 2021</p> <p>Photographs : James Steinkamp Photography</p> <p>Lead Architects : Carl Knutson, Nancy Gribeluck, Joshua Rubin, Kate Currie</p> <ul style="list-style-type: none"> • General Contractor : Turner Construction, Joelle Friedlander - Turner Construction • Landscape Architect : Landscape Architecture Bureau LLC, Joseph Chambers - Landscape Architecture Bureau LLC • Civil Engineer : Wiles Mensch Corporation, Joseph Mensch - Wiles Mensch Corporation 	<p>LEVEL 01</p>  <p>LEVEL 02</p> 	  

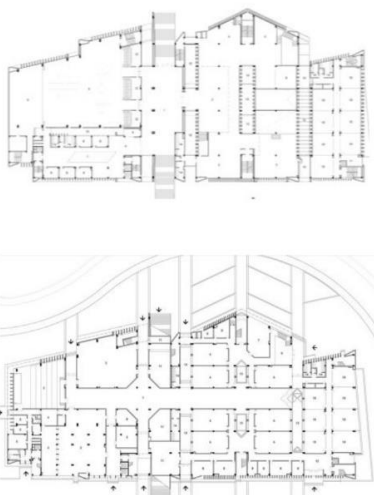

Architectural and aesthetic form analysis

Visual Complexity	interior color	Symmetry	Expertise
 <p>The building is a rectangular shape and is covered with a timber covering</p>	 <p>The interior design of the spaces is characterized by light colors as well as the presence of many large windows</p>	 <p>There is a symmetry in the main facade</p>	<p>Schwartz/Silver Architects Architecture Office- Boston, United States</p> <p>They designed 14 different buildings and these are some of their designs:</p> <p>Charlotte & William Bloomberg Medford Public Library - Rhode Island College Art Center - Rhode Island College Art Center - A. H. McCoy Federal Office - House at Tanglewood -</p>






The shape that defines the image of building	Materials	Functional character	The color of the facade
 <p>The shapes that formed the building are triangles formed together as a structure covering the facade, while the rest of the</p>	 <p>The main facade consists of wood and glass, but inside the floors were parquet and the ceiling was made of wood</p>	<p>The building consists of two floors, the first floor is for children, the main entrance and the reception space, while the second floor consists of labs, closed spaces and staff spaces</p>	 <p>The facade consists of glass and also Wood, which makes a cover on it</p>

Data of reference analyzed by the authors with respect to the previously mentioned visual factors³

Analytical Study of the building (Jiangxi College of Construction Complex)

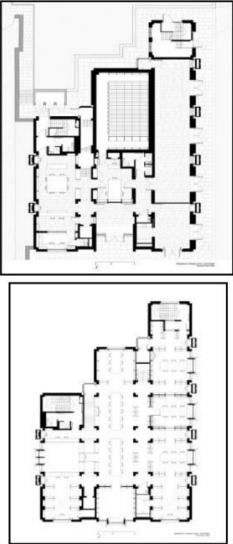

Building history	Building analysis	Illustrative images
<p>Architects: Architectural Design and Research Institute of SCUT Area : 31266 m² Year : 2020 Photographs :SFAP Lead Architects : Zhi Tao, Qinen Guo, Zijian Chen Design Team : Qinen Guo, Wenyu Lian, Tao Chen, Anyong He Structural Design : Hongtao Lai, Zhiwei He, Sijia Lin, Yong Xiong Electrical Design : Xiaofeng Huang, Tao Chen Interior Design : Qinen Guo, Ke Chen, Yang Ai, Chengjie Huang, Wenyu Lian Client : Jiangxi Hengsan Construction Engineering Co. City : Nanchang</p>		

Architectural and aesthetic form analysis




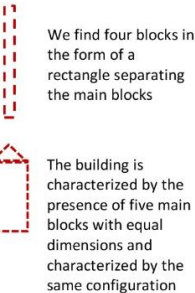

Visual Complexity	interior color	Symmetry	Expertise
 <p>The building consists of five blocks, we clearly see the lecture block is the largest and dominant block in the form</p>	 <p>The interior design is covered in white color with a gradient of ceilings and rectangular windows, which are characterized by the same</p>	 <p>There is no symmetry</p>	<p>Architectural Design and Research Institute of South China University of Technology is a well-known Class-A design and research institute in China. It possesses multiple qualifications for architectural activities such as engineering design, examination of construction drawings of architectural projects (including out-of-codes high-rise buildings), design of intelligent system engineering projects, engineering consultation, city planning, municipal public utilities, and engineering exploration. It has passed the ISO9001 quality system verification. After 30 years of development,</p>
<p>The shape that defines the image of building</p> <p>The building consists of five blocks, which are rectangles ending in sharp triangular corners</p>	<p style="text-align: center;">Materials</p>   <p>The main facade consists of aluminum cladding and glass cladding, but from the inside, the floor was parquet and the ceilings were gypsum board.</p>	<p style="text-align: center;">Functional character</p> <p>The building consists of two floors, the first floor is for the open library spaces and the lecture hall, while the second floor is for the closed spaces and the staff spaces</p>	<p style="text-align: center;">The color of the facade</p> <p>The facade consists of a combination of white color and the color of blue glass, which is covered with Casers</p>

data of reference analyzed by the authors with respect to the previously mentioned visual factors⁴

Analytical Study of the building (Magdalene College Library)



Building history	Building analysis	Illustrative images
<ul style="list-style-type: none"> • Architects: Niall McLaughlin Architects • Area : 2000 m² • Year : 2021 • Photographs :Nick Kane • Manufacturers : Eurban, Junckers, Neue Holzbau AG, Reynaers, Schüco, VMZINC • Main Contractor : Cocksedge • Structural Engineer : Smith and Wallwork • Project Manager : Savills • Quantity Surveyor : Gleeds • Acoustics Consultant : Max Fordham • M&E Consultant : Max Fordham 		

Architectural and aesthetic form analysis







Visual Complexity	interior color	Symmetry	Expertise
 <p>The main facade consists of five main blocks in the form of a rectangle ending above with a triangular block and separated by four towers</p>	 <p>We find the brown wood color covering most of the walls with the presence of a wooden floor made of Parquet</p>	 <p>The main facade is characterized by symmetry, as well as we see it clearly in the interior design</p>	<p>Niall McLaughlin Architects Architecture Office</p> <p>They designed 10 different buildings and these are some of their designs:</p> <p>Auckland Tower / Niall McLaughlin Architects- Hampshire House- Jesus College- Sultan Nazrin Shah Centre- Bishop Edward King Chapel- Burren House- House at Goleen- Student Accommodation, Somerville College</p>
<p>The shape that defines the image of building</p>  <p>We find four blocks in the form of a rectangle separating the main blocks</p> <p>The building is characterized by the presence of five main blocks with equal dimensions and characterized by the same configuration</p>	<p style="text-align: center;">Materials</p>  <p>The main facade consists entirely of bricks and there are openings of glass windows, but from the inside the walls were completely covered with wooden traditions, as well as the floor of Parquet</p>	<p style="text-align: center;">Functional character</p> <p>The main function of the building is to use it for reading, when walking in the main corridors of the building, we find books on the right and left placed in the shelves</p>	<p style="text-align: center;">The color of the facade</p> <p>The brown color predominates over the brick color on the destinations</p>

data of reference analyzed by the authors with respect to the previously mentioned visual factors⁵

Analytical Study of the building (Pierrefonds Public Library Chevalier Morales

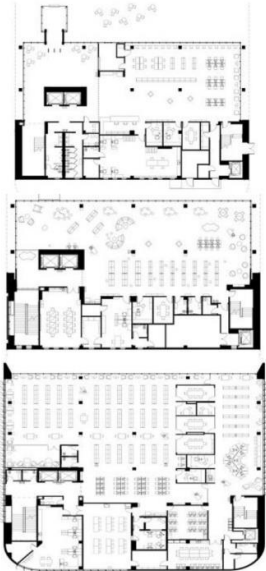

Building history	Building analysis	Illustrative images
<ul style="list-style-type: none"> • Architects: Chevalier Morales Architectes, DMA • Area : 4550 m² • Year : 2019 • Lead Architects : Stephan Chevalier, Sergio Morales and François Lemoine. Architects: Alexandre Massé, Julie Rondeau, Gabriel Lanthier, Céline Leclerc, Christian Aubin, Ève Beaumont-Cousineau, Catherine St-Marseille, Simon Barrette, Geneviève Riopel 		

Architectural and aesthetic form analysis


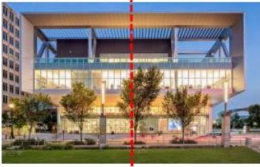
Visual Complexity	interior color	Symmetry	Expertise
 <p>The block is a rectangular block from which two triangles branch out representing the open reading spaces inside the library and the block is completely covered by glass panels</p>	 <p>We find the white color covering the walls and ceilings with the presence of marble in the floor</p>	 <p>There are no clear symmetries in the main facade</p>	<p>Chevalier Morales Architectes Architecture Office · Canada</p> <p>They designed 8 different buildings and these are some of their designs:</p> <p>Residence de l'Isle- Drummondville Public Library- Vallée du Parc Residence- Saul-Bellow Library- Résidence Roy-Lawrence- Houle- Thibault Residence- Strom Spa Nordique</p>
<p>The shape that defines the image of building</p>  	 <p>The exterior facades are completely covered with glass with the presence of aluminum casters, while the interior design is covered in white with the presence of gypsum board in the ceilings and marble in the floor</p>	<p>The building consists of two floors, the first floor is used for children's rooms, games, exercise rooms, electrical and mechanical rooms, while the second floor has open reading rooms, labs and cafe</p>	<p>The exterior facades are completely covered with glass with the presence of aluminum casters, Coated with white and blue color</p>

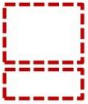

data of reference analyzed by the authors with respect to the previously mentioned visual factors⁶

Analytical Study of the building (River Center Branch Library)

Building history	Building analysis	Illustrative images
<ul style="list-style-type: none"> • Architects: Schwartz/Silver Architects, WHLC Architecture • Area : 49000 ft² • Year : 2020 • Photographs :Tim Mueller, Matthew Caillouet, Collin Richie • MEP Engineering : Associated Design Group, Inc. • Structural Engineer : SCA Consulting • Technology & Acoustics : Shen Milsom Wilke, LLC • Landscape Architect : Reich Associates • Civil Engineering : CSRS • General Contractor : Buquet & LeBlanc, Inc. 		



Architectural and aesthetic form analysis

Visual Complexity	interior color	Symmetry	Expertise
 <p style="font-size: small;">The building consists of a prominent main block in the form of a rectangle</p>	<p style="font-size: small;">The interior design is characterized by a white color in the walls with some drawings on the walls and the floor is covered with dark marble</p>	 <p style="font-size: small;">We can observe the presence of a metric in the main interface</p>	<p style="font-size: small;">Schwartz/Silver Architects Architecture Office· Boston, United States</p> <p style="font-size: small;">They designed 5 different buildings and these are some of their designs:</p> <p style="font-size: small;">Charlotte & William Bloomberg Medford Public Library- Rhode Island College Art Center- A. H. McCoy Federal Office- A. H. McCoy Federal Office- House at Tanglewood</p>






The shape that defines the image of building	Materials	Functional character	The color of the facade
 <p style="font-size: small;">The building consists of two blocks, the Upper Block is the main block, which is the prominent block, and below is another small rectangular block</p>	 <p style="font-size: small;">The exterior is covered with glass, while the interior is covered with white color on the walls</p>	<p style="font-size: small;">The building consists of three floors, the first floor has a main entrance and a reception space, while the rest of the floors have open reading spaces for reading and lab Labs</p>	<p style="font-size: small;">The exterior is covered with blue glass and white walls</p>

data of reference analyzed by the authors with respect to the previously mentioned visual factors⁷

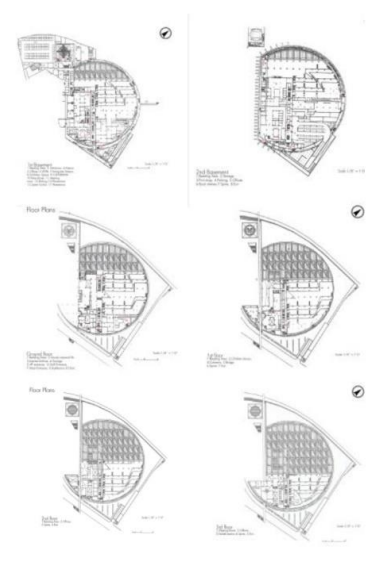
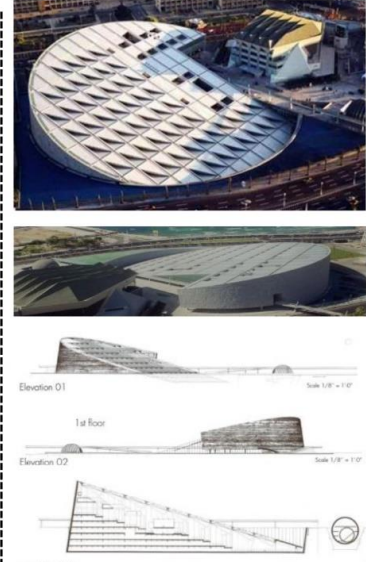
Analytical Study of the building (Viby Library & Culture House)

Building history	Building analysis	Illustrative
<p>Architects: <u>Christensen & Co. Architects, Primus Arkitekter</u> Area : <u>1400 m²</u> Year : <u>2021</u> Photographs : <u>Niels Nygaard</u> Design Manager : <u>Saskia Peinow, David Bjørnsdall Nielsen, Marie Morsing Jacobsen</u> City : <u>Viby Sjælland</u> Country : <u>Denmark</u></p>		

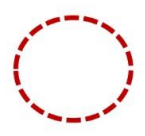

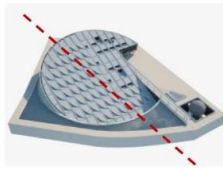
Architectural and aesthetic form analysis


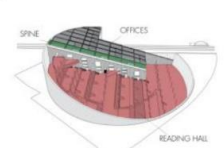
Visual Complexity	interior color	Symmetry	Expertise
 <p>When looking at the main facade of the building, we find that it takes the form of cracks and is emptied with glass holes</p>	 <p>The walls cover the white color with the presence of some wood cladding in addition to shelves and lots of lights</p>	 <p>There is a symmetry in the main facade</p>	<p>Christensen & Co Architects Architecture Office- Denmark</p> <p>They designed different 15 buildings and these are some of their designs:</p> <p>Odsherred Theatre -Linneaus University in Kalmar-K.B. Hall- Forsyning Helsingør Operations Center-</p>
<p>The shape that defines the image of building</p>  <p>The dominant geometric figure on the main facade is the shape of adjacent triangles</p>	<p>Materials</p> <p>The main facade is covered with cladding made of white wood and at the bottom the openings and doors are made of glass</p>	<p>Functional character</p> <p>The building consists of two floors, the ground floor consists of the main entrance, reception space and places to buy gifts and food, while the second floor consists of closed reading spaces and special spaces for children</p>	<p>The color of the facade</p>  <p>The destinations are covered in white color with small openings at the top, and the first floor is completely made of glass</p>

data of reference analyzed by the authors with respect to the previously mentioned visual factors⁸

Analytical Study of the building (Alexandria Public Library)		
Building history	Building analysis	Illustrative
<p>Architect :</p> <p><u>Snohetta</u> <u>Craig Dykers</u> <u>Christoph Kapeller</u> <u>Kjetil Thorsen</u></p> <p>Designed in : 1988</p> <p>Built in : 1995-2002</p> <p>Cost : \$200.000.000 USD</p> <p>Location : El Shatby, Alexandria, Egypt</p>		

Architectural and aesthetic form analysis

Visual Complexity	interior color	Symmetry	Expertise
<p>The basic geometric shape of the building is the shape of the circle</p> 	 <p>Use wood in the plastering of most of the internal walls of the library spaces, while binding the columns, laying soundproof layers, and using soundproof wood on the floor so that the rest of the people in the library are not disturbed</p>	 <p>There are no clear symmetries in the main facade</p>	<p>Snohetta</p> <p>They designed different 5 buildings and these are some of their designs:</p> <p>MEMORIAL MUSEUM PAVILION , Tverrfjellhytta Pavilion,, Oslo Opera House,, Library of Alexandria, Ground Zero</p>

The shape that defines the image of building	Materials	Functional character	The color of the facade
<p>The building consists of a cylindrical shape with triangular and square openings used to bring light into the building</p> 	<p>Wood was used in the interior design while glass openings were used to cover the entire building from the outside</p> 	<p>The main function of the building is as a reading and exhibition museum</p>	<p>The colors of the main destinations are white with the presence of the blue color used in the windows</p>

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ata of reference analyzed by the authors with respect to the previously mentioned visual factors⁹

Analytical Study of the building (Bibliotheca Alexandrina El Gouna branch)

Building history

Alexandria— ElGouna Library, founded by the Sawiris family, is an embassy of the BA, set on the track of accomplishing the Bibliotheca's mission of spreading knowledge and understanding beyond the restraints of a single city. ElGouna Library is the archetype of a new age in librarianship: the number of books on the shelves does not exceed 750 physical books, but the true wealth of this library lies in how it is technologically and digitally set up to face the challenges of our time. An additional feature that will add a cultural dimension to ElGouna Library is the CULTURAMA and the Webcasting service, a service that broadcasts live feeds of the events taking place in the BA Conference Center will also be locally archived on servers at ElGouna Library so that visitors can access them at any time they choose, and at a high speed. ElGouna library will become a worthy representative of the BA by the Red Sea, setting an example for modern libraries to come on the importance of immortal digitized material and may it stand as a beacon to collaboration

Building analysis

The building is a single floor inspired by Hassan Fathi architecture, where the use of domes and narrow openings makes the building a computer lab, as well as reading spaces, as well as in the middle a large open courtyard

Illustrative



Architectural and aesthetic form analysis

Visual Complexity

When you see the building, we see that it consists of a set of rectangular blocks, each block is topped by a dome

interior color



The interior design contains a mixture of Hassan Fathi architecture as well as modern architecture with the use of small openings and yellow color in most walls

Symmetry



There is symmetry and rhythm in interior design and exterior destinations

Expertise

El Gouna is a tourist resort located in Hurghada on the Red Sea coast. The origin of the resort dates back to 1990, when Orascom Hotels and development company developed it on a group of islands as one of its tourism projects. El Gouna is 22 km from Hurghada International Airport to the North, and it is separated from Cairo by a distance of 470 km.

The shape that defines the image of building



Use paints and stones in the sides of the building with some wood in the exterior design

Materials

Use paints and stones in the sides of the building with some wood in the exterior design

Functional character

The main function of the building is its use for reading with a database of many books up to 50,000 thousand books.

The color of the facade

Exterior destinations mix between Hassan Fathi architecture and modern architecture with the presence of some domes and cellars as well as the use of stones and small openings

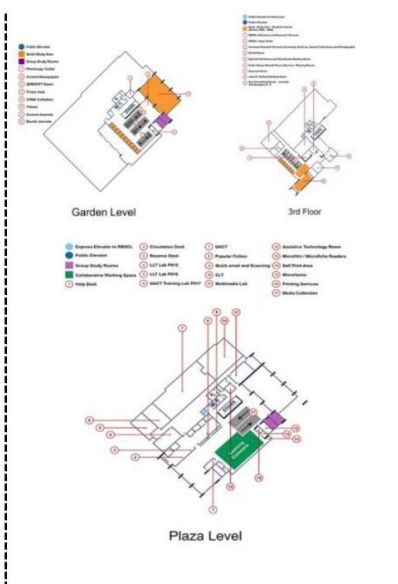
data of reference analyzed by the authors with respect to the previously mentioned visual factors¹⁰

Analytical Study of the building (American University private library)

Building history Building analysis Illustrative

By 1922, three years after its founding, AUC had a small reading room as part of the Faculty of Oriental Studies on its Tahrir campus. In 1959 the library was moved to Hill House and managed by librarians and faculty. The collection primarily includes books in English and Arabic. In 1973 the library created the first computerized folder collectibles list. The collection was reclassified in the Dewey Decimal System to the library of Congress contact number system between 1972 and 1975. In 1982 the main library moved to a new purpose-built facility on the Greek Campus (the corner of Mohammed Mahmoud and Youssef El Gendy streets originally belonged to the Greek community). In 1986 the library implemented one of the first online catalogs in the Middle East through the German-Belgian Dubis / Libis system.

While 750 books are the apparent stock of the library, the digital material available at El Gouna, which has been provided by BA, contains more than 50,000 other ones. These 50,000 books are stored on the Digital Assets Repository (DAR), a repository for all types of digital material.



Architectural and aesthetic form analysis

Visual Complexity interior color Symmetry Expertise

The geometric figure from which the blocks are formed is the shape

The interior design is characterized by the presence of wooden floors with stone covering, which has openings in The Shape of a square so that you can enter the lighting of the building

There is no symmetry

University libraries and learning technologies is a school affiliated with the American University in Cairo . The university is located on the new campus in New Cairo, Egypt. The university libraries and technological means of learning include the following libraries: the main university library, the library of rare books and special collections (including the University Archives and records department) and the Center for teaching and learning.

The shape that defines the image of building

Materials

Functional character

The color of the facade

The geometric figure from which the blocks are formed is the shape of a rectangle




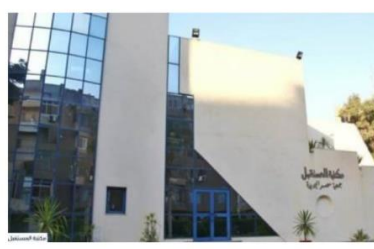
There is no The material from which the building is made is a combination of stone and marble as well as wood3

The main function of the building is its use for reading






The main color of the facades of the building is a special gradient of Brown

data of reference analyzed by the authors with respect to the previously mentioned visual factors¹¹

Analytical Study of the building (The future library in Suez)

Building history	Building analysis	Illustrative
<p>As part of the policy of paying attention to the culture of the child, the Integrated Care Association has adopted the establishment of a group of libraries to encourage children to read in a calm and appropriate atmosphere in which all the ways they like to read and read are available .</p> <p>The plot of land at Gesr Suez Street has been allocated to be the headquarters of one of these libraries (the library of the future) and the basic idea of the design was built on achieving the required and specific program of making reading rooms for children and youth</p>	<p>First floor Plan</p>  <p>second floor</p> 	 

Architectural and aesthetic form analysis

Visual Complexity	interior color	Symmetry	Expertise
 <p>The mass is a cubic shape that has been divided and we find the dominant shape at the destination is the gradient that resembles the gradient of a ladder</p> 	 	 <p>There is no symmetry</p>	<p>The designer company has not been found</p>
The shape that defines the image of building	Materials	Functional character	The color of the facade
<p>The geometric shape controlling the mass is the shape of a cube with glass openings in the form of triangles</p>	<p>In External destinations, use paints with the addition of granite at the main entrance and openings made of glass, while inside, use marble floors and paints in the walls without using bindings</p>	<p>The main function of the building is to be used as a children's library, reading rooms and lectures</p>	<p>The dominant color on the main facade is the beige-white color</p>

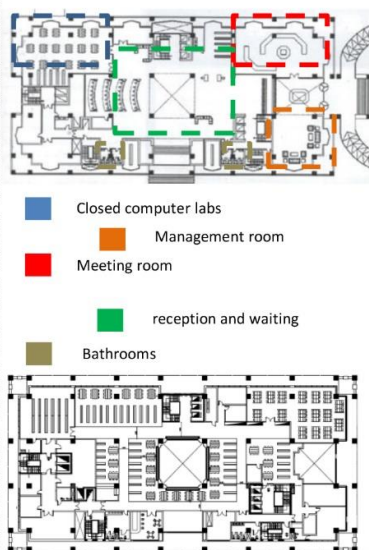
data of reference analyzed by the authors with respect to the previously mentioned visual factors¹²

Analytical Study of the building (Central Library of Cairo University)

Building history

The Cairo Central Library was opened in 2008 in the presence of Mrs. Suzanne Mubarak, the university library and its objectives are derived from its educational institution, and the success of the University in fulfilling its mission depends on the validity of its libraries, where it is responsible for the educational and research process at the University, and the library's mission is an integral part of the University's mission, which focuses on education, research and community service, which helps students, researchers and professors to fulfill their mission, which provides them with various sources of information, organizes, preserves and maintains, and also has the task of guiding and teaching beneficiaries how to access to information containers and how to benefit from them.

Building analysis



Illustrative



Architectural and aesthetic form analysis

Visual Complexity

The basic form of the building is the shape of a rectangle with weapons placed on the main facade in the form of a triangle



interior color



The interior design of the building consists of marble floors and a suspended ceiling of gypsum, as well as some walls covered with wood traditions

Symmetry



There is symmetry and rhythm in design

Expertise

Arab Contractors Company is an Egyptian state Joint Stock Company, subject to the law of public sector bodies and companies No. 97 of 1983, owned by the Ministry of housing, utilities and urban communities and the National Investment Bank, working in the field of construction and construction of buildings, bridges, roads, tunnels, airports, dams, archaeological restoration, electromechanical works, engineering consulting, and infrastructure projects.

The shape that defines the image of building



The geometric configuration of the building consists of adjacent rectangles and in the middle of them is a



Materials

In the outer part we see most of the walls have been covered with marble (granite) and some gypsum formations have been added

Functional character

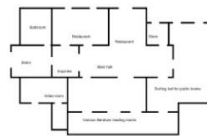
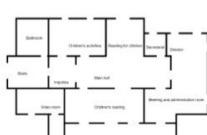
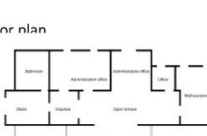



The building consists of 6 basement floors + low ground + high ground + 5 floors, the building is on a surface of 3200 square meters. the library is planned to accommodate about a million books. the library contains a visual and audio library, a department for the maintenance of folders, a department for the production of visual and audio media, a room for the production of microfilm films, a room for the production of video tapes and other audio tapes, and an international conference hall for 400 people.

The color of the facade





The colors of the destinations there are three colors that distinguish the destinations of the building, the colors of black and brown marble, as well as the colors of white gypsum and the last writing in gold

data of reference analyzed by the authors with respect to the previously mentioned visual factors¹³

Analytical Study of the building (Mubarak Public Library)

Building history	Building analysis	Illustrative
<p>Mubarak Public Library is one of the largest public libraries in Egypt and one of the best of all, it is one of the leading cultural projects in Egypt, the result of a joint Egyptian-German international cooperation involving three parties:-</p> <ul style="list-style-type: none"> - The Egyptian Ministry of culture is represented by the Cultural Development Fund. The Bertelsmann Foundation is a German NGO working in various fields of public service, including the field of public libraries. - Integrated Care Association <p>The Mubarak Public Library was opened on Monday, March 21, 1995, and since that date, the library has been carrying out a new concept in providing library services to a large group of the population in Egypt, and this positive interaction between the library and the public has been reflected during the previous fifteen years.</p>	<p>First floor Plan</p>  <p>second floor</p>  <p>third floor plan</p> 	  

Architectural and aesthetic form analysis

Visual Complexity	interior color	Symmetry	Expertise
<p>The component geometric shape of the building is the shape of a rectangle</p>  <p>The shape that defines the image of building</p>  <p>The building consists of a set of windows in the form of a rectangle in the middle of a block with small openings and from below the main entrance is</p>	 <p>The floors of the library are made of marble with the presence of suspended ceilings and the presence of wood binding on the walls</p> <p>In the main facade we find the building is a mixture of gypsum and brick</p> <p>In interior design The floors of the library are made of marble with the presence of suspended ceilings and the presence of wood binding on the walls</p>	 <p>There is no symmetry</p> <p>The main function of the building is its use for reading .The building is located on three floors on an area of 600 square meters, surrounded by a flourishing garden on an area of 2000 square meters, and it is originally a distinctive "villa" with a special architectural style, and it has been configured to meet the needs of the library, in terms of suitable spaces for halls, efficient ventilation and air conditioning, lighting quality based on natural lighting, and appropriate furniture in terms of form and</p>	<p>Arab Contractors Company is an Egyptian state Joint Stock Company, subject to the law of public sector bodies and companies No. 97 of 1983, owned by the Ministry of housing, utilities and urban communities and the National Investment Bank, working in the field of construction and construction of buildings, bridges, roads, tunnels, airports, dams, archaeological restoration, electromechanical works, engineering consulting. and infrastructure projects.</p> <p>The main facade consists of two basic colors white and red</p>
	Materials	Functional character	The color of the facade

data of reference analyzed by the authors with respect to the previously mentioned visual factors¹⁴

Analytical Study of the building (Misr Public Library, Hurghada)

Building history

Location:

The library is located in Hurghada in a privileged area bordered to the north by Mubarak International Park, to the South by the shadwan hotel group, to the East by the sea beach and to the West by Abdel Moneim Riad square.

Area:

The total area of the site is about 4450 square meters, the library building is about 450 square meters.

Building analysis

Library components:

It consists of two floors (ground and first): ground: it includes an information hall for children, an activity hall, seminars, a green corner and the library administration. The first floor includes: an information hall for adults – a training hall – an internet and Multimedia Hall – a technical processing Hall – a conference hall with a capacity of 50 seats. The library has also been established an annex building to the library with an area of 700 square meters, consisting of two ground and first floors, which includes a hall for activities and hobbies, a science club, an audio-visual media hall and an information hall for young people.

Illustrative



Architectural and aesthetic form analysis

Visual Complexity

The geometric shape that dominates the building is the shape of the cylinder, so we see that the higher we rise, the diameter of the cylinder decreases



interior color



In the interior spaces, marble was used in floor coverings, large glass openings and light colors

Symmetry



There is symmetry and rhythm in design

Expertise

The designer company has not been found

The shape that defines the image of building

The building consists of many configurations such as a cylinder, which is the main component, rectangular slats that stand out as an arm to emphasize the entrance, and glass windows in the form of a rectangle



Materials

In the internal spaces, marble was used in the flooring, as well as in the external stairs, such as the use of glass in window openings and paints for walls

Functional character

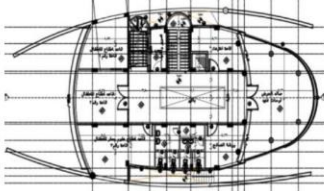
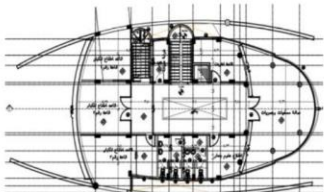


Due to the lack of libraries in Hurghada, the Misr Public Library was opened in Hurghada to be a cultural platform for the region and the main goal of the building is to use it for reading and lectures






The color of the facade

The predominant color in the facade is white with the use of glass in a simple way in the openings

data of reference analyzed by the authors with respect to the previously mentioned visual factors¹⁵

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ARCHITECTURAL ENGINEERING AND URBAN RESEARCH**
PRINT ISSN 2785-9665 ONLINE ISSN 2785-9673
VOLUME 5, ISSUE 1, 2022, 115 – 149.

Analytical Study of the building (Egypt Public Library, Ezbet El Borg)		
Building history	Building analysis	Illustrative
<p>On May 18, 2021, the Egyptian Public Library opened in Ezbet El Borg as one of the regional branches in the delta of the Egyptian public library system, specifically a branch of the Egyptian Public Library in Damietta, in the presence of His Excellency Prime Minister Dr. Mustafa metbouly, governor of Damietta, Dr. A number of important visits came to the library after the official opening in the presence of the minister of Culture Dr. Inas Abdel Dayem, as well as the former president of the Republic, counselor Adly Mansour, and the presence of this edifice is a cultural leap and a cultural leap for the people of the city of izbet El Borg as well as the neighboring villages of the city, as the library has been since its opening an effective educational and enlightening institution that seeks to catch up with technological development and seeks to achieve developmental and developmental goals</p>	<p>First floor Plan</p>  <p>second floor plan</p> 	 

Architectural and aesthetic form analysis			
Visual Complexity	interior color	Symmetry	Expertise
  <p>The basic geometric shape controlling the perspective of the building is the shape of the cylinder</p>	 <p>The floors are marble and the walls are covered with paints</p>	 <p>There is symmetry and rhythm in design</p>	<p>The city of izbet Al-Burj was chosen to implement the project of creating the first women-friendly city. the choice of izbet Al-Burj to realize the project on its land came for many reasons, including the geographical nature of the city, as well as most of the men of the city travel abroad permanently, leaving the women to raise their children and take responsibility along with their husbands.</p>
<p>The shape that defines the image of building</p>  <p>We see the cylindrical shape dominating the perspective with the presence of square - shaped window openings and two curved arms along the length of the building to emphasize the entrance</p>	<p>The facade of the building is covered with glass cladding with weapons on both sides of the building</p>	<p>The library was established on an area of 2000 m divided into :</p> <ul style="list-style-type: none"> - The library building consists of four floors - Multiple units of light installations to be used as places for vocational training and skills development .The Public Library of Egypt contains information halls for adults, children and youth, a multimedia corner, a seminar and conference hall, a lending and Information area, halls for training and activities <p>The library is surrounded by a park, as well as the Safe City for women, which provides its services to women and girls from training courses and teaching crafts in addition to helping in marketing products.</p>	<p>The predominant color is blue, the color of the glass, and beige, the color of the traditions on the exterior walls</p>

data of reference analyzed by the authors with respect to the previously mentioned visual factors

Experts results of Delphi technique

In the Delphi technique, a group of knowledgeable individuals are polled using a set of questions, and then they are given the opportunity to comment further on their responses. When new information is evaluated by the panel, the experts' opinions are subject to change with each new round of analysis.

Ten experts reviewed the performed analysis of the visual perception factors of architectural forms to give relative weights to those factors which are Visual Complexity, Colour, Symmetry, Familiarity, Knowledge and experience, shape, Materials in addition to Functional character, and the cases which can assess their ability to give weights clearly on presented analysis, the cases chosen under criteria of the top buildings on the architectural website of Archdaily , while the Egyptian cases chosen from the governmental official website which highlight the main educational facilities in Egypt, the result from the performed four rounds summarized at tables no. 1, 2 and 3, as follows;

Table 1. Given weights per each expert to each criterion of visual factors.

Weightage	Given weights per each expert to each criterion								Sum per expert
100% total	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Functional character	
Expert 1	20	10	5	10	15	15	5	20	100%
Expert 2	20	15	10	5	10	15	15	10	100%
Expert 3	10	5	10	15	15	15	10	20	100%
Expert 4	15	10	10	10	20	10	10	15	100%
Expert 5	20	5	15	5	20	5	10	20	100%
Expert 6	20	10	10	20	10	5	10	15	100%
Expert 7	15	15	15	15	10	10	10	10	100%

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Expert 8	15	10	10	20	15	15	5	10	100%
Expert 9	25	15	5	10	10	10	10	15	100%
Expert 10	25	5	10	5	20	10	15	10	100%
Mean of weights	20%	10%	10%	10%	15%	10%	10%	15%	100%
	0.2	0.1	0.1	0.1	0.15	0.1	0.1	0.15	1

Table 2. Given rank per each expert to each international library building according to the previously assigned relative weights from 1:5, where 5 is the maximum level of expressing the factor and 1 is the lowest level.

Weightage 100% total	Given weights per each expert to each criterion								Total Score
	20%	10%	10%	10%	15%	10%	10%	15%	
	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Function al characte r	
Alaska state library	3	5	3	4	4	5	5	5	4
Chulalong korn library	1	2	5	4	3	3	2	4	3
DCPL library	4	4	4	3	3	5	4	5	4
Jiangxi library	5	5	1	2	2	5	5	3	4
Magdalen e Library	4	2	4	3	3	3	3	3	3
Pieerefond s library	3	4	3	4	4	4	3	3	4
River center library	4	4	4	3	3	4	3	4	4
Viby library	4	3	4	2	2	2	3	3	3
	4	4	4	3	3	4	4	4	

Table 3. Given rank per each expert to each national library building according to the previously assigned relative weights from 1:5, where 5 is the maximum level of expressing the factor and 1 is the lowest level.

Weightage 100% total	Given weights per each expert to each criterion								Total Score
	20%	10%	10%	10%	15%	10%	10%	15%	
	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Function al characte r	
Bibliotheca Alexandrina - Alex	5	4	4	3	4	5	4	5	4
Bibliotheca Alexandrina - Gouna	4	3	4	2	2	2	2	2	3
AUC library	5	5	5	5	5	4	4	4	5
Future library	3	3	3	2	2	2	3	2	3
Central library	4	4	4	2	2	3	2	3	3
Misr- Giza	3	1	4	2	2	3	3	4	3
Misr- Hurgada	2	3	4	1	1	1	2	2	2
Misr- Ezbet El-Burg	2	1	3	1	1	1	1	1	1
	4	3	4	2	2	3	3	3	

After a group of experts has been polled with a series of questions, their aggregated and anonymous responses are discussed. A "collective reaction" from the experts will allow them to tailor their reactions to the extent to which they understand the information at hand by being applied on the chosen 16 buildings. After several rounds of questioning, the group's collective opinion is relayed to the panel. Reaching a consensus which is crucial to the Delphi method.

The high ranked libraries buildings from the Egyptian cases of study, get chosen for the second stage of the experiment by regenerating their form according to the priorities of visual factor means assigned by experts and defined as high impact on visual perception in the analysis, so every building from the chosen four entered to the regenerative Rhino which inscribed the plugin of Grasshopper software of in order of the arrangement of the seven elements which is different between every building and the other.

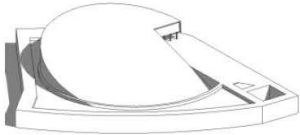
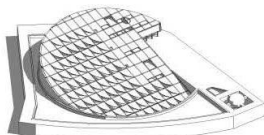

Artificial intelligence form-generation software is used as the backbone upon which a wide variety of add-ons, from environmental analysis to robotic control, are built. It's the same a lot of new features were added in for prior the missing elements which received a low rank.

Primarily, the software is utilized in the development of generative algorithms, such as those utilized in the creation of generative art. As it has many parts that can be used to generate 3D shapes. Aside from logical algorithms, programs can also include a variety of additional algorithms, such as arithmetic, textual, audiovisual, and tactile ones, Supporting the decision-making process in the early stages of design, those kinds of software offers a wide range of 2D and 3D interactive graphics that are accessible to designers. It streamlines analysis, automates and speeds up calculations, and gives clear graphical representations in the software 3D modeling interface .

7. Results and Discussion

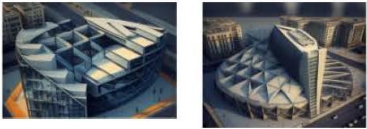



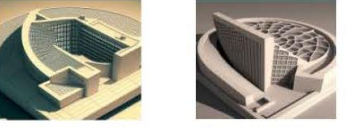
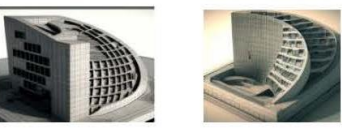
After modelling the chosen libraries buildings in Egypt by Autodesk Revit, the images of the every building model were extracted, one image that is integrated and another image without openings and shaping to show the stages of building formation. Then a step of an attempt done to develop the building from the analysis elements (Familiarity-shape-Functional character) and a set of alternatives for each of the three elements regenerated through the artificial intelligence program (Ai-midjourney) where the input models entered and prompt script feed the software to regenerate, this helped in developing the cases so that the simulation process take place.

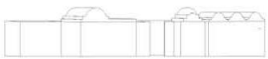


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3d without shaping(by revit)	3d shaping and openings(by Revit)	The current form of the building
		







Weightage 100% total	Given weights per each expert to each criterion								Total Score
	20%	10%	10%	10%	15%	10%	10%	15%	
	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Functional character	
Bibliotheca Alexandrina - Alex	5	4	4	3	4	5	4	5	4

We introduced modeling to the midjourney program and these results were extracted

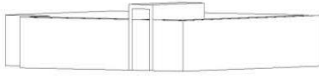


alex familiarity	alex shape	Functional character
		
		

3d without shaping(by revit)	3d shaping and openings(by Revit)	The current form of the building
		

Weightage 100% total	Given weights per each expert to each criterion								Total Score
	20%	10%	10%	10%	15%	10%	10%	15%	
	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Functional character	
Bibliotheca Alexandrina - Gouna	4	3	4	2	2	2	2	2	3







Gouna familiarity	Gouna shape	Gouna character
		
		




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3d without shaping(by revit)	3d shaping and openings(by Revit)	The current form of the building
		



Weightage 100% total	Given weights per each expert to each criterion								Total Score
	20%	10%	10%	10%	15%	10%	10%	15%	
	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Functional character	
AUC library	5	5	5	5	5	4	4	4	5

We introduced modeling to the midjourney program and these results were extracted

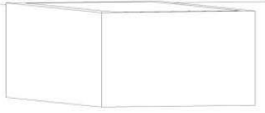

alex familiarity	alex shape	Functional character
		
		

3d without shaping(by revit)	3d shaping and openings(by Revit)	The current form of the building
		

Weightage 100% total	Given weights per each expert to each criterion								Total Score
	20%	10%	10%	10%	15%	10%	10%	15%	
	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Functional character	
Future library	3	3	3	2	2	2	3	2	3







Gouna familiarity	Gouna shape	Gouna character
		
		

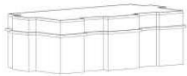


**INTERNATIONAL JOURNAL OF
ARCHITECTURAL ENGINEERING AND URBAN RESEARCH**
PRINT ISSN 2785-9665 ONLINE ISSN 2785-9673
VOLUME 5, ISSUE 1, 2022, 115 – 149.

3d without shaping(by revit)	3d shaping and openings(by Revit)	The current form of the building
		

Weightage 100% total	Given weights per each expert to each criterion								Total Score
	20%	10%	10%	10%	15%	10%	10%	15%	
	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Functional character	
Central library	4	4	4	2	2	3	2	3	3

We introduced modeling to the midjourney program and these results were extracted

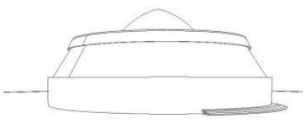
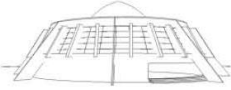

alex familiarity	alex shape	Functional character
		
		

3d without shaping(by revit)	3d shaping and openings(by Revit)	The current form of the building
		

Weightage 100% total	Given weights per each expert to each criterion								Total Score
	20%	10%	10%	10%	15%	10%	10%	15%	
	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Functional character	
Misr- Giza	3	1	4	2	2	3	3	4	3







Gouna familiarity	Gouna shape	Gouna character
		
		

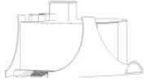
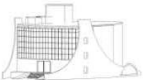

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Weightage 100% total	Given weights per each expert to each criterion								Total Score
	20%	10%	10%	10%	15%	10%	10%	15%	
	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Functional character	
Misr-Hurgada	2	3	4	1	1	1	2	2	2

We introduced modeling to the midjourney program and these results were extracted

alex familiarity	alex shape	Functional character
		
		

3d without shaping(by revit)	3d shaping and openings(by Revit)	The current form of the building
		

Weightage 100% total	Given weights per each expert to each criterion								Total Score
	20%	10%	10%	10%	15%	10%	10%	15%	
	Visual Complexity	Colour	Symmetry	Familiarity	Knowledge and experience	shape	Materials	Functional character	
Misr- Ezbet El-Burg	2	1	3	1	1	1	1	1	1

Gouna familiarity	Gouna shape	Gouna character
		
		

8. Conclusion

As a result of the offered strategy to develop design alternatives utilising artificial intelligence and form creation software, a wide variety of designs may be evaluated while modifications are being made to existing buildings. This enables a greater number of options to be considered. The fact that the methodology was devised in the first place makes this at least theoretically viable. The Delphi approach, which was implemented in this research's form generation experiment, serves as the foundation for the methodology that is being proposed here. In light of the fact that library buildings are considered to be public structures, the purpose of this methodology is to conduct an investigation into the aspects of each building that call for an enhancement to the visual appearance of the structures.

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