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Case of Culture House of the city of Khenchela

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بسم الله الرحمن الرحيم

DIDCATION

To my family for the unwavering support throughout the journey.

To every person who contributed and supported the accomplishment of this modest endeavor.

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ABSTRACT

The research delves into the multidimensional nature of perceived architectural quality and its significance in the field of architecture. It explores how perception plays a crucial role in stimulating users and influencing their judgments regarding whether an architectural phenomenon meets the specified requirements and satisfies the needs of its occupants. To gain insights into the perceived architectural quality, a thorough assessment was conducted on the ALI-SOUAIHI culture house, situated in the city of Khenchela in northeastern Algeria. This analysis involved examining the diverse perspectives and inclinations of various segments of the population to form a comprehensive understanding of the overall perception of the building's quality. The research methodology employed a five-point Likert scale questionnaire and adopted a quantitative approach to evaluate the perceived architectural quality of the culture house. This in-depth study aims to enrich our understanding of the subject matter by providing detailed insights, analysis, and data.

The cognitive response and perception of architectural quality heavily rely on how users perceive and judge various aspects of the stimuli. This plays a crucial role in evaluating the architectural value of a building. Therefore, one of the objectives of this study is to analyze the cognitive response and explore the complex relationships between its different dimensions. To achieve this, the study adopts a multidisciplinary approach, integrating insights from psychological literature on perception and cognition, as well as the marketing perspective on perceived quality and satisfaction related to architectural structures. The study focuses on assessing the participants' judgments regarding the perceived architectural quality of a cultural facility. This comprehensive investigation aims to enrich our understanding of the cognitive processes involved in perceiving and evaluating architectural buildings.

Moreover, Computer aided parametric design plays a crucial role in offering a wide range of solutions for modeling and the design process. The second objective of this research is to explore the collaboration between parametric design and simulation-based tools, aiming to create a parametric model that exudes a strong sense of perceived quality. The concept of perceived quality is introduced as a fundamental aspect when developing sustainable models. It aims to establish the intricate connections between this concept, existing parametric design practices, and the simulation-based environment. By implementing a responsive process, this research endeavors to incorporate these concepts into a proposed model, where various parameter variations will be systematically tested and applied as a means to overcome design-related challenges.

Parametric design is an innovative approach that utilizes algorithms and customizable systems to automatically generate a wide range of outcomes, forms, and shapes based on inputted data. This design model can be easily modified through a list of parameters and commands, resulting in a more efficient overall workflow. The beauty of parametric design lies in its ability to provide designers with flexibility in exploring different design options and easy access to modeling and simulation data. This enables them to improve the quality of constructions and analyze the impact of the chosen design process on the comfort levels of structures. By expanding on the possibilities offered by parametric design, architects and engineers can create intelligent and sustainable structures that are tailored to the specific needs of their environment. Through this in-depth approach, parametric design becomes a powerful tool for enhancing the overall quality and performance of architectural projects.

The findings of the study indicate that several socio-demographic factors such as gender, age, residency, and profession with the exception of education, have had an impact on perceived architectural quality and the users' cognitive response. Furthermore, it was observed that the dimensions of the previously mentioned concept, exhibited strong correlations and were susceptible to the influence of socio-demographic variables. From these results, we can conclude that the opinions expressed by respondents can be interpreted as a cognitive response, which in turn serves as an indicator of perceived architectural quality. This implies that individuals' perceptions of architectural quality are influenced by various socio-demographic characteristics, and their opinions can be valuable in assessing the overall quality of architectural designs. Moreover, a parametric model was proposed to improve some aspects of the overall perceived quality.

Keywords: cognitive response, perceived architectural quality, perception, assessment, culture house, parametric design, modeling

RÉSUMÉ

La recherche examine la nature multiforme de la qualité architecturale perçue et son importance dans le domaine de l'architecture. Il explore le rôle de la perception pour stimuler les usagers et influencer leurs jugements sur la question de savoir si un phénomène architectural répond à des exigences spécifiques et répond aux besoins de ses occupants. Pour mieux comprendre la qualité architecturale perçue, une évaluation complète a été menée sur la maison de la culture ALI-SOUAIHI, située à Khenchela, dans le nord-est de l'Algérie. Cette analyse impliquait d'examiner les diverses perspectives et préférences de différents segments de la population pour former une compréhension globale de la perception globale de la qualité du bâtiment. La méthodologie de recherche a utilisé un questionnaire sur une échelle de Likert en cinq points et une approche quantitative pour évaluer la qualité architecturale perçue de la maison de la culture. Grâce à cette enquête approfondie, l'étude vise à améliorer notre compréhension du sujet en fournissant des informations, des analyses et des données détaillées.

La perception et l'évaluation de la qualité architecturale sont fortement influencées par la manière dont les utilisateurs perçoivent et évaluent divers aspects des stimuli. Il s'agit d'un facteur crucial pour déterminer la valeur architecturale d'un bâtiment. En conséquence, l'un des principaux objectifs de cette recherche est d'analyser la réponse cognitive et d'examiner les relations complexes entre ses différentes dimensions. Pour ce faire, l'étude adopte une approche multidisciplinaire, intégrant les enseignements de la littérature psychologique sur la perception et la cognition, ainsi que la perspective marketing sur la qualité et la satisfaction perçues par rapport aux structures architecturales. L'étude se concentre spécifiquement sur l'évaluation des jugements des participants concernant la qualité architecturale perçue d'un équipement culturel. Grâce à cette enquête approfondie, l'objectif est d'améliorer notre compréhension des processus cognitifs impliqués dans la perception et l'évaluation des bâtiments architecturaux.

En outre, l'utilisation de la conception paramétrique assistée par ordinateur est de la plus haute importance car elle offre une gamme diversifiée de solutions tant pour la modélisation que pour le processus de conception. L'objectif principal de cette étude est d'étudier la synergie entre la conception paramétrique et les outils basés sur la simulation, dans le but ultime de créer un modèle paramétrique qui dégage un profond sentiment de qualité perçue. La notion de qualité perçue est introduite comme élément fondamental dans le développement de modèles durables, visant à établir les liens complexes entre ce concept, les pratiques de conception paramétrique existantes et l'environnement basé sur la simulation. Grâce à la mise en œuvre d'une approche réactive, cette recherche s'efforce d'intégrer ces concepts dans un modèle proposé, dans lequel diverses variations de paramètres seront systématiquement testées et appliquées pour surmonter les défis liés à la conception.

La conception paramétrique est une méthodologie de pointe qui utilise des algorithmes et des systèmes personnalisables pour générer automatiquement une vaste gamme de résultats, de formes et de formes basés sur les données saisies. Ce modèle de conception peut être facilement ajusté grâce à un ensemble complet de paramètres et de commandes, ce qui permet d'obtenir un flux de travail plus rationalisé. L'attrait de la conception paramétrique réside dans sa capacité à accorder aux concepteurs la flexibilité nécessaire pour explorer diverses options de conception et accéder sans effort aux données de modélisation et de simulation. Cela leur permet d'améliorer la qualité des constructions et d'analyser l'impact du processus de conception choisi sur les niveaux de confort des structures, en particulier dans les régions arides où les solutions environnementales intelligentes sont primordiales. En exploitant tout le potentiel de la conception paramétrique, les architectes et les ingénieurs peuvent façonner des structures intelligentes et durables, adaptées aux exigences spécifiques de leur environnement. Grâce à cette approche méticuleuse, la conception paramétrique apparaît comme un outil puissant pour améliorer la qualité et la performance globales des projets architecturaux.

Les résultats de l'étude suggèrent que plusieurs facteurs sociodémographiques, tels que le sexe, l'âge, la résidence et la profession, ont influencé la qualité architecturale perçue et la réponse cognitive des utilisateurs. Notamment, l'éducation n'a pas eu d'impact significatif. De plus, il a été observé que les dimensions des concepts susmentionnés présentaient de fortes corrélations et étaient sensibles à l'influence de variables sociodémographiques. Sur la base de ces résultats, on peut déduire que les opinions des répondants peuvent être considérées comme une réponse cognitive, servant d'indicateur de la qualité architecturale perçue. Cela indique que les perceptions individuelles de la qualité architecturale sont façonnées par diverses caractéristiques sociodémographiques et que leurs opinions peuvent être précieuses pour évaluer la qualité globale des conceptions architecturales. De plus, un modèle paramétrique a été proposé pour améliorer certains aspects de la qualité globale perçue.

Mots-clés : qualité architecturale perçue, réponse cognitive, perception, évaluation, maison de culture, conception paramétrique, modélisation

ملخص

تبحث الدراسة في الطبيعة المتعددة الأوجه للجودة المعمارية المتصورة وأهميتها في مجال الهندسة المعمارية. ويستكشف دور الإدراك في تحفيز المستخدمين والتأثير على أحكامهم بشأن ما إذا كانت الظاهرة المعمارية تلبي متطلبات محددة وتلبي احتياجات شاغليها. للحصول على فهم أعمق للجودة المعمارية المتصورة، تم إجراء تقييم شامل لدار الثقافة علي سوايحي، الواقع في خنشلة، شمال شرق الجزائر. تضمن هذا التحليل فحص وجهات النظر المتنوعة لشرائح مختلفة من السكان لتشكيل فهم شامل للتصور العام لجودة المبنى. اعتمدت منهجية البحث على استبيان يستخدم مقياس ليكرت المكون من خمس نقاط واستخدمت منهجًا كميًا لتقييم الجودة المعمارية الملموسة لدار الثقافة. ومن خلال هذا التحقيق الشامل، تهدف الدراسة إلى تعزيز فهمنا للموضوع من خلال توفير رؤى وتحليلات وبيانات مفصلة.

يتأثر إدراك وتقييم الجودة المعمارية بشكل كبير بكيفية إدراك المستخدمين وتقييمهم للجوانب المختلفة للمحفزات. وهذا عامل حاسم في تحديد القيمة المعمارية للمبنى. ونتيجة لذلك، فإن أحد الأهداف الرئيسية لهذا البحث هو تحليل الاستجابة المعرفية وفحص العلاقات المعقدة بين أبعادها المختلفة. ولتحقيق ذلك، تتخذ الدراسة نهجا متعدد التخصصات، يتضمن رؤى من الأدبيات النفسية حول الإدراك، فضلا عن منظور التسويق حول الجودة المتصورة والرضا فيما يتعلق بالهياكل المعمارية. تركز الدراسة بشكل خاص على تقييم اراء المستجوبين فيما يتعلق بالجودة المعمارية المتصورة للمنشأة الثقافية. من خلال هذا التحقيق الشامل، الهدف هو تعزيز فهمنا للعمليات المعرفية المشاركة في إدراك وتقييم المباني المعمارية.

علاوة على ذلك، فإن استخدام التصميم البارامتري بمساعدة الكمبيوتر له أهمية قصوى لأنه يقدم مجموعة متنوعة من الحلول لكل من النمذجة وعملية التصميم. الهدف الأساسي من هذه الدراسة هو دراسة التآزر بين التصميم البارامترى والأدوات القائمة على المحاكاة، مع الهدف النهائي المتمثل في إنشاء نموذج بارامتري ينضح بإحساس عميق بالجودة المتصورة. يتم تقديم فكرة الجودة المتصورة كعنصر أساسي في تطوير النماذج المستدامة، بهدف إنشاء روابط معقدة بين هذا المفهوم، وممارسات التصميم البارامترية الحالية، والبيئة القائمة على المحاكاة. من خلال تنفيذ نهج سريع الاستجابة، يسعى هذا البحث إلى دمج هذه المفاهيم في نموذج مقترح، حيث سيتم اختبار البيانات المختلفة وتطبيقها بشكل منهجي للتغلب على التحديات المتعلقة بالتصميم.

التصميم البارامترى هو منهجية متطورة تستخدم الخوارزميات والأنظمة القابلة للتخصيص لإنشاء مجموعة واسعة من النتائج والنماذج والأشكال تلقائيًا بناءً على البيانات المدخلة. يمكن تعديل نموذج التصميم هذا بسهولة من خلال مجموعة شاملة من التعليمات والأوامر، مما يؤدي إلى سير عمل أكثر انسيابية. تكمن أهمية التصميم البارامتري في قدرته على منح المصممين المرونة اللازمة لاستكشاف خيارات التصميم المختلفة والوصول بسهولة إلى بيانات النمذجة والمحاكاة. وهذا يمكّنهم من تحسين جودة المنشآت وتحليل تأثير عملية التصميم المختارة على مستويات الراحة في الأبنية. من خلال تسخير الإمكانات الكاملة للتصميم البارامترى، يمكن للمهندسين المعماريين تصميم هياكل ذكية ومستدامة مصممة خصيصًا لتلبية المتطلبات المحددة للبيئة المحيطة بهم. من خلال هذا النهج الدقيق، يظهر التصميم البارامترى كأداة فعالة لرفع الجودة الشاملة وأداء المشاريع المعمارية.

تشير نتائج الدراسة إلى أن العديد من العوامل الاجتماعية والديموغرافية، مثل الجنس والعمر والإقامة والمهنة، أثرت على الجودة المعمارية المتصورة والاستجابة المعرفية للمستخدمين. والجدير بالذكر أن التعليم لم يكن له تأثير كبير. بالإضافة إلى ذلك، لوحظ أن أبعاد المفاهيم المذكورة أعلاه أظهرت ارتباطات قوية وكانت عرضة لتأثير المتغيرات الاجتماعية والديموغرافية. وبناء على هذه النتائج، يمكن استنتاج أن آراء المستجيبين يمكن اعتبارها استجابة معرفية، وتعمل كمؤشر للجودة المعمارية المتصورة. ويشير هذا إلى أن تصورات الأفراد للجودة المعمارية تتشكل من خلال الخصائص الاجتماعية والديموغرافية المختلفة، ويمكن أن تكون آرائهم ذات قيمة في تقييم الجودة الشاملة للتصميمات المعمارية. علاوة على ذلك، تم اقتراح نموذج بارامترى لتعزيز جوانب معينة من الجودة الشاملة المتصورة.

الكلمات المفتاحية: الجودة المعمارية المتصورة، الاستجابة المعرفية، الإدراك، تقييم، دار الثقافة، التصميم البارامترى، النمذجة

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ABBREVIATIONS AND ACRONYMS

RPQM	Respondent's perceived architectural quality mean
PSQ	Perceived spatial quality
PC	Perceived comfort
PR	Perceived reliability
PBD	Perceived build quality
RDI	Respondent’s dimension item
RCRM	Respondent’s cognitive response mean
RDM	Respondent’s dimension mean
PVQ	Perceived visual quality
PF	Perceived function
PS	Perceived symbolism
CI	Confidence interval
U	Mann-whitney u
Z	Z-score, also referred to as standard score
p	P-value
$\chi 2$	Chi-square
rho	Spearman correlation
df	Degrees of freedom
Sig	Significance
ηp^2	Eta-squared, refers to the effect size
eta2	Eta-squared, refers to the effect size
r	Pearson's r, refers to the effect size
M	Mean
Mdn	Median
SD	Standard deviation
SE	Standard error
H_Gh	Irradiation of global radiation horizontal
Gh	Use of precalculated radiation map based on satellite and ground information due to low density of network. (Share of satellite data 100%)
H_Bn	Irradiation of beam
H_Dh	Irradiation of diffuse radiation horizontal
N	Cloud cover fraction
Lg	Global luminance
Ta	Air temperature
RH	Relative humidity
Td	Dewpoint temperature
DD	Wind direction
FF	Wind speed
p	Air pressure
O	Opening size

IR gr	The incident radiation of the simulated grid
IR max	The maximum incident radiation
SIR	Summer incident radiation
WIR	Winter incident radiation

Units

Radiation in [kWh/m²]
Temperature in [°C]
Pressure in [hPa]
Wind speed in [m/s]
Luminance in [lux]

GENERAL INTRODUCTION

A. Introduction

Perceived quality is a term used to describe how consumers subjectively evaluate a product or service based on their own unique perceptions, preferences, and expectations. It encompasses a wide range of factors that influence recipients'' evaluation, including the functionality, aesthetics, reliability, and overall user experience of the product or service. This concept holds great significance, particularly in industries where user satisfaction and loyalty are key determinants of success. It is crucial for projects to understand and prioritize perceived quality as it directly impacts users' perceptions and decision-making processes.

For that reason, architectural design plays a significant role in determining the perceived quality of a building. This crucial aspect involves the meticulous creation of structures that not only serve their functional purposes but also possess visually appealing qualities. To achieve this, architects must consider a multitude of technical and artistic aspects in order to meet the diverse needs and desires of the building users. The success of architectural design heavily relies on the perceived quality of the final product, as it directly affects the satisfaction and perceived value of the users. Therefore, architects strive to create buildings that effectively blend functionality, aesthetics, and user preferences to ensure an optimal user experience and overall satisfaction.

Furthermore, architectural design incorporates more than just the utilitarian aspects of a building. Its purpose goes beyond functionality, aiming to create spaces that evoke emotions, inspire individuals, and offer a positive and enriching experience for both occupants and visitors. Various elements, such as the building's physical form, choice of materials, spatial arrangement, lighting design, acoustic considerations, and overall ambiance, all contribute to the perceived quality of the architectural design.

Thus, Effective architectural design is crucial in regards to meeting the needs and preferences of users, thereby significantly improving their overall experience. Not only does it result in greater satisfaction, but it also boosts productivity and promotes well-being. A well-executed architectural design seamlessly integrates functionality, aesthetics, and the surrounding environment, creating a harmonious and balanced relationship.

Therefore, in order to attain a superior level of perceived quality in architectural design, architects must take into consideration multiple factors. These include gaining a deep understanding of the client's specific needs and customizing the design accordingly. This process involves conducting extensive research, performing thorough analysis, and employing creative problem-solving techniques. Architects must also consider various pertinent elements such as the cultural context, local regulations, sustainability practices, and user behavior. By carefully considering and addressing these factors, architects can deliver satisfactory architectural designs. Additionally, it is fundamental to ensuring the alignment of the design with the wider context and intended use of the building. It is essential for the design to seamlessly blend into the overall architectural style of the surrounding area, while also paying homage to the historical and cultural significance of the site. Moreover, the design should establish a symbiotic relationship with the urban or natural environment in order to create a sense of harmony and integration.

In the same context, perceived quality is a crucial factor in architectural design, with a significant impact on the overall satisfaction and well-being of users. A well-executed design not only caters to users' needs but also incorporates aesthetic appeal and creates a positive experience. This standpoint emphasizes the importance of considering how a building is perceived, both functionally and emotionally. By prioritizing perceived quality, architects can create spaces that are not only visually appealing but also functionally efficient and emotionally satisfying. This enriches the users' experience and contributes to their overall satisfaction. Taking into account the concept of perceived quality enables architects to create thoughtful designs that enhance the usability, attractiveness, and the overall experience.

This connects to Parametric design that emerged as a highly influential and transformative tool in the field of architectural design, completely revolutionizing the way architects approach the process of shaping buildings and structures. By harnessing the power of computational algorithms and incorporating various parameters, architects are able to generate and manipulate design elements in an incredibly versatile and customizable manner. This groundbreaking approach to architectural practice is of utmost significance, as it brings forth a multitude of benefits and opportunities for architects to push the boundaries of innovation and unleash their creative potential.

In the realm of architectural design, parametric design has truly transformed the landscape, offering a wide-ranging and all-encompassing methodology that goes beyond traditional methods, with its utilization of computational algorithms, along with the integration of various topologies.

This kind of process in design offers numerous benefits, with one of its key advantages lying in its ability to optimize and streamline the overall design process. This is achieved by leveraging digital tools and algorithms that facilitate rapid iteration and exploration of various design options. By manipulating different parameters and configurations, architects can ascertain the impact on crucial factors such as structural integrity, energy efficiency, and aesthetics. The utilization of data-driven analysis empowers architects to make well-informed decisions, resulting in a final design that successfully aligns with the intended goals and objectives. Ultimately, this exploration and evaluation of possibilities enable architects to create designs that are not only visually appealing but also technically advanced and sustainable.

On top of that, it offers a multitude of advantages, with one significant aspect being its ability to handle complex geometries and intricate detailing. Unlike traditional design methods, which often struggle with intricate shapes, patterns, and repetitive elements, parametric design enables architects to effortlessly create highly sophisticated forms, patterns, and geometries. In the past, these intricate designs were often deemed impractical or even impossible to construct. However, with the advent of parametric design, architects are now empowered to bring these once elusive visions to life. This transformative capability of parametric design paves the way for new possibilities in architectural expression, resulting in unique and iconic structures that captivate the imagination and effortlessly stand out in the built environment. By transcending the limitations of traditional design, parametric design enriches architectural endeavors, pushing the boundaries of creativity and innovation to new levels of ingenuity and achievement.

In addition, parametric design facilitates a highly responsive approach to site-specific constraints. By using algorithms and computational tools, architects can generate designs that are not only aesthetically appealing but also functional and well-adapted to their surroundings. This responsive design approach ensures that buildings harmonize with their environment, respecting the natural and cultural context in which they are situated.

In a more elaborative manner, parametric design provides for architects the ability to effectively address the unique conditions and limitations of a particular site. By integrating information derived from the environment, including solar orientation, wind patterns, and topography, architects can create buildings that are finely optimized for their specific surroundings. This facet of parametric design significantly contributes to sustainability efforts by actively promoting energy efficiency and passive design strategies, thereby mitigating the overall environmental impact of constructed edifices.

Parametric design not only promotes collaboration and integration in the architectural process but also facilitates interdisciplinary collaboration with engineers, fabricators, and stakeholders through the use of digital tools and computational platforms. This collaborative approach allows for seamless information and idea exchange, resulting in a more holistic and integrated design process. Moreover, the ability to share and manipulate digital models in real-time significantly improves communication, minimizes errors, and enhances project coordination efficiency.

Besides, parametric design has become increasingly critical in the field of architectural design for several reasons. Firstly, it offers the potential to streamline the design process by optimizing various aspects of the project. This optimization can range from reducing material waste to improving energy efficiency. Additionally and as previously mentioned, parametric design allows architects to explore and create complex geometries that might have been difficult or even impossible to achieve using traditional design methods. The ability to intricately shape and manipulate forms opens up new possibilities for architectural expression and innovation.

In terms of collaboration, the integration of parametric design enables architects to work more efficiently with various participants. Through parametric modeling and visualization, designers can effectively communicate their ideas and concepts to clients, engineers, and builders.

B. Research problematic

As the complexity of architectural projects continues to grow, the challenge of achieving a satisfactory perceived quality has become increasingly difficult due to the multitude of factors that must be considered. In order to address this issue, there is a need for the development of sophisticated parametric tools with high throughput capacity, versatility, and maneuverability. These tools can be utilized to effectively and systematically improve the perceived quality of various aspects of cultural architectural projects.

Hence, to comprehensively evaluate perceived quality and the cognitive response of users to architectural quality, it was imperative to undertake a reconceptualization of perceived quality as a novel concept within the field of architecture. Perceived architectural quality, being a multidimensional entity (according to Myers & Shockers, 1981; Petrick, 2002), necessitates a deeper understanding of the intricate relationship between a user's perception and cognition in relation to the architectural structure itself. The concept of perceived quality has been elucidated by Aaker (1991) and other researchers, such as Aaker and Jacobson, (1994); Hellofs and Jacobson, (1999); Rao et al. (1999); and Wolfinbarger & Gilly (2003). However, there remains a dearth of empirical studies that thoroughly explore and define the implications of this concept specifically in architecture, which is a multidisciplinary field that strives to cater to various user needs encompassing functionality, psychology, cognition, ergonomics, climate, and economy, as highlighted by Akin (2001).

Perceived architectural quality is related to cognitive perception, which refers to the mental process in which individuals organize and interpret the information they perceive, and then assigning it with specific meanings and connotations (Bittencourt et al., 2015). This intricate process arises from the interaction between cognition and perception, combining the information gathered through perception with various cognitive abilities such as memory, attention, learning, thinking, intelligence, communication, and language. By employing these cognitive faculties, individuals imbue the perceived information about a structure or object with a more complex and profound significance. Moreover, the cognitive response is dependent on how users perceive the qualities and different aspects of the object in question.

The research approached cognitive response and perceived architectural quality by considering various disciplines, including psychology's understanding of perception and cognition, as well as marketing's perspective on how perceived quality relates to architectural buildings. Additionally, it emphasizes the need to integrate these concepts into the field of architecture and tailor them to its unique characteristics. The ultimate goal is to develop comprehensive conceptual models that encompasses both perceived quality and cognitive response on a global scale.

This work illustrates the significance of evaluating and analyzing the user's cognitive response to better understand the perceived architectural quality of buildings. By adopting a multidisciplinary approach that draws upon the psychological literature on perception and cognition with respect to the architectural building, this work seeks to investigate the complex relationships between various factors that contribute to the user's response. The ultimate goal is to enhance the overall perceived architectural quality and revisit intention of the building. This analysis underscores the importance of examining user experiences and responses to the architectural environment.

Through a rigorous exploration of cognitive response, this work sheds new light on the subjective quality research and contributes to the broader understanding of how people perceive different aspects of the architectural building.

The analysis highlights the seriousness and rigor of the research, corresponding to the enriched purpose of the study.

The research at hand revolves around two fundamental questions, which encompass the entire inquiry into perceived quality and parametric modeling. These questions serve as the crux of the investigation and are crucial to understanding the underlying problem:

Is the Culture House of Khenchela city distinguished by an architectural quality that is perceived as being in line with modern architectural standards?

In order to enhance the perceived architectural quality of the Culture House of the city of Khenchela, can we take advantage of parameterization as a viable alternative that offers numerous opportunities to enrich the architectural aspects of the building and elevate its overall quality?

C. Research hypothesis

The research on perceived quality and parametric modeling is centered around two major questions, which serve as the fundamental issues to raise hypothesis that need to be addressed.

H0: perceived architectural quality is a subjective construct that can be measured and assessed to form an understanding of the quality of the building.

H1: parametric modeling tools can be used to improve the quality of cultural facilities in the context of the city of Khenchela up to the standards of modern architecture.

D. Research objectives

- Defining perceived architectural quality as a concept.
- Assessing the perceived architectural quality of the Khenchela culture house.
- Assessing the cognitive response of culture house users.
- Developing a custom Python component.
- Optimizing the modeling process and improving the design of the Khenchela culture house using the custom component.
- Proposing a corrective action procedure in order to optimize the perceived architectural quality of buildings in Algeria.

- ***Defining the notion of perceived architectural quality***

Architecture is an art form that is primarily based on visual and mental perception, encompassing all the senses to create a complete architectural experience. However, this concept can be broken down into several dimensions which are combined in the architectural model based on their relation with parametric design applications and their significance in the field. This study focuses specifically on the relationship between architectural quality and parametric design applications, and how they contribute to the overall quality of the architecture. The selected dimensions include elements such as functionality, aesthetics, spatial organization, and sustainability, among others. These various dimensions are taken into consideration when designing a building, with the aim of creating an all-inclusive experience for the users.

Architectural quality, as perceived by an individual, is commonly judged based on recognition, experience and perception. User-perceived quality refers to how the design, functionality and meaning of a building affect their satisfaction and the value they provide. Various building characteristics and criteria contribute to users' perceived quality, which can differ depending on their perspectives and evaluations.

It is important to note that buildings with comparable quality of representation can lead to different perceived value estimates due to subjective differences. This information aims to inform readers about the subjectivity of user-perceived quality in architectural evaluation.

This differentiating feature may be used to evaluate how well the Khenchela Culture House is received since, in each user's viewpoint, every component of this structure differs from those of other, comparable buildings. As a consequence, the quality as perceived by visitors may be evaluated from a variety of angles, such as presentational aesthetics, functionality, comfort, and the general impression of safety.

The preferences and choices people make when visiting the building are also influenced by ergonomics and the space/function relation. Subjective values might include the amount of time spent looking up information, assessing the appearance and style of buildings, accessibility, and the general quality of the activities and services.

The perceived architectural quality, which includes multidimensional aspects that reflect various perceived values, such as the perceived social aspect, the perceived emotional response, and the perceived functional value, is the factor that directly influences the intention to revisit the building, according to the literature review. These factors can be thoroughly discussed as specific factors connected to the perceived architectural quality.

- ***Understanding the concept of behavioral loyalty***

Building attachment refers to the deep and intricate connection that exists between an individual and a physical structure. It encompasses various aspects; including cognition, emotions, and behavior, which all play a significant role in shaping this reciprocal relationship. This bond goes beyond a mere functional purpose

The increased prevalence of globalization and mobility has sparked significant interest in the concept of attachment to buildings. In an era where individuals constantly move and relocate, the bond between a person and their physical structure has become increasingly fragile and warranting extensive research. This comprehensive exploration aims to delve deep into the multifaceted relationship between individuals and the buildings they inhabit.

- ***Making use of parametric design for the sake of improving perceived architectural quality***

One of the many fields where Computer Aided Design (CAD) is utilized is parametric design. Also known as algorithmic design, this design approach allows the designer to explore an extensive selection of options and the ability to generate numerous solutions based on programming languages and algorithms. It is possible to better understand the nature of the design and how it might be enhanced in a variety of areas, including aesthetic and perceived quality, performance, and comfort, in conjunction with simulation tools. The performance of the digitally constructed model may be examined and evaluated, allowing for the provision of more effective solutions. Thanks to the exact form manipulation, flexible process, and adaptable controls that encourage creativity and innovation, designers may benefit from this developing CAD technology, particularly in the pre-design phase. Examples of parametric design software that provides designers greater freedom so they may concentrate on the creative part of design creation include Generative Components, Grasshopper, and Digital Project. It's critical to comprehend how form exploration and design, parametric design and simulation tools and related activities, and this methodology work together to enhance and optimize perceived architectural quality.

- ***Assessment of the perceived architectural quality of the Khenchela culture house***

An anonymous five-point Likert scale questionnaire was adopted and developed from the literature review and theoretical analysis (based on the studies of Aaker, Giordano, Crozier, Cupchik, Lewalski, Baxter and Norman) to assess the perceived architectural quality of the Khenchela growhouse, distributed based on judgmental sampling.

- ***Improving the building design by taking advantage of user perception***

Architects and environmental psychologists have been dedicated to enhancing the quality of buildings for many years by placing strong emphasis on the influence of the human factor and its interaction with the built environment. In their pursuit, environmental psychologists delve into various aspects such as the impact of architectural design on individuals' personal and social lives, as well as the specific needs and preferences of building occupants. This knowledge is then translated into practical applications in contemporary architecture, ensuring the creation of spaces that truly cater to the well-being and satisfaction of their users.

- ***Development of a customized Grasshopper component***

The process involves developing a specialized module that uses a programming language capable of interpreting multiple paradigms. This module is designed to generate a grid with multiple dimensions and is implemented using the object-oriented programming (OOP) approach. By incorporating both data attributes and programming methods, the module attains a cohesive logical structure.

In detail, the creation of the custom component centers around the utilization of an interpreted programming language that can support various paradigms.

- ***Designing the new envelope of the Khenchela culture house using the custom component***

Proposing a new exterior envelope design of the Khenchela culture house using the customized component in order to optimize the perceived architectural quality of the building.

E. Methodology

To achieve a comprehensive understanding of various disciplines, it is crucial to highlight the significance of interdisciplinary and multidisciplinary approaches. By adopting these approaches, disciplines can establish a close relationship and mutually benefit from each other's theories, methods, and data. This emphasizes the interconnectedness and interdependence of different fields of study, as long as concepts are borrowed carefully (Rapoport, 1990).

Architecture has the remarkable ability to assimilate and incorporate fresh ideas and theories from various disciplines, enabling it to enhance the quality of construction and adapt to changing needs. This process is not only limited to the physical aspect of architecture, but also involves a deeper understanding of the surrounding environment, context, and even the behavior and inclinations of those who are directly affected by architectural interventions. By embracing concepts from other fields of study, architecture can evolve and grow, continually improving architectural quality.

The qualitative approach in research involves conducting directive interviews and performing semiotics and semantics analysis. This method focuses on the subjective aspects of the study, aiming to gather insights and understandings. On the other hand, the quantitative approach relies on numerical data and employs structured questionnaires that may have closed or multiple-choice questions (Giordano, 2006). Statistical analysis is also utilized in this methodology to analyze the data collected. It is worth noting that by combining both qualitative and quantitative approaches, researchers can achieve a more comprehensive and profound understanding of the perceived architectural quality. This integration allows for a more enriched exploration of the subject, considering both subjective experiences and statistical evidence.

This research employs a mixed methods approach that draws upon data analysis from previous studies in the field of parametric design. The main objective is to uncover solutions by defining concepts related to perceived quality and optimizing design aspects, ultimately establishing guidelines for their integration into architectural design development. Given the complexity of effectively categorizing and classifying intangible concepts and incorporating them into a coherent design strategy as manageable variables, a procedure of data collection and analysis, specifically through simulation-based techniques, is employed. This approach allows for a comprehensive understanding of design quality from various perspectives, particularly in conjunction with advanced modeling technologies, as depicted in **Figure A**.

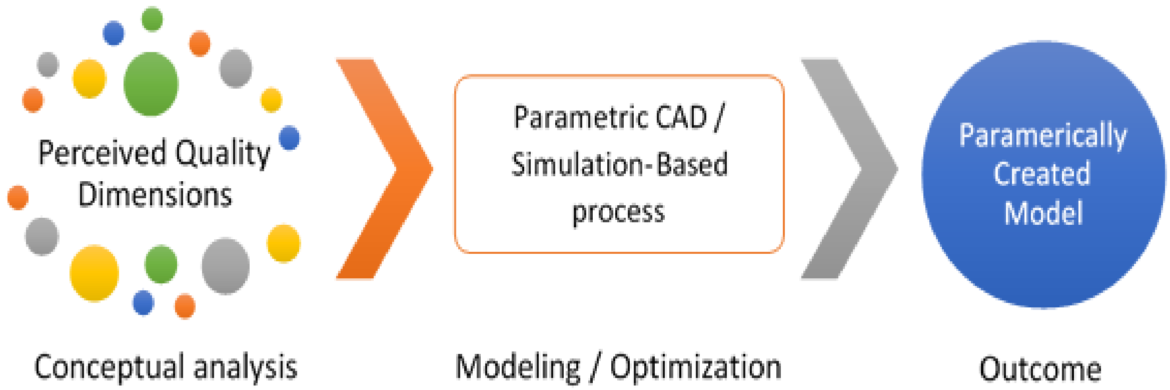


Figure A. *A graphic demonstrating the research methodology (Hamdaoui and Adad, 2020).*

In order to gain a comprehensive understanding of perceived architectural quality and cognitive response, an interdisciplinary approach was employed, incorporating insights from the fields of psychology, cognition, marketing, and architectural studies. This approach considered the psychological literature on perception and cognition, as well as the marketing viewpoint on perceived quality in relation to architectural phenomenon, for the purpose of exploring the various facets of perception and cognition that contribute to the overall perceived quality of architectural buildings **(Figure B)**. Furthermore, it was crucial to adapt and integrate these concepts into the field of architecture, taking into account its unique characteristics, with the ultimate goal of developing holistic and universally applicable conceptual models for understanding both perceived architectural quality and cognitive response.

The evaluation model in this research uses the Likert scale as a measuring tool however it also inspires from other multidimensional scales like : aesthetic appeal (Pedersen, 1978); evaluation (e.g., good-bad) urbanization, and organization (e.g., ordered-chaotic) (Horayangkura, 1978); aesthetic appeal and physical organization (Vielhauer, 1965, as cited by Hershberger, 1972).

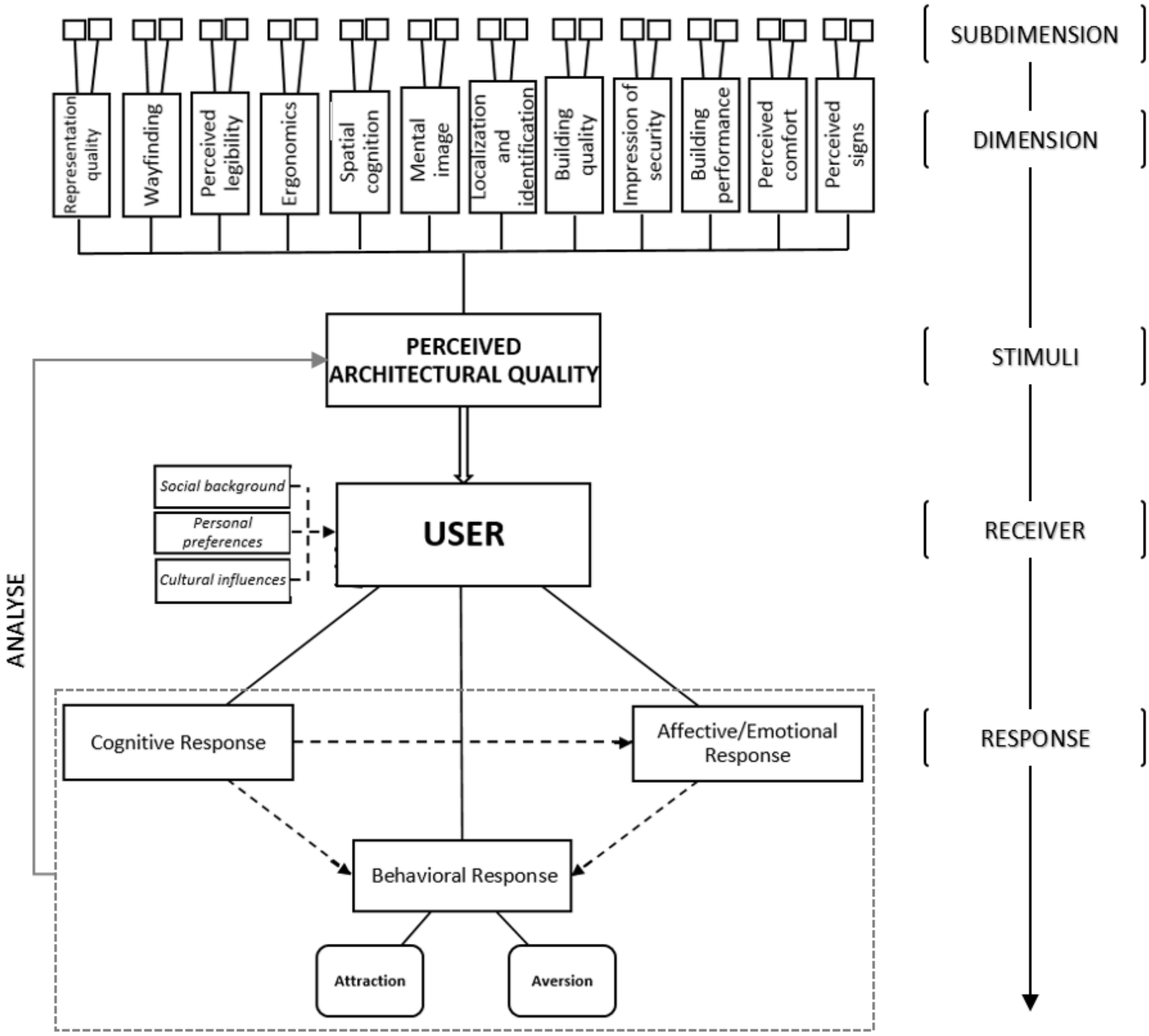


Figure B. *The relations between the perceived architectural quality dimensions and the user's responses (Source: Author).*

- ***Sampling Procedure***

To comprehensively evaluate the user's response to the building and subsequently enhance its architectural quality, it is imperative to have access to empirical data (Canter & Wools, 1970). These empirical data play a crucial role in assessing the user's tendencies.

According to Canter and Wools (1970), there is a straightforward method to understand user behavior, which involves eliciting people's opinions and thoughts regarding various aspects of a building. Questionnaires, a verbal measurement tool, can be employed to assess architectural performance. However, it is crucial to ensure that the questionnaire effectively conveys sophisticated ideas with precision and simplicity, thus minimizing bias and confusion. Additionally, conducting consistency and reliability tests is essential to establish the credibility of the obtained results. By employing this methodology, understanding the user's behavior and enhancing the evaluation of architectural spaces can be enriched.

The survey was administered to a diverse group of 200 participants, representing different age groups, residencies, and education levels, in order to thoroughly analyze the perspectives and tendencies within each subgroup and to equally gain a comprehensive understanding of the perceived quality of the cultural house building **(Figure C)**.To ensure the accuracy and reliability of the data, 10 pilot surveys were distributed to examine the validity of the questionnaire and to minimize the potential influence of the halo effect, which could lead to an overvaluation of certain criteria and consequently bias the interpretation of the findings. Furthermore, interviews conducted with the occupants of the building played an integral role in refining and clarifying the survey questions, ensuring they were free from any confusion or ambiguity.

$$\text{Sample size} = \frac{\dfrac{z^2 \times p\,(1-p)}{e^2}}{1 + \left(\dfrac{z^2 \times p\,(1-p)}{e^2 N}\right)}$$

Figure C. *Initial sample size calculation formula. (Source: https://www.surveymonkey.com/mp/sample-size-calculator/)*

Whereas:

N = population size (114472)

e = Margin of error (≈7)

z = z-score (1.96 corresponding to confidence level of 95%)

Table A: *Result of the sample size calculation*

Population Size	114472
Confidence Level (%)	95
Margin of Error (%)	≈7
Sample size	200

The margin of error, which indicates the level of uncertainty in survey results, typically ranges from 4% to 8% at a confidence level of 95%. This means that Margin of Error of the study falls within the acceptable range of research (Pollfish, 2023; Voxco, 2023; and Zoho Survey, 2023; Lyons and Hearne; cited in Trone Research and Consulting, 2023 as cited by Zulfaqar et al., 2023) **(Table A)**.

F. Research limitations

The research has three primary limitations. The first limitation lies in the challenge associated with subjectively evaluating quality, as it necessitates the reliance on individuals' judgments to analyze multidimensional constructs. Consequently, the perceived quality of a building is greatly influenced by users' subjective perceptions of its various aspects (Tsiotsou, 2006; Ariffin et al., 2016; Steenkamp, 1990). It is important to note that these perceptions can be subject to alteration based on the timing and context in which the information is received (Asshidin et al., 2016) and are likely to evolve over time due to factors such as knowledge and experience (Zeithaml, 1988).

Secondly, aside from the factors that have been examined, there is potential for further exploration of socio-demographic factors. Therefore, an analysis could also delve into these additional socio-demographic aspects.

Moreover, the research was conducted to present a subjective evaluation of the architectural quality of a specific facility in a particular city, as well as the cognitive reactions exhibited by its users. However, it would be highly advantageous to broaden the assessment scope by examining the quality of analogous establishments in various cities, thereby enabling comparative analyses leveraging the comprehensive dataset obtained. This expansion not only enhances the breadth and depth of the research but also allows for a holistic understanding of the architectural landscape in diverse urban settings.

G. Previous studies

Despite the abundance of literature discussing architectural quality, there is a dearth of detailed and thorough studies on perceived quality specifically within the architectural context. Nonetheless, certain aspects of this concept can be borrowed from other disciplines such as commerce and marketing psychology. Additionally, the method of parametric design is experiencing rapid growth, extending its influence to the fields of architectural modeling, design, and optimization. As a result, this research draws from various significant references to provide an examination of the subject matter.

- Baxter, M. (1995). *Product design: Practical methods for the systematic development of new products*. Stanley Thornes.
- Ching, F. D. K. (2015). *Architecture: Form, space, & order* (4th ed.). John Wiley & Sons.
- Crilly, N., Moultrie, J., & Clarkson, P. J. (2004). Seeing things: Consumer response to the Visual Domain in product design. *Design Studies*, *25*(6), 547–577. https://doi.org/10.1016/j.destud.2004.03.001
- Crozier, W. (1994). *Manufactured pleasures: Psychological responses to design*. Manchester University Press.
- Cupchik, G C. (1999). Emotion and industrial design: Reconciling meanings and feelings. First International Conference on Design & Emotion, Delft, Netherlands. 75–82.
- Garvin, D. A. (1984). What does "product quality really mean? *Sloan Management Review*, 26: 25-43.
- GIORDANO, J. L. (2006). *L'approche qualité perçue* (Éditions d'Organisation). Groupe Eyrolles.
- Gregorians, L., Velasco, P. F., Zisch, F., & Spiers, H. J. (2022). Architectural experience: Clarifying its central components and their relation to core affect with a set of first-person-view videos. *Journal of Environmental Psychology*, 82, 101841. https://doi.org/10.1016/j.jenvp.2022.101841
- Jabi, W. (2013). *Parametric design for architecture*. Laurence King.
- Kolarevic, B. (2003). *Architecture in the digital age: Design and manufacturing*. Taylor & Francis.
- Lewalski, Z. M. (1988). *Product esthetics: An interpretation for designers*. Design and Development Engineering Press.
- Lynch, K. (1960). *The image of the city*. MIT Press.
- Ng, C. F. (2020). Perception and Evaluation of Buildings: The Effects of Style and Frequency of Exposure. Collabra: Psychology, 6(1): 44. DOI: https://doi.org/10.1525/collabra.324
- Norman, D. (2013). *The design of everyday things*. New York: Basic Books.
- Norman, D. A. (2004). *Emotional design: Why we love (or hate) everyday things*. Basic Books.
- Rapoport, A. (1990). *History and precedent in Environmental Design*. Plenum Press.

- Rudolph, P. (1961). Paul Rudolph. for Perspecta. *Perspecta*, *7*, 51. https://doi.org/10.2307/1566866
- Silvestri, C. (2009). *Perception et conception en architecture non standard: Une approche expérimentale pour l'étude des Processus de conception Spatiale des Formes complexes*. Architecture, aménagement de l'espace. Université Montpellier II - Sciences et Techniques du Languedoc.
- Tedeschi, A., Andreani, S., & Wirz, F. (2014). *AAD_Algorithms-aided design: Parametric strategies using grasshopper*. Le Penseur Publisher
- Zusne, L. (1970). *Visual perception of form*. New York: Academic Press.

H. Research tools

The research integrated two distinct categories of tools in its methodology. Firstly, it utilized tools associated with social sciences and statistical analysis. These tools allowed for a comprehensive examination and evaluation of the data gathered. Secondly, the research also made use of tools related to modeling and simulation. The first kind consisted of:

- Standardized tests: they are commonly employed assessment instruments designed to evaluate an individual's proficiency or aptitude in a particular field, encompassing aspects such as language proficiency, cognitive abilities, and behavioral competencies.
- Survey: it serves as a questionnaire; it was distributed among a group of individuals with the purpose of collecting data that would provide insights into their attitudes, beliefs, or tendencies.
- Interview: A face-to-face conversation that takes place between the researcher and an active user of a building. The primary objective of this interaction is to gather valuable data pertaining to the user's experiences, opinions, and behaviors (See Appendix 9).
- Ethnography: A research methodology that is extensively used for the purpose of observing and studying a specific group of individuals in their natural environment. The primary objective of this approach is to gain an understanding of their culture, beliefs, and practices by closely observing their behavioral patterns, and social interactions.

Application tools in this regard are:

- IBM SPSS 28.0
- GPower 3.1

While, the modeling and simulation tools consisted of:

- Rhino 7
- Grasshopper 1.0.0007
- Ladybug
- Meteonorm 8
- Python

I. Thesis structure

The thesis consists of a total of seven chapters besides the general introduction and the general conclusion (**Figure D**).

The theoretical section is composed of four chapter that covers the bibliographical research and the state of art of notions and concepts related to the subject of the thesis.

The analytical part consists of three chapters that present the findings of the statistical tests and the results of the modeling and optimization.

General introduction: includes research problematic, research hypothesis, research objectives, methodology, research limitations, previous studies, research tools, and thesis structure.

Chapter 01: the subject matter at hand revolves around the comprehensive analysis and exploration of the theoretical aspects related to the perception and cognition within the realm of architecture.

Chapter 02: it takes interest in defining perceived architectural quality as a concept in addition to its composing dimensions.

Chapter 03: the subject matter explores the intricate interplay between form and design in connection with perception, incorporating discussions on relevant concepts and principles.

Chapter 04: It highlights the significance of utilizing the parametric process as a design method.

Chapter 05: it concerns the comprehensive evaluation of the perceived architectural quality of the Culture House of the City of Khenchela and the exploration of its various aspects.

Chapter 06: it relates to assessment of the user's cognitive response as an indicator of the perceived architectural quality of the culture house of the city of Khenchela.

Chapter 07: applying the parametric process as a design method for modeling and optimization of the Culture House.

General conclusion: uncovers the conclusions drawn from this work resulting from the use of various assessment conceptual models, recommendations are suggested for improving the perceived architectural quality and the cognitive response, a corrective action procedure is proposed, and the future prospects are unveiled.

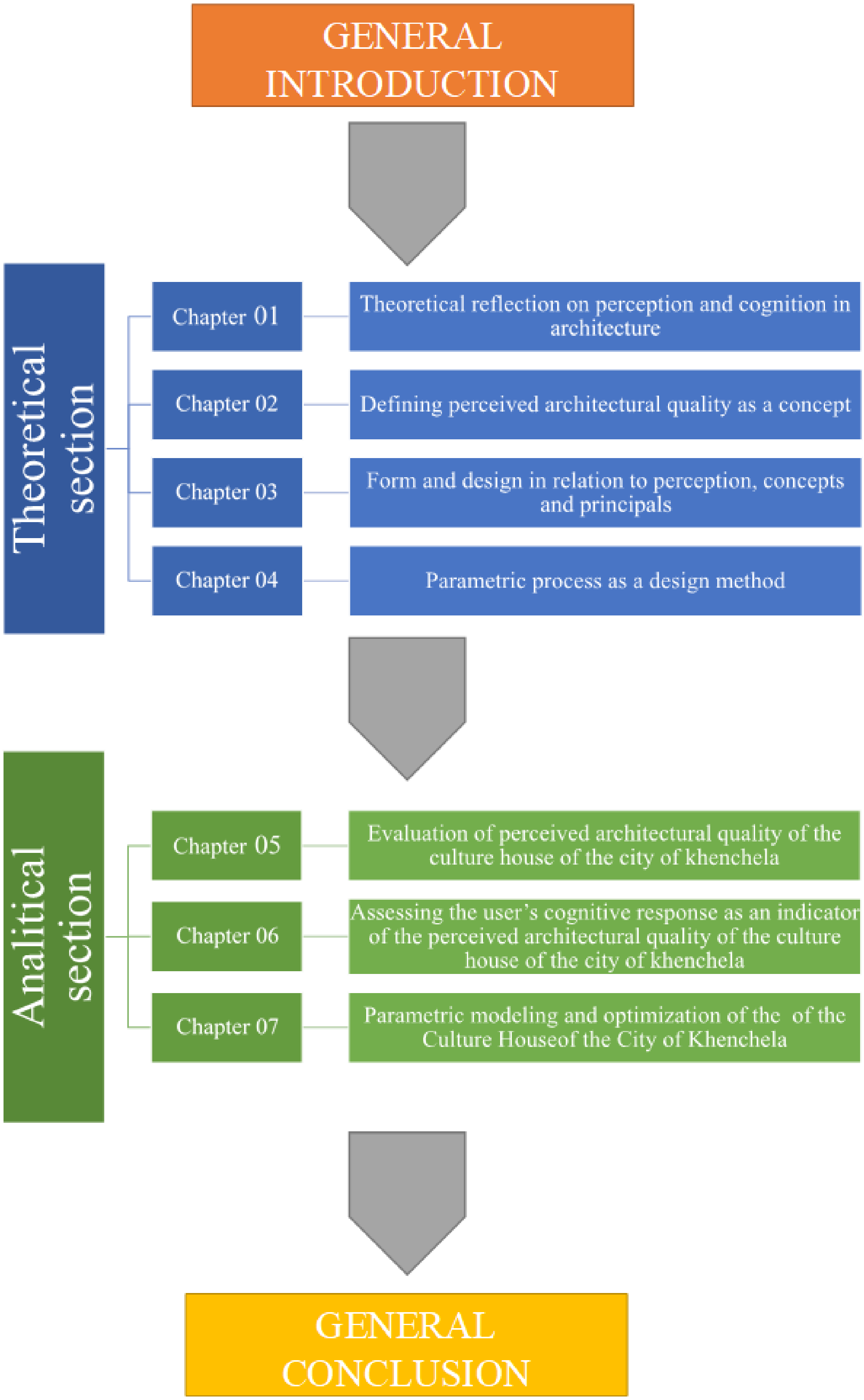


Figure D. *Thesis structure (Source: Author).*

CHAPTER I: THEORETICAL REFLECTION ON PERCEPTION AND COGNITION IN ARCHITECTURE

1.1. Introduction

Perception serves as the fundamental foundation for all human actions and endeavors. The outcomes that we perceive, whether they be objects, sounds, or any other sensory experience, are merely the products of our perception and do not necessarily reflect the true reality of the entity. Instead, they are subjective and personal interpretations that form an integral part of our understanding and interaction with the world around us. By shaping our knowledge mechanisms, perception plays a crucial role in enriching our comprehension of the environment.

The mechanisms mentioned are formed by interacting with the external world, allowing individuals to shape their own understanding of reality on both personal and collective levels. As a result, these mechanisms provide the perceiver with interpretations that require careful decoding to fully comprehend. The process involves engaging with the perceived stimuli and assimilating them into one's cognitive framework.

Analyzing people’s perceptions of architectural edifices and spaces is an essential step in the direction of understanding and comprehending the subjective aspect of architectural quality. Different features of the building catch the attention of the perceiver, the style, size, shape, colors, and arrangement of various elements.

These characteristics can be perceived individually or as a one entity to generate different responses and reactions. Accordingly, it is necessary to understand the perception as a phenomenon to be able to identify the needed qualities to improve the architectural building. According to Ng (2020) , Many researchers explored the field of evaluation based on perception on many subjects such as: building exterior (Herzog, & Gale, 1996; Herzog & Shier, 2000; Nasar, 1994); residential areas (Horayangkura, 1978), city districts (Lowenthal & Riel, 1972); houses (Canter, 1969); interiors of buildings (Canter & Wools, 1970; Vielhauer, 1965, cited in

Hershberger, 1972); urban spaces (Herzog, Kaplan, & Kaplan, 1976) and building facades (Akalin, Yildirim, Wilson, & Kilicoglu, 2009; Ikemi, 2005; Stamps, 1999). high-rise buildings (Stamps, 1991); and large, modern office buildings (Gifford et al., 2000).

The architectural building is in its context (Julean, 2016). The importance of considering the architectural building within its context cannot be overstated. It is imperative to seek and implement a thoughtful process and methodology of design that allows the project to effectively adapt to various contexts. This necessity arises from the understanding that each architectural endeavor is unique and must account for factors such as location, and surroundings.

1.2. Perception

Perception, being inherently subjective, is intricately tied to individual viewpoints. It engenders a plethora of personal interpretations, as experts and non-experts appraise a building from dissimilar vantage points. An expert, armed with analytical prowess, assesses a structure through a lens of rationality and functionality, placing emphasis on efficiency and performance-related attributes.

Conversely, a non-expert gravitates towards aesthetically pleasing features, resulting in divergent perspectives. Consequently, their respective decisions and judgments are informed by disparate criteria, highlighting the multifaceted nature of perception.

Therefore, perception plays a vital role in generating emotions and sensory experiences. It is important to acknowledge that human perception is susceptible to misinterpretations and errors, resulting in the formation of subjective interpretations of an object that may not align with its reality (Giordano, 2006). In other words, our perception shapes the way we feel and experience the world around us, but it is not always an accurate representation of the truth.

According to Giordano (2006), perception can be described as a complex set of processes that allow individuals to make sense of the world around them. These processes enable us to effectively interpret and organize the vast amount of information that is continuously being received from our environment.

However, due to the sheer volume of information, it becomes necessary for our perception to be selective in its translations. In other words, we filter and prioritize the incoming sensory data, focusing on what is essential.

Perception plays a vital role in our ability to gather knowledge about our surroundings and engage with them effectively. However, it is important to note that what one person perceives may differ from how another person perceives the same thing. The act of perceiving enables us to acquire a deeper understanding of the world around us and facilitates meaningful interpretations.

Perception, which can be understood as the process through which we make sense of the world around us, is influenced by various cognitive processes. In order for us to fully grasp the meaning behind our perceptions, it is crucial for these processes to work together in a cooperative manner. This collaborative effort allows us to interpret stimuli, develop sentiments and create meaning

According to Giordano (2006), perception can be: immediate, experienced, or evoked **(Figure 1-1)**.

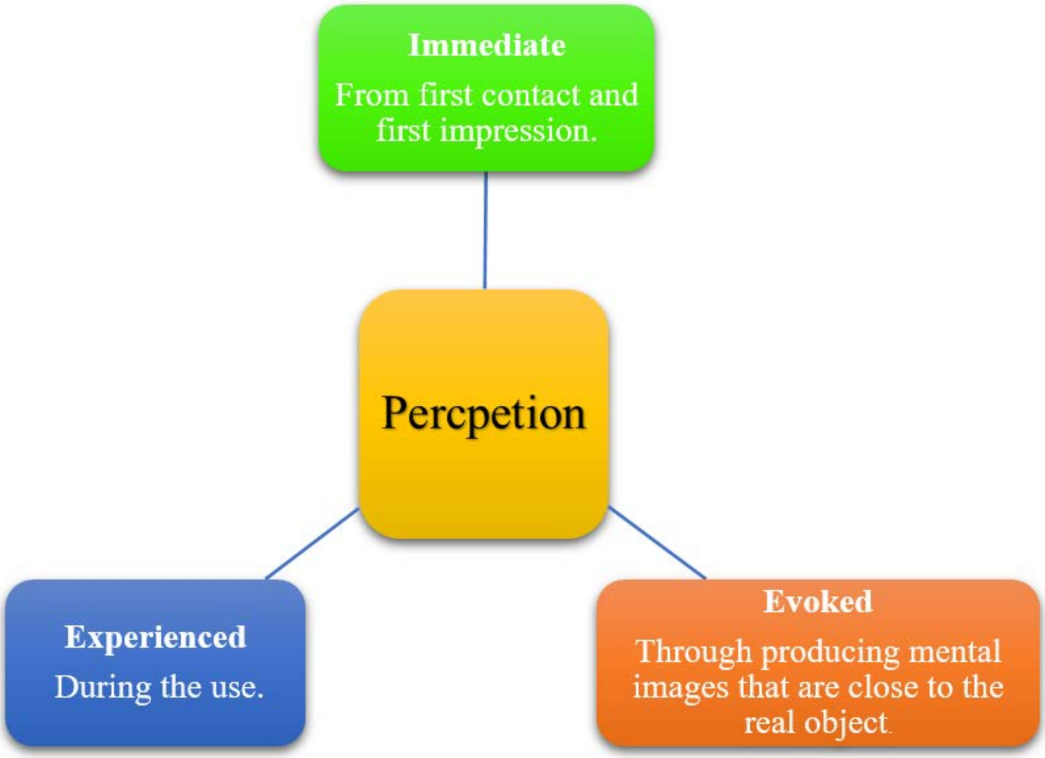


Figure 1-1. *Perception according to Giordano (2006)*

The first impression, for example depends on three factors:

- Stereotypes
- Preconceived ideas
- Prejudices

1.3. Perception and the poly-sensory aspect

According to Giordano (2006), perception encompasses a multi-sensory dimension that involves the integration of various sensory inputs, including sensation and the processing and arrangement of information, to construct interpretations. It is important to note that perception extends beyond the conventional five senses and encompasses additional sensory modalities. In other words, the act of perceiving goes beyond merely seeing, hearing, touching, tasting, and smelling. Perception involves a complex and intricate process that involves the integration of multiple sensory inputs **(Table 1-1)**.

Table 1-1: *The different senses, modified by author from the work of Giordano (2006)*

	Senses	**Description**
Distance senses	Vision	The vision is the most stimulated sense that treats and analyze the majority of sensory information that concerns space, it is a directional sense that anticipate and detect from distance a portion of the viewed space. The visual information is the first to arrive to the memory and consciousness. Binocular vision allows for the reconstruction of depth and the third dimension. The eye catches minor details and inform the brain to build representations and mental images.
	Hearing	It is a simultaneous and sequential process that treats temporal events; it is a sense that works even when sleeping and allows the individual to operate the act of focalization and to wake up in accordance with certain space and time. There are acoustics effects resulting from the interaction of multiple sounds. Sounds contribute to the creation of an ambiance and to influencing the cognitive and affective responses and the perception of time.
	Smell	This sense concerns the brain and the memory, it is an important modality that can appreciate and discern very special and personal smells. Humans can discern about 4000 smells. The sense of smell can bring pleasure but can also be used as an alert indicator; it can also recall profound memories and trigger instantaneous and spontaneous emotions that can be either favorable or unfavorable.
Contact Senses	Touch	It is used to keep contact. The skin ability to sense is mechanic and thermal, immediate and sensitive that allows for exploring objects through superficial contact

		and palpation. The sense of touch is essential for the quality of use; it provides information related to comfort, wellness, pleasantness, and familiarity. The tactile sensibility varies from a body region to another, and the hand is more performing that the eye for the recognitions of different properties such as texture, roughness, and elasticity of materials.
	Taste	The appreciation of taste is an intuitive and rational judgment. The taste sensitivity brings either pleasant or un pleasant sensations and similar to the smell modality it can also be used as an alert indicator, hence the individual only consumes things that he has confidence in. it can recognize four qualities: sweetness, saltiness, sourness and bitterness. It is affected by innate and acquired factors; the cultural and social environment also may contribute to the evolution of this modality.
Internal Senses	Kinesthetic and Balance	It refers to the position of the body member, the somatosensory system and the perception of the body modification. It is the sense that has essential indications of the position (horizontal, vertical, before, behind), without it, messages from other senses cannot be comprehended. It also concerns the detection of forms and the apprehension of space, the mobility or what's called kinesthetic, and the sense of acceleration.
	Muscle Stretch	The general opinion is that muscle spindles are fundamental mechanoreceptors that encode muscle stretch and offer accurate data in regards to limb posture and movement kinematics.
Time perception	Chronoception	There are different notions for time perception; it may refer to the succession of events, the perceived period of time that corresponds to the type of act made, it can be relatively considered as a long period of time or a short period based on what brings pleasure to the perceiver.

According to Lynch (1960), the sensory experiences of tactile and inertial senses (touch and movement) play a role in perception, but it is the sense of sight that holds the greatest importance and dominance. Visual stimuli have a profound impact on our perception, as they enhance our ability to form mental images and understand our surroundings.

1.4. Stages of world perception

Giordano (2006) mentions and defines three stages of perception:

1.4.1. *Selection and filtering*: it refers to the mechanism associated with the stimuli, coding the sensory information and the separate analysis of different characteristics of the stimuli.

1.4.2. *Organization*: it refers to regrouping the information, and structuring it into global units or forms.

1.4.3. *Interpretation*: it refers to the fact that the cognitive treatments doesn't only concern conceptual and symbolic associations but equally concern the automatic aspects of perceptual mechanisms. Pervious knowledge is necessary for identification and automatic response, hence, the organism treats a huge amount of information simultaneously.

1.5. Representations and the three levels of brain

According to H. Laborit, J. Mélèse and E. Berne (as cited by Giordano, 2006), there are three levels operating in the brain, responsible for different processes as shown in **Figure 1-2**:

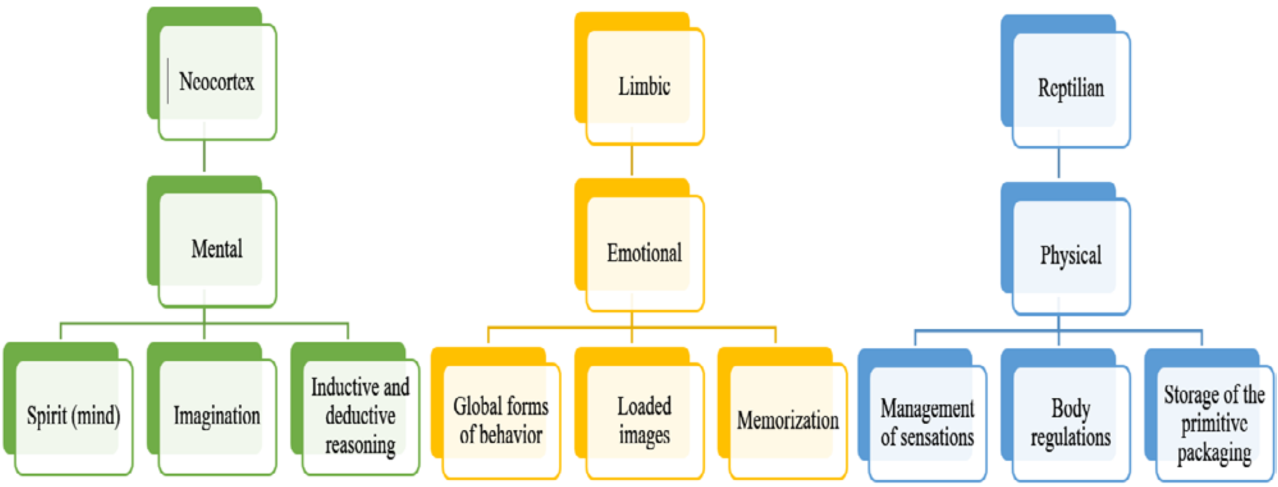


Figure 1-2. *H. Laborit, J. Mélèse, and E. Berne's three levels of the brain (as cited by Giordano, 2006).*

1.6. Categories and types of biases in regards to perception

Giordano (2006) noted three categories of biases: individual bias, biases relating to the object aspects, and environmental biases. Each category also consists of three types of biases:

1.6.1. Individual biases:

a) Physiological biases:

- Perception is filtered by sensory modalities and has a limited field.
- Perception is influenced and perturbed by fatigue.

b) Bias related form: global and immediate impression:

- The emotional and affective response determines the impressions generated by perception.
- First impression guides the following perceptions.

c) Cognitive discrepancies and subjective aspects:

- Prejudgments and prejudices lead to errors of perception.
- Expertise, knowledge, makes perception sharper and more accurate.
- If an individual is alerted beforehand, he will no longer make his own analysis.
- The perceiver sees what he wishes and wants to see.
- Attention concentrates on particular points.
- The memory produces habits that are hard to change.
- Motivation is a factor that pushes the perceiver to explore beyond the perceived.

1.6.2. Biases relating to the object aspects:

a) First impression or experience of use:

- The type of use modifies the spontaneous first impression.

b) Bias related to the power of the object:

- The appearance of the object can be deceiving and gives different ideas about its true nature.
- Certain aspects of an object can divert attention.

c) Details with strong impact:

- A certain detail can generate a bad global impression.

1.6.3. *Environmental biases:*

a) Viewpoint:

- Different viewpoints produce different perceptions.

b) Ambient bias:

- The context and the ambiance influence perception and modify what is perceived.

c) Social biases:

- Different interpretations are produced due to the variations of the cultural codes.
- The influence of the social group changes the interpretation of the individual accordingly.
- The image influences and guides the perception.

1.7. Perception and conception

It is important to acknowledge the interconnectedness of the perceptual and conceptual aspects. It is widely recognized that the initial phase involves perception, wherein the individual experiences the physical space and perceives any movement within it.

Additionally, cues pertaining to the properties of light, sound, and the surrounding environment, such as materials and colors, are also received. Subsequently, the complex process of conceptualization begins, wherein the acquired information is analyzed and comprehended, taking into account aspects like arrangement, rhythm, significance, and symbolism.

This perceptual-conceptual interaction bears resemblance to cognitive processes in certain ways. This comprehensive analysis delves into the intricate nature of the relationship between perception and cognition, enriching our understanding of this intriguing connection.

1.8. Mental representations

Memory processes and stores the sensory-system-received information into mental representations or images. Therefore, mental representations can be thought of as memory data (Silvestri, 2009).

Lynch (1960), noted that the vivid mental representation of the building is related to its:

- Shape
- Color
- Texture

1.9. Perceptual action

Perceptual action or the operation of pairing and learning where an agent is able to communicate with its environment (either real or virtual) through mental operation that exclusively visual, pairing occurs via observations related to mental representations saved in memory while the process of learning allows the fast treatment and analysis of a big amount of information as a response to the constant change and evolution of the physical world (Silvestri, 2009).

In the same context, Giordano (2006) highlights that the recognition of forms is immediate and simultaneous, it is a perception from the first look that includes the global impression of details, the immediate impression is determined afterwards. First impression is essential and influence the subsequent judgments of the perceiver.

Perception can also be defined as the permanent interaction with real objects during contacts; it consists of experiencing the reality and acquiring knowledge (Giordano, 2006).

Giordano (2006) states that perception is influenced by:

- Context
- Environments
- Situation

1.10. Cognition

Silvestri (2009), noted that the study of cognitions touches multiple and different disciplines such as psychology, linguistics, economy and art, hence the cognitive discipline is considered as an independent field, in this context. He adds that E. Legrenzi states that the main objective of this discipline is to form an understanding in regards to how any naturel or artificial system function:

- Perceive and filter information of its environment through *perception.*
- Memorize and erase information from *memory*.
- Create new ideas through the process of *thinking*.
- Communicate, take decisions and adapt and to be adapted to the environment via *conception*.

When addressing issues pertaining to human creativity and the design process, it becomes crucial to reflect upon the connection between the internal functioning of the mind and the principles governing the organization of the external physical world.

This is paramount because mental processes play a fundamental role in the design process itself, whereby the interaction between the internal and external realms forms the foundation. Understanding how the mind operates internally and how it relates to the external world is vital for a comprehensive comprehension of design and creativity. By examining the convoluted relationship between the mental and physical aspects, we can enrich our understanding of the design process and enhance its effectiveness (Silvestri, 2009).

According to Alain Berthoz (as cited by Giordano, 2006), cognition covers the following tasks:

- Perception
- Memory
- Reasoning
- Language
- Motor skills
- Categorization
- Emotions
- Attention
- Vision
- The interactions between the previously mentions tasks

Giordano (2006) also mentions that cognition as a process consists of four main operations (**Figure 1-3)**:

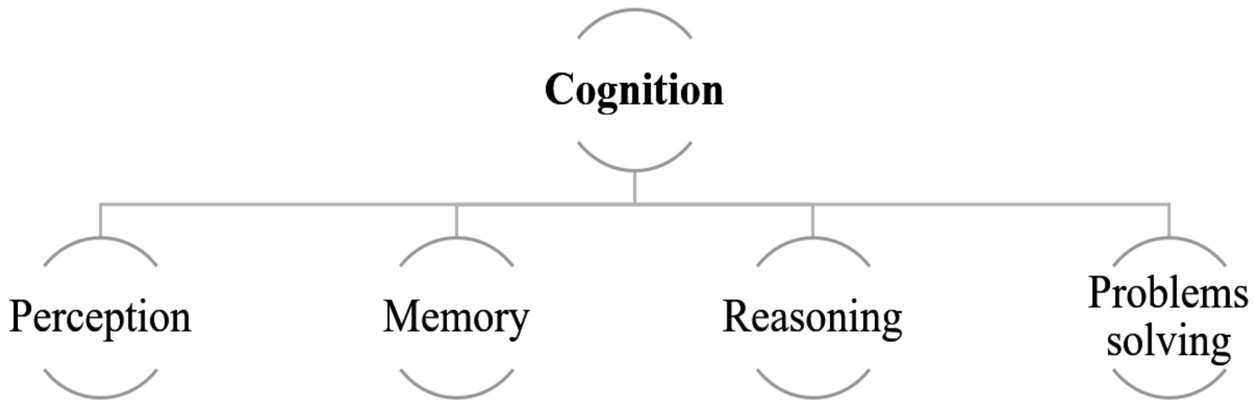


Figure 1-3. *Cognition according to Giordano (2006)*

1.11. Cognitive perception

According to Yazdanfar et al. (2015), there is an association between perception as a process and cognition. Giordano (2006) says that cognitive perception, also called conceptual perception, intervenes fundamentally in the cognitive aspects of the interpretation of what is perceived, it is based on reasoning and deductions resulting from:

- Perceiving:

It refers to the understanding and the comprehension, and the need to render the perceived intelligible, perception is, therefore, the interpretation of sensory data based on reasoning mechanisms.

- Seeing through an imaginative perspective:

The process of cognition does not only translate the sensory data, it also, corrects, enriches, and transforms them leading to forming perception, and it is, consequently, a mental representation.

He additionally states that, experience, memory and reasoning contribute to this process, rendering the process of cognitive perception the result of:

1.11.1. *Attention*:

It guides the spirit (mind) to do certain actions and details as it is seen to be fit.

1.11.2. *Intelligence*:

It refers to the judgments that establish the relations between the perceived objects.

1.11.3. *Memory*:

It allows the recognition of objects based on what was learned and encountered before.

1.11.4. *Imagination*:

It helps in making perceptions during the process of the project.

1.12. Cognitive response

Crilly et al. (2004) noted that the cognitive response pertains to the user's evaluations, specifically referring to the assessments made about a product's perceived qualities, which are derived from the information acquired through the senses. In other words, when users interact with a product, they form judgments about its characteristics by processing sensory information. These judgments are crucial as they influence the overall perception and evaluation of the product. Similar to Crilly et al. (2004), other authors classified the cognitive response into three categories **(Table 1-2)**.

Table 1-2: *Categories describing cognitive response.*

Lewalski (1988)	**Crozier (1994)**	**Baxter (1995)**	**Cupchik (1999)**	**Norman (2004)**	**Crilly et al. (2004)**
Visual 'X-values'	Response to form	Intrinsic attractiveness	Sensory/ Aesthetic response	Visceral design	Aesthetic impression
Visual 'Y-values'	Response to function	Semantic attractiveness	Cognitive/ Behavioral Response	Behavioral design	Semantic representation
Visual 'Z-values	Response to meaning	Symbolic attractiveness	Personal/ Symbolic response	Reflective design	Symbolic association

1.13. Preconceptions influencing human creativity

Silvestri (2009) mentioned that are barriers (preconceptions) that influence the human creativity and by extension the process of design such as:

- Cognitive barriers
- Individual barriers
- Collective barriers
- Cultural, social and ethical norms

The architect should consider them before initiating the process of design and also during it.

1.14. Concepts related to perception phenomena

1.14.1. Complexity

"The more potential noticeably different elements and settings exist, the greater the chances of people perceiving them and experiencing complexity." (Rapoport, 1990, p:).

The concept of complexity in architecture arises from the presence of diverse and distinct architectural elements, each displaying unique and non-repetitive patterns. This arrangement not only adds intricacy to the design but also introduces a sense of diversity and richness in the visual experience

In the realm of human perception, individuals often find intricate amalgamations of elements captivating due to the cognitive effort required to decipher the interconnectedness of the information at hand. Research conducted by Wohlwill (1976) sheds light on the preference for scenes that possess a moderate level of complexity, as opposed to those that are excessively complex.

The concept of complexity within a building refers to the presence of numerous information units that need to be easily understood and grasped. Complexity not only encompasses the idea of novelty and originality but also entails unpredictability. As Chan (1998) suggests, complexity in a building entails an intricate arrangement of information and challenges the occupants' ability to gather information.

According to Herbert A. Simon, complexity arises from the intricate interaction of numerous components in a non-trivial manner (Rudolph, 1961). The multifaceted nature of complex systems stems from the juxtaposition, contradiction, and contrast of different elements, as well as the complementarity and unity that arise from their combined utilization. It is through these intricate dynamics and the way these elements are employed that complexity emerges.

1.14.2. Novelty

An innovative product should have the ability to immediately convey its purpose and functionality without relying on users to figure it out on their own. This means that the product should effectively communicate its features without waiting for the user to discover it himself (Giordano, 2006).

According to Rapoport (1990), it is postulated that an individual's perception is not static but rather dynamic, requiring constant stimulation. Without such stimulation, a state of "stimulus satiation" may occur, leading the individual to actively avoid or dismiss any stimuli encountered. For instance, when a person frequently passes by the same building, especially if it lacks complexity, they become accustomed to it, resulting in a diminished perception of its significance. This familiarity and lack of novelty can lead to a sense of boredom, ultimately influencing their perception. It is a natural inclination for humans to continuously seek out new information and gravitate towards elements that exhibit novelty and uncertainty. Therefore, in order to maintain a heightened perception, introducing elements of complexity and novelty becomes essential to engage and stimulate the individual's cognitive processes.

Rapoport (1990), additionally, noted that when a stimulus, such as a building or a specific component, possesses distinct and innovative qualities, it has the ability to capture attention and be acknowledged by one's consciousness. This implies that a shift in state is necessary during this process. The uniqueness and novelty of the stimulus play a crucial role in attracting and engaging one's awareness, prompting a transformative experience. Learning and experience play a crucial role in uncovering a profound level of intricacy and discerning subtle variations, disparities, and subtle indications.

1.14.3. Order

Order, in its essence, pertains to the arrangement and organization of elements in a manner that is logical, cohesive, and coherent. A sense of order is established when elements are interconnected in a way that is familiar and compatible, creating a state of equilibrium.

In order to achieve visual richness, complexity and order play vital roles, but striking a balance between the two is of utmost importance. Generally, complexity generates engagement and heightens arousal, whereas order facilitates comprehension and reduces arousal. As a result, when arousal levels are moderate, the aesthetic appeal is significantly heightened, as stated by Nasar (1989). This implies that, for visual stimuli to be visually stimulating, a delicate equilibrium between complexity and order needs to be established.

Le Corbusier (1986) emphasizes that architecture encompasses more than just fulfilling practical requirements such as utility, comfort, and arrangement. He posits that architecture is first and foremost an art form that strives for magnificence, organization, harmony, and evocation of emotion. He equally, highlights the significance of achieving order and unity in satisfying our visual senses. According to him, the key to creating a visually pleasing environment lies in the ability to achieve order and unity in accordance with the evident laws.

In certain situations, and due to various compelling circumstances, the conventional notion of order in architecture may need to be disrupted in order to create anomalies and introduce a sense of uncertainty. These disruptions, in turn, bring validity and significance to the architectural design. As stated by Rudolph (1961), this deliberate disturbance of order holds the potential to enhance the overall meaning and impact of architecture.

Ching (2015) categorized order into three sections: Physical, Perceptual, and Conceptual

1.14.3.1. Physical: it includes form and Space (the duality of solids and voids, interior and exterior)

1.14.3.2. Perceptual: It concerns both the sensory perception and recognition of the physical elements through sequential experience. Among the components it consists of there is:

- Entry
- Movement through space
- Space functions and activities
- Light, sound, texture and color quality

1.14.3.3. Conceptual: it refers to how the relationships between the elements of building are comprehended (either ordered or disordered), and how to respond to the meanings evoked by these elements and systems. It includes:

- Images
- Patterns
- Signs
- Symbols
- Context

1.14.4. Rhythm

From the standpoint of architecture, rhythm encompasses the predictability and pattern of elements and details. It plays a crucial role in reducing the perceived complexity over time, although in certain instances, the concept of sequential perception introduces fresh and novel information (Chan, 1998).

Sequential perception pertains to the perceiver's comprehension of elements and details in a specific and sequential order, wherein the information is grasped in a temporal and consecutive manner (Huang, 2011).

Rhythm is a fundamental aspect of design, characterized by a state of equilibrium and repetition. It is through these harmonious elements that rhythm is achieved, whether it be through simple symmetries or more intricate and complex patterns. (Le Corbusier, 1986).

1.14.5. Diversity

According to Le Corbusier (1986), Diversity should not be regarded as mere ornamentation in architecture, but rather as a fundamental principle that manifests in the design.

In order to generate interest and capture attention, it is crucial to ensure that there is a noticeable diversity and differentiation of elements.

These distinctions can be strengthened through a range of cues, including cultural or personal significance, the principle of figure-ground relationship from Gestalt psychology, salience, prominence, and congruence (Rapoport, 1990).

By incorporating these factors, we can create a comprehensive understanding of how to attract attention and engage the user.

1.14.6. Familiarity

Herzog et al (1976) brought attention to the fact that familiarity has the potential to breed contempt. The individual who becomes well-acquainted with all facets of a structure, particularly if it possesses a simplistic design lacking in complexity, may gradually lose interest in these aspects over time. This waning interest can be attributed to the perceiver's heightened perception and cognitive awareness of the multiple cues associated with the building. As their familiarity grows, they may find themselves complacent, mentally overlooking or disregarding these once noteworthy elements.

Buildings with familiar and typical designs tend to generate positive judgments as long as they are not too plain and average, on the other hand atypicality in design is well received by users because it offers them new and additional information to process as long as it is not extreme, chaotic and deprived from any sense, therefore moderation is the key factor in this case.

1.14.7. Mystery

According to Ikemi (2005), when faced with enigmatic landscapes, observers tend to generate an innate inclination to explore, particularly when encountering concealed sections within a structure. These obscured areas spark curiosity within the perceiver, compelling them to seek further knowledge and delve deeper into the unknown aspects of the building. Additionally, in his research, Ikemi (2005) noted that in high mystery conditions, participants showed a preference towards an average of 12 facades that were presented to them. This indicates that when the element of mystery is heightened, individuals tend to gravitate towards it.

The visible parts of a building often convey complexity and the introduction of new elements. However, the hidden parts of the building contribute to the overall mystery associated with it. In this context,

Ikemi (2005) in his findings found that on average the 12 facades that he presented to the participants were preferred in the high mystery condition.

Vestigial elements, as pointed out by Rudolph (1961), possess a certain level of ambiguity in their meaning. It is this ambiguity that, in turn, introduces a multitude of rich and diverse meanings, representing a crucial aspect of transformative change and the revitalization of old structures. This entails the process of remodeling aging buildings, imbuing them with new purposes, programs, and symbolic significance.

In the specific context of the culture house of the city of Khenchela, the main purpose is to revitalize the building both in terms of functionality and structure. Additionally, there is a strong emphasis on enhancing its visual appeal and instilling a new symbolic significance in order to:

- Ascertain its value as only the cultural facility in the city.
- Improve its perceived quality.
- Rise its revisit intention.
- Render it representative of the region identity.

By enveloping the building with an exoskeleton, the old structure is effectively concealed. This not only adds visual richness and symbolic significance through the new envelope, but also introduces an intriguing element of mystery. As the observer notices the presence of another structure hidden beneath the new one, an exploratory response is triggered, encouraging curiosity and exploration. This interplay between the visible and hidden layers not only enhances the overall aesthetics but also deepens the engagement of the observer by evoking a sense of discovery and intrigue.

1.14.8. Congruence

According to the research conducted by Wohlwill (1982) and Groat (1982), it has been observed that people generally show a preference for buildings that are in harmony with their surroundings. This preference holds true both for buildings situated in natural environments and for those situated among neighboring structures.

In his study, Rapoport (1990) emphasized the crucial role of understanding the interplay between the environment and human behavior. He argued that designing spaces and structures should consider the congruency between the characteristics of both humans and their surrounding environment. This means that a successful design must align with and accommodate the needs and preferences of individuals.

The disregarding of the human factor and the environment surrounding a building, and approaching things from a narrow perspective without considering these variables, will ultimately result in a project that is disconnected from its context and lacks practicality. This situation can be likened to an intruder being suddenly introduced into a foreign environment without any adaptation, leading to issues arising from incompatibility. By failing to acknowledge and integrate the influence of human behavior and the surrounding environment, the project loses its connection to reality and becomes detached from its intended purpose. It is essential to consider these factors comprehensively to ensure that the project is enriched with context, and relevance.

Congruence can be achieved by integrating various principles derived from Gestalt psychology, such as similarity, continuity, symmetry, and connectedness.

1.14.9. Legibility

Legibility, coherence, and wayfinding are crucial factors that contribute to users' understanding of a space and their sense of place. Some individuals appreciate when spaces provide clear and easily accessible information, allowing them to navigate with ease and certainty. On the other hand, there are those who find allure in the unknown, enjoying the element of mystery and anticipation.

In order to ensure that a building effectively communicates information, it is imperative to conduct a thorough visibility analysis, especially in relation to its surroundings. This analysis aims to maximize the visibility of the building's various components, thereby maximizing the amount of information it conveys to viewers. It is worth emphasizing that even if a building possesses remarkable aesthetic appeal, its details need to be fully visible and unobstructed. This ensures that the aesthetic experience of those observing the building remains complete and fulfilling. Thus, prioritizing visibility becomes crucial in delivering a holistic and impactful architectural encounter.

Buildings perception is influenced by unique and unexpected features, as well as how these features are arranged together. According to Berlyne (1960, as cited by Akalin et al., 2009), such buildings possess novel, dissimilar, and surprising characteristics, which contribute to the complexity of the overall structure. Chan (1998) further defines these features as visual units of information that allow observers to perceive and distinguish novelty or dissimilarity in the building's perception process. By incorporating these distinct and eye-catching details, the building becomes enriched with complexity and depth, providing a unique experience for its observers.

Chan (1998) raised the question of how dissimilarity can be perceived as chaotic or pleasant. In an attempt to shed light on this matter, he put forward Peter Smith's (1974, 1987) hypothesis. According to Smith, the notion put forth is that, apart from deriving enjoyment from novel and unexpected elements, the effective assimilation of new information is also crucial. It is important to note that if the level of detail surpasses the overall cohesion, the perceptual apparatus fails to fully comprehend this information if *particularity* outweighs *unity*. In other words, while novelty and surprise are significant components, the balance between specific details is necessary.

Le Corbusier (1986), in his book, emphasized the transformative nature of architecture, which is constantly navigating the ever-evolving realm of laws and regulations, while also benefiting from the advancements and tools offered by the industry. It is crucial for architecture to assimilate these changes and capitalize on the latest technologies and innovative ideas in order to achieve groundbreaking design that exudes novelty and innovation. This process entails a continuous adaptation to the shifting landscape of architectural practice, as well as an exploration of creative possibilities offered by emerging technologies.

If it is considered that complexity and novelty can be inferred from the visible elements of a building, it is equally important to acknowledge the level of mystery associated with the hidden aspects. This mystery refers to the degree of uncertainty and ambiguity that is inferred from these concealed elements (Ikemi, 2005). Therefore, architects must exercise caution when finding the right balance between these psychological aspects in order to achieve the desired equilibrium that not only satisfies the recipient but also avoids causing confusion.

In a study conducted by Ikemi (2005), it was stated that a significant partial correlation between the concepts of novelty and complexity, revealing that the level of novelty is influenced by the diversity of elements and shapes involved. The findings further highlighted that when complexity remains constant, novelty plays a crucial role in amplifying the sense of mystery. This implies that the more varied and intricate the elements and shapes are, the higher the level of novelty experienced.

The uniqueness of the architectural style not only adds distinction to the building but also enhances its functionality as a memorable landmark. This distinctive architectural style contributes significantly to the legibility of the structure, making it easily recognizable and memorable to all who encounter it (Evans et al, 1982).

When discussing the concept of mystery in relation to a building, we are referring to the subtle cues and information that the building conveys, captivating the receiver's interest and enticing them to visit, delve into its details, and gain a deeper understanding of its essence. The notion of mystery in architecture lies in the ability of a building to evoke curiosity, drawing individuals to explore its secrets.

Le Corbusier (1986) emphasizes the importance of unity in a work of art. He also argues that elements with distinct attitudes and characteristics play a significant role in creating interest and capturing attention. In order for a building to be impressive and stand out, the presence of unique qualities is essential. By incorporating these notable traits, a building can establish its identity, leaving a lasting impact on viewers.

According to Chan (1998), contemporary buildings are often criticized for their lack of functionality, uniformity, and lack of visual interest. This issue is particularly evident in Algerian architecture, which tends to exhibit repetitive styles, shapes, and volumes without any distinguishing characteristics or meaningful attributes.

This repetitiveness not only results in a lack of identity and novelty but also diminishes the overall significance and meaning of these architectural designs.

1.14.10. Visibility

Nasar (1984a), established how important form and visibility and here it is worth mentioning that visibility is a vital factor because no matter how pleasing the appearance of building is, if its contour is not clear enough and doesn’t offer the needed time for perception, the perceiver won’t be able to collect the entirety of information that permits him to appreciate the visual qualities of this building.

Viewing angles are equally important for the visual perception and scale estimation, therefore the choice of the construction site and how the building is positioned must be considered carefully, taking into account paths and the physical context. According to Evans et al. (1982), a building is visible when three conditions are fulfilled:

- If the building’s main viewpoint (the most prominent) is frequently passed by people.
- If the building is located near a major orientation.
- If the building is located near a circulation system.

1.14.11. Scale and Perspective

The observer's perception of the building is influenced by its scale in relation to himself and his surroundings. This allows him to see it as a cohesive entity made up of different components. Furthermore, the visual information from each individual part is integrated to create a holistic representation of the entire structure. This takes into account the interplay between scale, perception, and visual information. (Chan, 1998).

According to Ching (2015), the way we perceive visual information, such as the shape, size, and proportions of objects, is greatly influenced by the characteristics of the surface on which they appear.

When it comes to determining the scale of a building, for instance, the observer can benefit from elements that have a significant size and visual context. In addition, the perspective from which we view patterns can impact how we perceive them, and the use of colors can further emphasize and distinguish these patterns.

It is worth noting that variations in patterns can be achieved not only by altering the patterns themselves but also by manipulating light and shadow. By doing so, a comprehensive understanding of visual perception is obtained, highlighting the intricate relationship between surface properties and our interpretation of visual information (**Figure 1-4**).

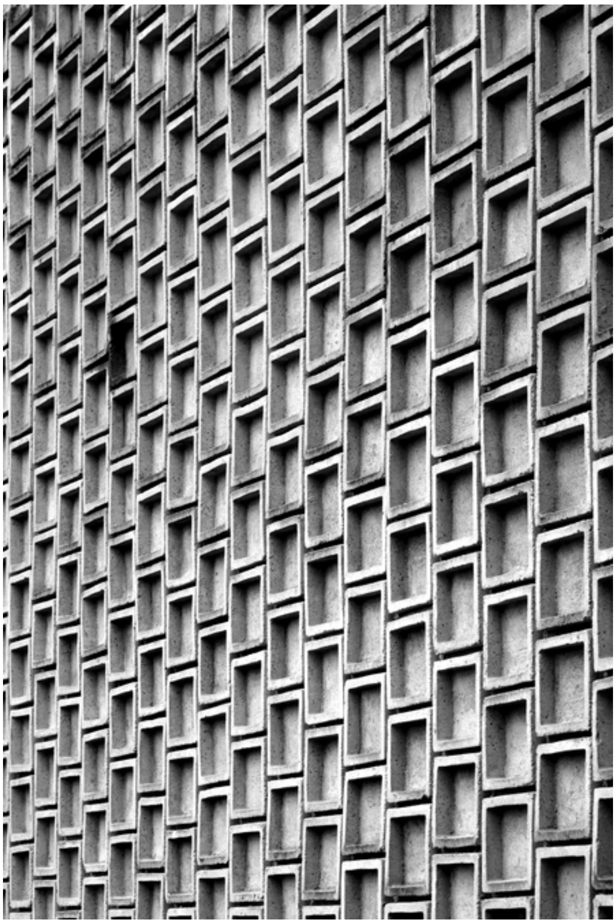


Figure 1-4. *IBM Research Center, La Guade, Var, France, 1960–1961. (Source: IBM Research Center, La Gaude, France. Works.io. (n.d.). Retrieved April 13, 2023, from https://www.works.io/101887/ibm-research-center-la-gaude-france)*

1.15. Visual perception

A study conducted by Blijlevens et al. (2011) reveals a strong connection between the concept of typicality and aesthetic perception. The findings suggest that an atypical design can actually be more aesthetically pleasing, given that it does not deviate excessively from the expected norms or typicality (Cowen-Elstner, 2018). This correlation between typicality and aesthetic appeal highlights the importance of balance in design.

Also, based on the research conducted by Veryzer and Hutchinson (1998), it has been observed that designs that deviate significantly from the standard norms have a lesser positive impact on aesthetic perception. In light of this, the objective of this study is to delve into the interpretation of aesthetic perception as a distinct concept by users.

It is well-established that designs with aesthetic appeal have a greater influence in fostering positive attitudes compared to unaesthetic designs (Kurosu & Kashimura, 1995). These aesthetically pleasing designs evoke feelings of attachment, loyalty, and encourage revisit intention, while also ensuring long-lasting usability. This positive sensory experience heavily contrasts with unaesthetic designs that tend to hinder cognitive performance. The primary focus of this study is to provide an exploration of the nuances and implications surrounding the concept of aesthetic perception.

In architecture, the concept of aesthetic design holds immense significance. It entails the notion that a visually pleasing building has the power to influence the observer in a profound manner, ultimately leading to the creation of a positive feedback loop that influences both functionality and accessibility.

On the other hand, an unaesthetic design has the potential to diminish the overall utility and social value of a structure. Therefore, it becomes evident that aesthetically appealing designs are more favorable to the users, gradually garnering acceptance and tolerance for any inherent design flaws. Moreover, a well-executed design not only fosters creative thinking and modernity but also embodies originality, thereby instilling a crucial sense of confidence. This understanding, as argued by Lidwell et al. (2018), highlights the significant role that aesthetics play in shaping our perceptions and interactions with architectural spaces.

Visual perception is considered subjective aspect to present objective reality (Yazdanfar et al., 2015). The aesthetic aspect of a building plays a significant role in how it is perceived, and this perception is closely tied to one's level of knowledge and understanding. The visual appeal of a structure greatly influences how people perceive it (Julean, 2016).

According to Purcell (1986), architects play a crucial role in bringing about change within an established environment, aiming to improve both functionality and the quality of life. They are introducers of change. Drawing inspiration from the Vitruvian virtues of stability, utility, and beauty, architects strive to incorporate these elements into their designs. Beauty, or the aspect of delight, is a fundamental component of this triad.

It encompasses a range of affective experiences, ranging from attractiveness and pleasantness to excitement and interest. The presence of beauty not only enhances the overall aesthetic appeal but also contributes to a more enriching and fulfilling experience for the recipient.

Based on research from Nasar (1989), it can be concluded that aesthetic quality plays a critical role in shaping how people perceive and evaluate various aspects. This dimension encompasses several factors that hold significant influence over individuals' perceptions and judgments. Additionally, other researchers highlighted the previous claim (Hershberger & Cass, 1974; Horayangkura, 1978; Oostendorp & Berlyne, 1978; Ward & Russell, 1981).

According to Stamps (1999), the visual aspect of a building holds immense significance when it comes to its design. The visual appeal plays a vital role in attracting attention and creating a lasting impression on viewers. It relates to:

1. The division of the facade, whether it
2. The number of openings.
3. Breaking up the volume.

Nasar (1989) proposed a framework of environmental esthetics of five measures, which are an extension of Brunswik's lens model:

- Physical
- Perceptual/cognitive.
- Urban affect.
- Well-being.
- Spatial behavior.

This framework takes account of sociodemographic and environmental context as contextual variables.

The research conducted by Groat (1988) indicated that when it comes to perceived compatibility, the design of the building facade holds significant importance compared to site organization or massing. This highlights the innate visual bias of humans and underscores the crucial role of facade treatment. Being the foremost and most conspicuous element of a building, the facade plays a pivotal role in forming initial impressions. Its visual quality, encompassing the overall form, employed patterns, meticulous attention to detail, and the chosen color palette, greatly influences the observer's perception and judgment of the building's aesthetic appeal.

According to the assertions made by Lynch (1960), certain elements within the landscape, such as buildings, possess distinct visual characteristics that have a compelling ability to captivate and engage the attention of individuals. These features possess qualities that make them highly attractive.

Hence, they equally:

- Reinforce the observer's attention,
- Contribute to Enrichment of his experience.

"To take an aesthetic interest in a building is to attend to it in all its completeness, to see it, not in terms of narrow or predetermined functions, but in terms of every visual significance that it will bear" (Scruton l979 as cited by Chan, 1998). Every detail of the building holds a significant meaning on its own and combined with other elements the significance may increase the meaning, thus, the latter can be more profound.

The conceptual model demonstrated by Jankowski et al., (2018) depicts the possible links between the following painting's aspects:

- Formal aspects
- Content
- Temperament
- Expertise
- System of personal meanings
- Aesthetic appreciation

Temperament qualities play a crucial role as mediators in establishing a meaningful connection between the evaluation of a painting and its formal features.

Experts possess an understanding of the intricate qualities inherent in artworks, which significantly influence their overall composition, they are aware of advanced characteristics related to the artwork that affect their composition such as:

- Complexity of colors
- Complexity of their saturation values
- Painting fragmentation.

Regardless of one's level of expertise, the evaluation of an artwork is heavily influenced by the cultural and personal significance. Moreover, personal meanings play a major role in shaping the connection between cultural meanings and how the aesthetics of the artwork is perceived **(Figure 1-5)**.

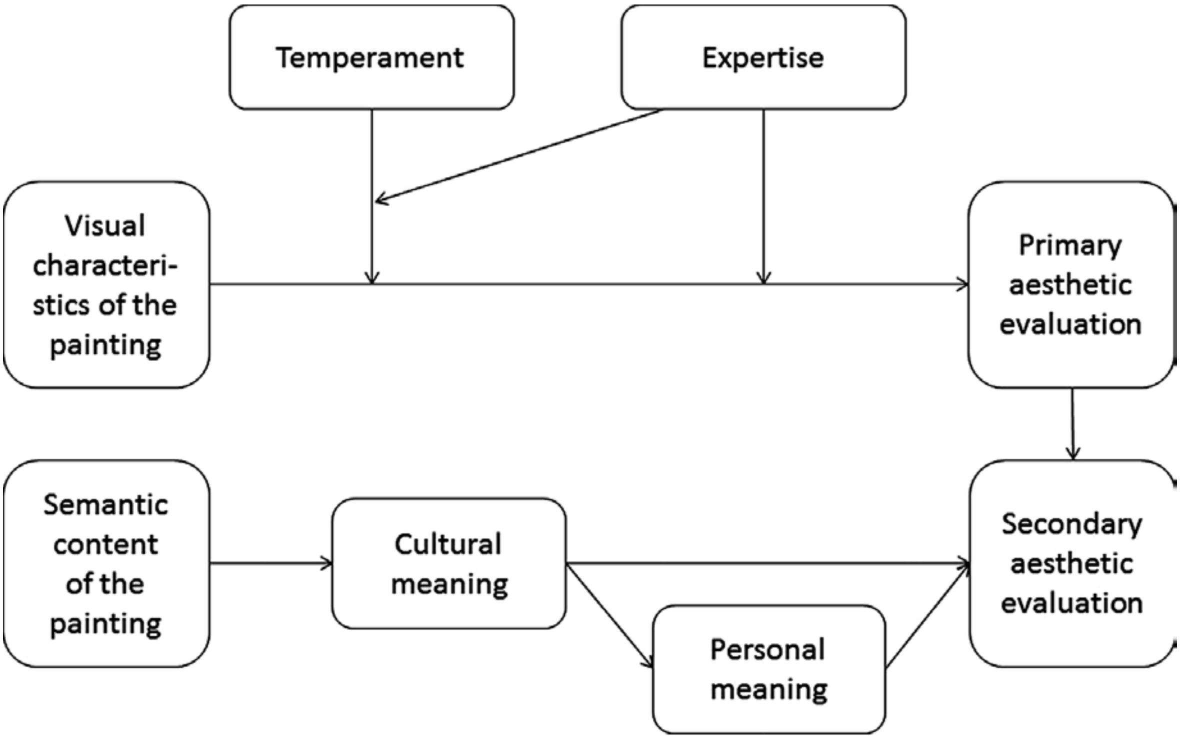


Figure 1-5. *Conceptual model of relationships between formal elements and aesthetic appreciation. (Jankowski et al., 2018)*

Venturi (1966) said, *"Old clichés in new settings achieve rich meanings which are ambiguously both old and new, banal and vivid" (p.44)*. By skillfully blending the concepts of antiquity and modernity, and effectively incorporating traditional elements into a fresh architectural setting and function, it becomes possible to attain a remarkable level of profundity in meaning.

However, the benefits do not end there. This deliberate fusion also has the potential to elevate the perceived visual beauty, enhance the overall identity, and reinforce the sense of place. The amalgamation of the old and the new creates a comprehensive narrative that resonates deeply, leaving a lasting physical and conceptual impact.

In the field of architecture, Chan (1998) delves into the captivating notion of what renders a specific section of a building visually appealing. Expanding upon this inquiry, he offers insights into the theories surrounding the perception of visual forms. One notable theory he explores is the Gestalt theory, exemplifying the figure/ground principle as a case in point.

1.16.Spatial perception

The objects arrangement in space, the distance between them, the occupation density

Moreover, the contribution to the openness or closeness of space are defining attributes of space (Sonnenfeld, 1966). In this regard, he also mentions “spatial adequacy” which characterized by isolation and difference. Individuals are in need of closed space that provides privacy and in same time they seek openness and the difference and diversity it offers from natural scenes to architectural objects and the combination of the various forms that catch attention and create interest.

Gimblett et al. (1985), suggests that the opportunity of involvement is affected by:

- Physical accessibility
- Distance of view
- Spatial definition

In regards to perception, the space envelops the observer, providing a unique and subjective experience for each individual. This experience is shaped not only by the built environment, including buildings and enclosed areas, but also by the interaction with public spaces such as squares and streets, as well as the enchanting presence of natural landscapes (Julean, 2016).

The human experience of space is greatly influenced by the surrounding environment. In particular, the design and layout of architectonic interiors play a crucial role in shaping our perception of space through our bodily senses (Pasqualini et al., 2018).

Pasqualini et al., (2018) indicated that there are effects that support the hypothesis stating that self-location is influenced by spatial clues.

External imagery plays a significant role in shaping mental imagery. When users perceive a building with a simple, coherent, and unique design, it stimulates the formation of a powerful mental image (Kirby, 1990). Conversely, imagery that exhibits complex and diverse patterns becomes more challenging to remember and retain in our minds. Therefore, the visual characteristics of an external image significantly affect the ability to create vivid mental representations.

The formation of mental images is accomplished through a series of consecutive perceptual actions. Each individual's experience of this process is distinctive, resulting in the perception and interpretation of images from diverse perspectives. Macarthur (2002) and Golledge (1991) both affirm that the differences in human sensory modalities and the information obtained from external stimuli contribute to the development of a distinct cognitive framework. This suggests that each person constructs a unique mental model, as stated by Ware (2012).

1.17.Perception and complexity

Spaces that possess a high degree of complexity have the potential to promote walkability and encourage visual exploration. Moreover, they create opportunities for various forms of social behavior, as can be observed in iconic places like Champs Elysees in Paris and Paseo Colon in Barcelona (Rapoport, 1990).

The visual richness and variety of elements (such as architectural style, urban design, green spaces, spaciousness, scenic views, and vibrant atmosphere) contribute to the captivating nature of these locations. This rich visual experience piques curiosity, captivates attention, and promotes a sense of exploration, making them highly enticing destinations for individuals.

According to the findings of Stamps (1999), it was concluded that the visual preference is predominantly influenced by the surface complexity, specifically referring to the complexity of the façade

The level of complexity plays the role of “a pacer” that lies between chaos and monotony (Rapoport and Kantor 1967 as cited by Rapoport, 1990) and diversive exploration is the result of the level of arousal (e.g., Wohlwill 1976 as cited by Rapoport, 1990)

Rapoport (1990) suggest that achieving complexity (which he describes as perceptual and multisensory) is done through two ways:

- Ambiguity: allusiveness and multiplicity of meaning, presenting suggestions instead of giving direct explanations. He also addresses the concept of “open-ended design” that means the user is not treated as a “mere user” but as a participant that has a room for suggestions and interpretations.
- Richness and variety: refer to environments with rich and varied elements that generate emotions of mystery, surprisingness, and unexpectedness.

Through integrating these two elements in the architectural design, the architect will not only be able to produce a physical building but rather a piece of art work that unfold meanings and connotation allowing the designer to communicate without words with the recipient, sending the latter an invitation to explore unexpected places and receive new information.

Complexity plays a significant role in motivating individuals to explore their surroundings and comprehend the information they receive (Ikemi, 2005). The level of intricacy in an environment serves as a stimulating factor.

Also, according to Rapoport (1990), there are various elements involved in making complexity such as:

- Number of elements
- Intensity against the background
- Novelty
- Surprisingness
- Incongruity
- Mystery
- Temporal variations

The element in question exhibits certain resemblances to the principles of Gestalt, such as the Figure-Ground, Articulation Principle, Intensity against the Background, Number of Elements/Similarity, Continuity, and Connectedness Principles.

The level of complexity in architecture should ideally strike a balance between monotony and chaos. A building composed solely of large, continuous blocks lacks the element of surprise that embodies complexity and captures attention, prompting contemplation. In order to achieve a comprehensive architectural design, it is essential to incorporate elements that challenge the traditional norms and expectations, invoking a sense of intrigue and fascination. Such features not only add visual interest but also invite reflection and contemplation, enriching the overall architectural experience.

According to Ng (2020), it was found that modern-style buildings (contemporary architectural designs) have been widely regarded as both complex and aesthetically appealing when compared to old-style buildings (traditional architectural styles).

Rapoport (1990) emphasizes on the importance of complexity of environment in providing information by saying: *"objectively more complex environments more easily provide greater amounts of potential information*." (p.266).

The more complex the design of a building is, the more information it presents for analysis each time. The architect cannot control the perceiver judgement for they are subjective and unpredictable, however he can control the strength of the signs and messages he communicates through enhancing the noticeability of elements to reach the wanted level of "*perceived complexity*".

Akalin et al. (2009) highlighted the findings of Berlyne, he mentioned that both arousing quality and complexity have a direct linear function (the more complexity is the more the arousing quality is), however pleasantness and complexity shows an inverted U-shaped function, where the intermediate level of complexity represents the highest peak of pleasantness, where the extremes (high or low) of complexity indicates minimum pleasantness. Chan (1998) also noted the relationship between complexity and pleasurableness, and complexity and arousal, in the first case, he stated that pleasurableness increases when complexity increases but once the latter surpass it optimum the pleasurableness of forms start to decrease. In the second case, there was a positive correlation between complexity and arousal, when arousal increases the perceived complexity of forms increases accordingly (**Figure 1-6**).

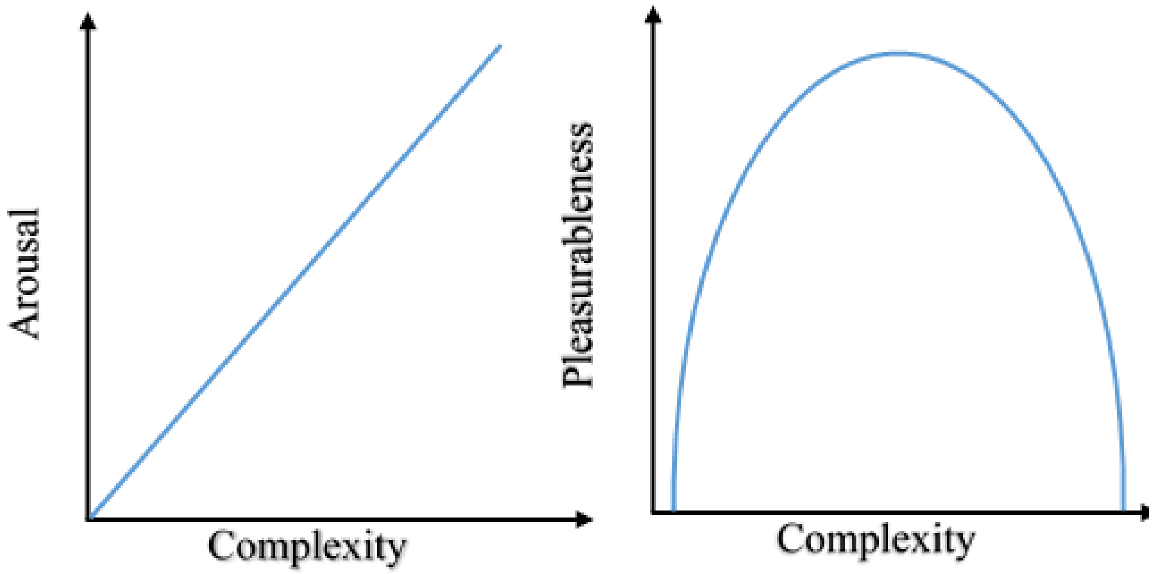


Figure 1-6. *The relationship between complexity and pleasurableness, and complexity and arousal according to Chan (1998), modified by Author.*

Architectural elements, such as shape, color, and materials, gain attention and complexity when they are aligned or congruent. This alignment leads to their noticeable presence and adds depth to the overall architectural composition. On the other hand, if these elements lack congruence, they may be disregarded or hardly be noticed (Rapoport, 1990).

The individual who perceives information may encounter difficulties in deriving enjoyment when faced with an overwhelming level of complexity or specificity (Chan, 1998).

Abraham Moles, in his book titled "Information Theory and Aesthetic Perception," emphasizes the fundamental concept that the measure of complexity lies in the quantity of information conveyed within a message. In order to accurately assess the message, it is essential to consider its originality and unpredictability, as these factors directly contribute to the amount of information it contains. Moles underscores the notion that the presence of novelty and unpredictability in a message indicates a higher level of information (Chan, 1998).

If we consider the outer appearance of a building, for instance, the complexity of its details appears more pronounced when the surface of the facade is relatively small. Conversely, if the facade has a larger surface area, the same details will appear less intricate in comparison (**Figure 1-7**). This phenomenon can be observed due to the way our perception of complexity is influenced by the size of the surface on which these details are displayed. (Chan, 1998).

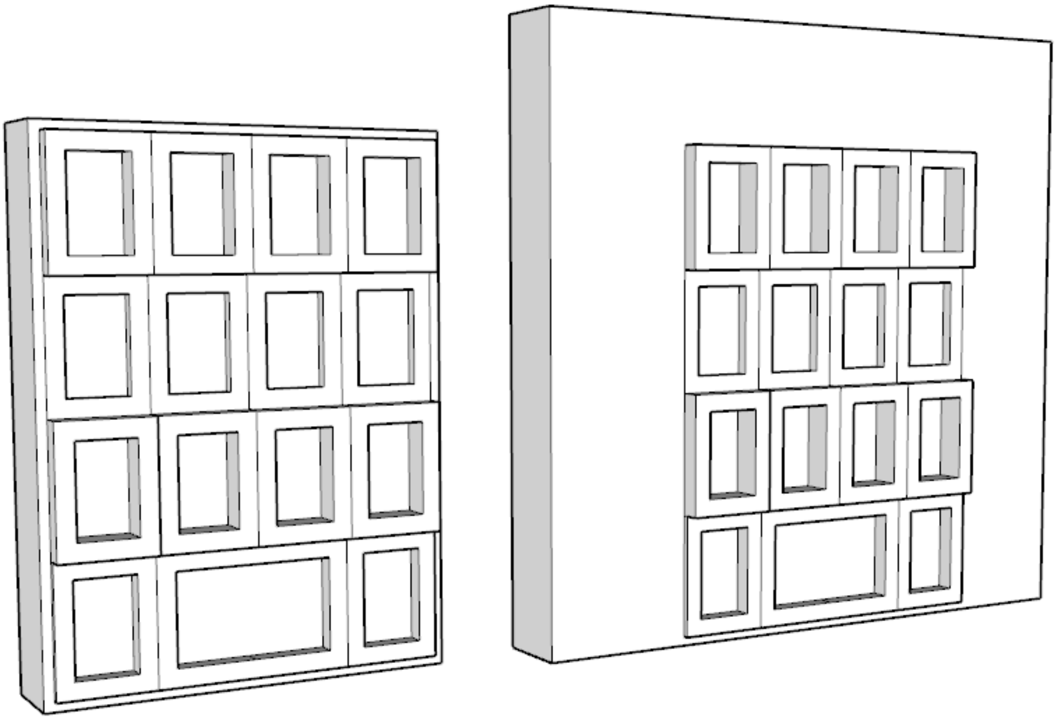


Figure 1-7. *Details complexity on façades of different surfaces (Source: Author).*

Venturi (1966) expressed his fondness for complexity and contradiction in architecture, asserting his distaste for incompetent designs that lack coherence and have no rhyme or reason. He reiterated his preference for architectural complexity and contradiction, drawing a connection to the multifaceted and ambiguous nature of contemporary experiences. Moreover, he emphasized the significance of the richness of meaning over clarity, emphasizing its relevance to both implicit and explicit functions in architecture. In essence, Venturi advocated for embracing the intricacies of architectural design to reflect the nuanced complexities of modern life and to prioritize the depth of significance over mere clarity of purpose.

Architecture of complexity according to Rudolph (1961) includes:

- Complex and contrapuntal rhythms.
- Diversity of elements
- Multiplicity

1.18.Perception of architectural details

Chan (1998) noted that there many factors that affect the formal complexity of buildings and defined each one of them:

1.18.1. The number of details:

If the count of discernible elements rises, there will be a corresponding upsurge in complexity, assuming all other factors remain constant.

This implies that as the number of distinguishable elements grows, the level of complexity likewise expands (**Figure 1-8**).

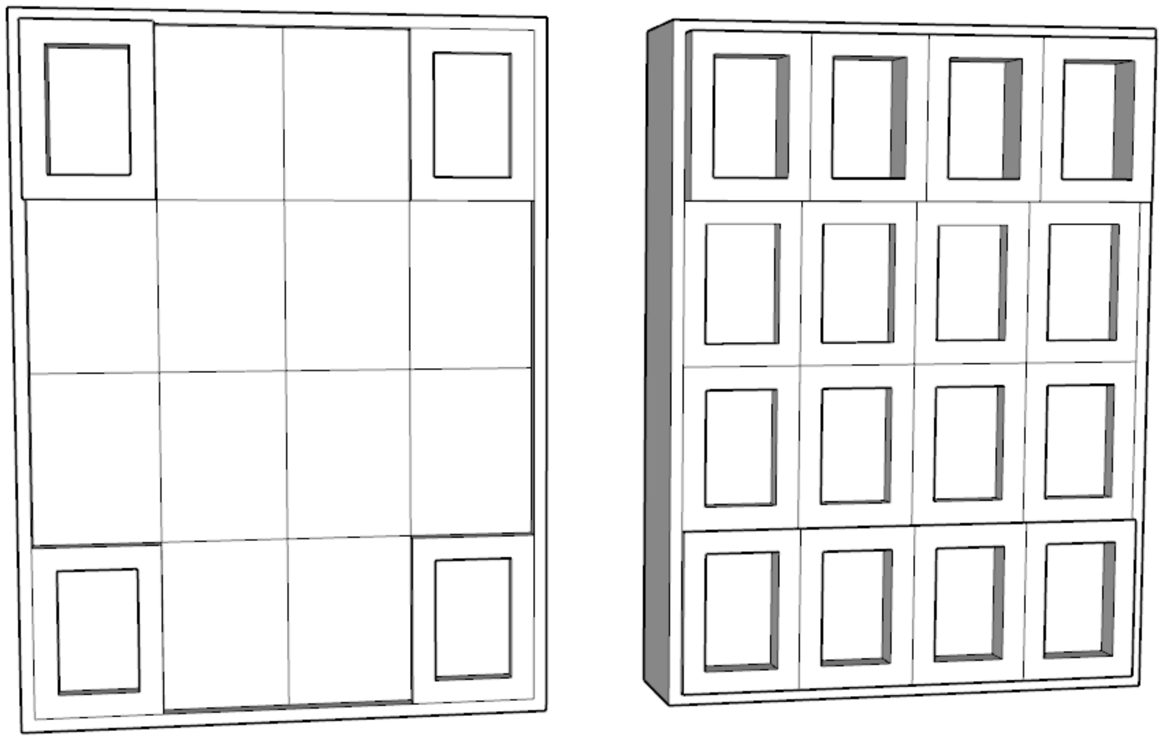


Figure 1-8. *Number of details increases perceived complexity (Source: Author).*

1.18.2. The novelty of details:

When considering these factors, it is important to note that they can be characterized by various attributes, including originality, dissimilarity, surprisingness, and unpredictability. However, in cases where the number of perceived elements comprising different groups is equal, the key determinant becomes the novelty of these elements - their level of unique and unprecedented qualities - as well as their degree of dissimilarity from one another (**Figure 1-9**).

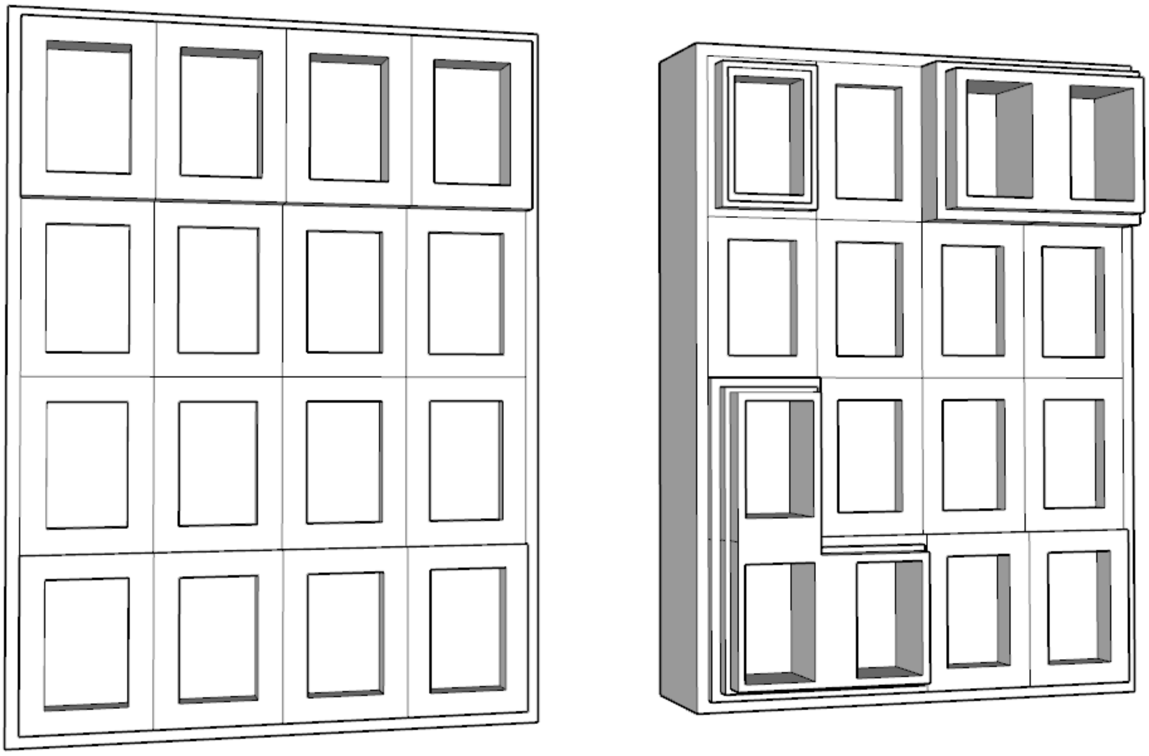


Figure 1-9. Impact of level of details on novelty *(Source: Author).*

1.18.3. Level of organization within elements:

When it comes to complexity and organization, there exists an interesting relationship wherein the more a certain set of elements is organized, the less complex it becomes. This reveals that there is a tendency for redundancy within organized elements, as they often convey repetitive information. Therefore, it is advisable to arrange elements in a more meaningful and purposeful manner. However, it is important to note that the interpretation of organizational patterns may vary across different cultures, highlighting the influence of cultural factors on our understanding of organization (**Figure 1-10**).

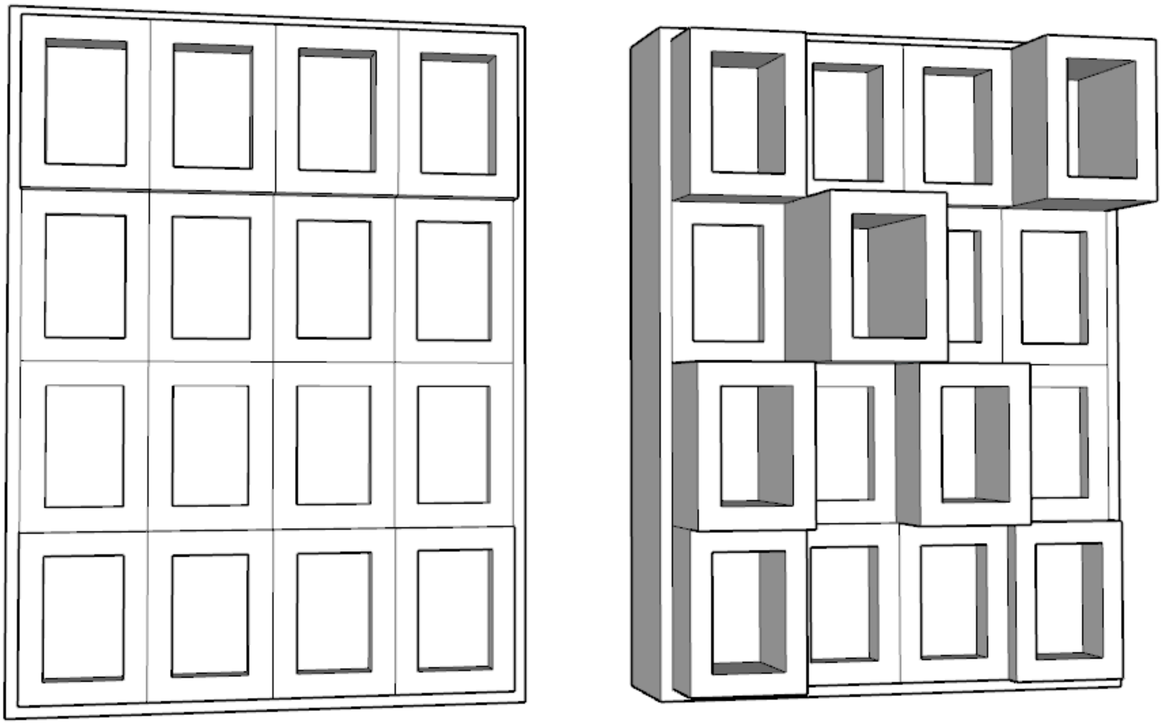


Figure 1-10. *Complexity is affected by level of organization (Source: Author).*

1.18.4. The rate of details:

Each individual building possesses its own unique set of characteristics and features, with the perception of these details being influenced by both temporal and spatial factors. As one navigates through a building, they are exposed to a multitude of information pertaining to various aspects of the structure. It is worth noting that the time taken to gather and assemble this information plays a crucial role in determining the overall complexity of a building. The duration in which details are observed and absorbed directly affects the level of intricacy associated with the structure.

Buildings are often defined by their unique and innovative features, which contribute to the complexity of their overall design.

According to Berlyne (1960 as cited by Akalin et al., 2009), these distinctive details, when combined and organized in a novel and unexpected manner, significantly affect the overall complexity of a building. The presence of original,

Chan (1998) offers an expansive definition of details, perceiving them as vital units of visual information that allow us to not only discern novelty or dissimilarity but also to fully grasp the intricacies and distinctive elements while perceiving a building.

As one becomes more familiar with something, there is a natural tendency to pay closer attention to details and appreciate the individuality and distinctiveness (Lynch, 1960).

According to Chan (1998), the terms "meaning" and "detail" represent distinct forms of information:

- Semantic information:

  The level of understanding and appreciation of semantic information is contingent upon the recipient's experience and knowledge.

- Aesthetic information:

  Which is more likely to be based on spontaneous reaction.

When referring to "detail" in the context of architecture, it pertains to the individual components that make up a building. These components, such as windows, columns, and other architectural elements, play a crucial role in imparting meaning and significance to the overall structure. In order for a detail to be meaningful, it must contain sufficient information and be thoughtfully incorporated into the bigger picture (Chan, 1998).

In the same light, Chan (1998) divides the building details into two types:

- Constructional details:

  Refers to how the building was constructed.

- Architectural details:

  Refers to the design and architectural elements of the building.

Visual perception plays a pivotal role in enhancing the overall understanding and appreciation of the architectural masterpiece (Chan, 1998).

According to Chan (1998), the presence of a multitude of architectural details contributes to the building's overall richness and complexity, resulting in a visually captivating structure. These intricate details add depth and character to the building, arousing a sense of curiosity and interest (**Figure 1-11**).

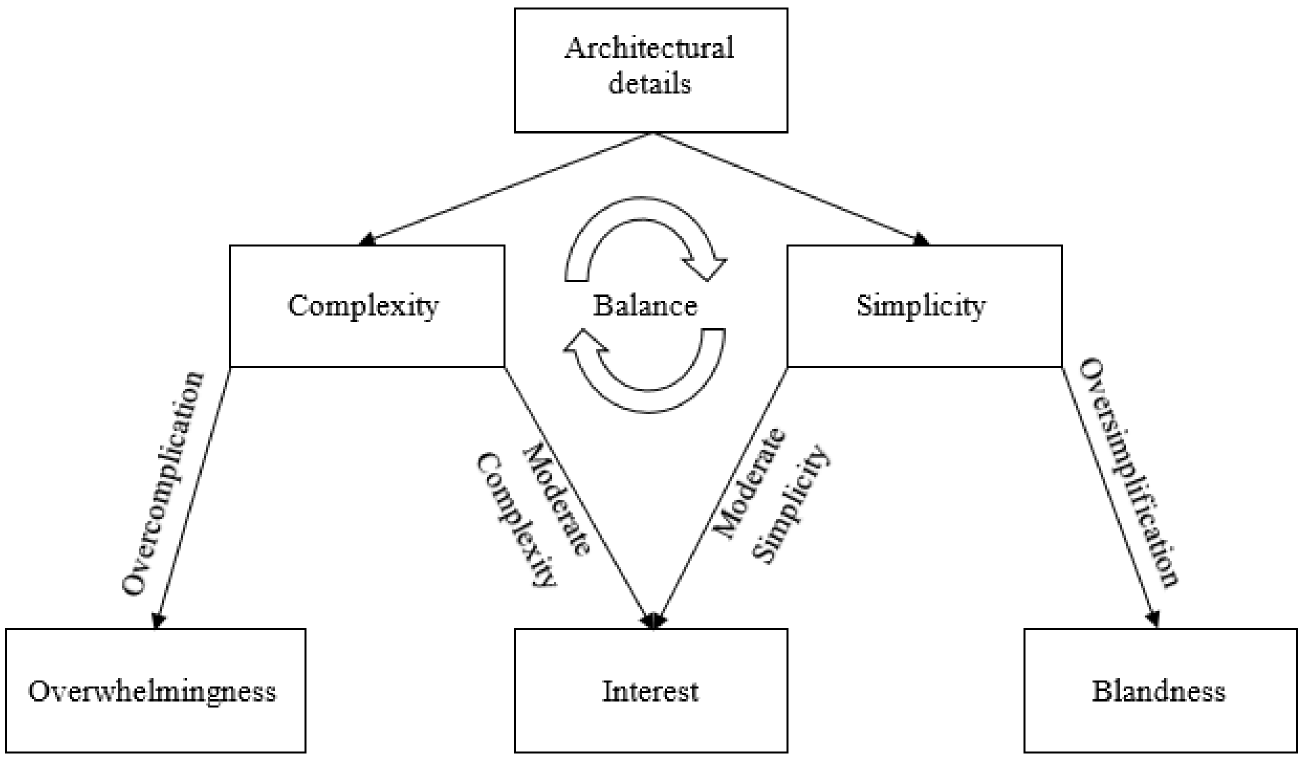


Figure 1-11. *Explanatory model of Architectural details in relation to complexity and simplicity (Source: Author).*

1.19.Information gathering and perceived cues

According to Chan (1998), the amount of information that can be received is dependent on:

- The strength of the stimulus. (The stimuli can be the building that triggers the response).
- The environment and its lighting intensity.
- The distance between the stimuli (source of information) and the recipient.
- The sensitivity and resolution of the receptor.
- The processing ability of the brain. (Differs from a person to another).

1.20.Movement perception through space

According to Ching (2015), the perception of movement in architecture is often seen as a continuous thread that connects the different interior and exterior spaces of a building.

He argues that as humans, we navigate through these spaces over time, creating a sequence of experiences. Furthermore, he categorizes this movement through space, also known as circulation, into five distinct categories and defines each one of them:

1.20.1. *Approach*: (approaching the building from a distant view).

Before entering the building, the observer approach through a certain path and during a certain duration and perceive it (the facades, the contour, surrounding spaces) from a far distance, this is considered as the first experienced space. There are three types of approach:

- Frontal approach: the observer heads towards the building through a visually direct and clear path that leads to the entrance of the building.
- Oblique approach: the observer heads towards the building following a redirected path that extends the time to reach the building.
- Spiral approach: similar to oblique approach the spiral approach prolongs the time to reach the building and offer additional perspectives and views.

1.20.2. *Entrance*:

It refers the transition from the outside to the inside, form a distinguished space to another, through a passage that provides visual and spatial continuity.

The entrance can be simply an opening in the wall or marked by notable and distinctive elements.

The shape of the entrance emphasizes the function and its position in relation to the façade affect the spatial organization.

The entrance can be:

- Flush entrance: it can be concealed and preserves the continuity of the wall.
- Projected entrance: it is notable and denotes a certain function and can also be used as a shelter.
- Recessed entrance: similar to the projected entrance, recessed entrance can provide shelter because it retreats inside the building.

1.20.3. ***Configuration of the Path***:

How spaces are sequenced along a path, it has a beginning and an end. The configuration of the path may enhance the spatial configuration and may be in contrast with it. There are numerous path configurations such as:

- Linear:

  It refers to straight paths in addition to curvilinear, segmented and branching paths.

- Radial:

  It refers to linear paths that has a central beginning or termination, which means that the paths either start from the same point or meet at same point.

- Spiral:

  A single, continues line that starts from a single point from whom it distances itself by revolving around it.

- Grid:

  This type of configuration is the result of the intersection of multiple parallel lines producing square and rectangular spaces.

- Network:

  As groups of points positioned in space connected together by paths.

- Composite:

  It refers to the combination of the previously mentioned configurations.

Path configuration in a building does not necessarily need to depend on one type but it can include many variations to serve the spatial and functional demands.

1.20.4. ***Path-Space Relationships***:

A path in relation to space, can be signified by edges nodes and an end. The path-space relationships can be:

- Pass by spaces:

  A path that passes by spaces perseveres their integrity an provides for a flexible configuration

- Pass through spaces:

  The path goes through spaces in an axial, oblique way or by the edge.

- Terminate in a space:

  The path termination point has a functional or symbolical significance.

1.20.5. *Form of the circulation space*:

Consists of rooms, halls, corridors etc. it may differ according to the definition of its boundaries, or how its form relates to the form of the area it connects.

Circulation space is divided to:

- Enclosed:

  A closed space that links other spaces with each other through entrances.

- Open on One Side:

  Like a balcony or a gallery that assures visual and spatial continuity from one side.

- Open on Both Sides:

  Like in the case of a colonnaded passageway that is open from both sides.

Each of these types of circulation plays a crucial role in determining the functionality of a building and requires careful consideration by the architects. It is essential for them to adapt and incorporate the specific form of circulation that best suits the function of the building.

1.21.Impact of walkability on gathering information

In terms of walkability, it is important to consider how it affects the perceived image of a certain place. One notable aspect is that pedestrians have the advantage of having more time to observe and gather information about the surroundings.

They can appreciate even the smallest details of a building, unlike individuals who rely on vehicles as their mode of transportation. Those driving vehicles naturally prioritize their attention on the road, leaving less room for concentrating on the environment. Moreover, the speed at which vehicles move restricts their ability to gather comprehensive information and fully grasp the intricacies of the views and elements that define a place.

In light of these differences, architects should be mindful of both types of individuals and strive to design spaces that cater to varying levels of attention and offer sufficient visual cues. This approach ensures that the design not only provides the necessary information but also allows for a noticeable and meaningful experience for both pedestrians and vehicle users.

1.22.Dimensions of knowledge

Yazdanfar et al. (2015) stated that Ittelson's (1978) theoretical basis had four diverse dimensions of knowledge which are demonstrated in **Table 1-3**:

***Table 1-3**: Ittelson's (1978) theoretical basis had four diverse dimensions according to Yazdanfar et al. (2015)*

Dimension	Definition
Cognitive aspect	Refers to the thoughtful process regarding environmental stimulus and organization.
Emotional aspect	Concerns the feelings of the individual in relation to his environmental perception and the knowledge that affects them.
Interpretive aspect	Refers to the accumulation of the individual's memories and he depends on them to compare and analyze the environmental stimulus.
Appreciative aspect	This aspect is related to priorities and values used to discern good from bad.

The research conducted by Yazdanfar et al. (2015) reveals a noteworthy distinction between architects and non-architects in terms of the four key dimensions: cognitive, emotional, interpretive, and appreciative aspects.

1.23.Unconscious influence of perception on architectural quality

Unconscious influence plays a significant role in shaping our perception of architectural quality. When evaluating a building, various factors come into play, including the user's past experiences, memories, and subconscious associations with certain ideas and emotions. These subconscious elements can significantly influence behavioral response to the perceived edifice, either in a positive or negative manner. It is crucial to consider these factors when assessing the overall perceived quality of a building, as they contribute to our understanding of its architectural value (Cowen-Elstner, 2018). This highlights the intricate relationship between the unconscious mind and our evaluation of architectural aesthetics, underscoring the need for a comprehensive exploration of this phenomenon.

1.24.First impressions

According to research conducted by Pham et al. (2001), when assessing a target, initial impressions can lead to a "Feeling-Based Evaluation." These evaluations can occur through direct perception or through mental visualization. It is important to consider these initial impressions as they play a significant role in shaping the overall assessment of the target.

According to Asch (1946), it has been found that our past memories have the potential to greatly influence the impression we form about someone or something, leading it to extend over a long period.

Certain characteristics of architecture have the potential to elicit an initial reaction, which in turn can prompt the formation of an early evaluation of the object even without a comprehensive experience of it. If the user establishes a favorable initial impression based on factors such as the building's visual appeal, this can subsequently influence their positive assessment of other aspects of the structure, and conversely, a negative first impression can result in unfavorable feedback regarding other elements of the building. Such initial perceptions play a crucial role in shaping overall opinions and judgments on architectural entities.

1.25. Formation of super-signs

According to Schuster & Beisl (1978), the concept of "formation of super-signs" involves the initial stage of summarizing similar signs within an architectural building, where essential elements are prioritized to create a comprehensive super-sign (**Figure 1-12**). This process emphasizes the importance of condensing and highlighting the key aspects of the building to form a cohesive and meaningful architectural representation. By prioritizing essential elements, the formation of super-signs allows for a more explicit understanding and enriched interpretation of the architectural building.

Upon initial observation, the observer's attention is drawn to the overall shape of the building, which is initially perceived with limited information (Grütter, 2020). However, with each subsequent glance, the observer becomes capable of discerning additional elements based on their inherent characteristics, leading to the development of a more coherent mental image of the building. This process of repeated observation allows for a gradual accumulation of details, resulting in a clearer understanding and perception of the structure in question.

Buildings that boast intricate and elaborate design features, as well as complex shapes, offer a wealth of information that requires greater effort and time for complete comprehension. The intricate details of these structures not only captivate the eye but also provide a multi-faceted narrative and multilayered data that necessitates more effort and time to be entirely perceived.

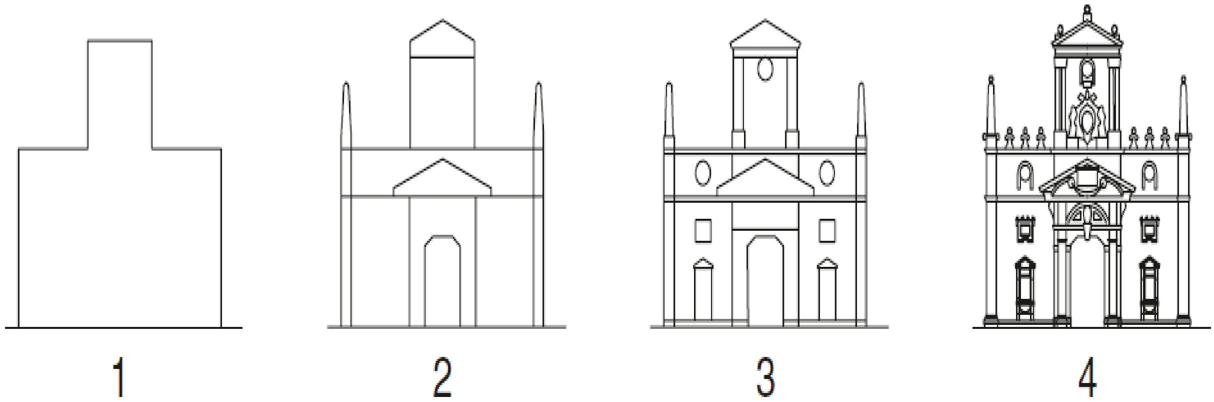


Figure 1-12. *The concept of "formation of super-signs" (Grütter, 2020).*

1.26.Connotations and meanings

"A valid architecture evokes many levels of meaning" (Venturi, 1966: p.16). In order to truly appreciate a building, it goes beyond its physicality and resonates as a masterpiece, inviting the viewer to explore its intricate layers of profound significance and embrace diverse interpretations. This, in turn, stimulates cognitive engagement, prompting individuals to delve deeper into their understanding and grasp the essence of what they perceive. The building becomes a conduit for thought-provoking contemplation, elevating it from mere architecture to a thoughtfully crafted embodiment of artistic expression. Its multifaceted nature transcends conventional boundaries, encouraging individuals to comprehend what is perceived.

Connotations, in the realm of language and communication, encompass the various interpretations and meanings that are ascribed to objects. These interpretations are shaped by the sociocultural codes that govern our understanding.

It is widely acknowledged that buildings serve a variety of purposes beyond their architectural significance, encompassing cultural, economic, and historical dimensions (Milligan, 2007). The importance of a building is determined by its ability to fulfill multiple roles. For instance, a visually appealing structure with a rich history and symbolic value will undoubtedly be held in higher regard by the public compared to a newly constructed building lacking a distinct message to convey. The multifaceted nature of buildings underscores their significance in society, as they intertwine with various aspects of life, making them essential contributors to the broader fabric of our communities.

When it comes to building features, Nasar (1994) proposed two distinct categories of attributes:

Formal aesthetics encompass various attributes such as shape, scale, complexity, proportions, rhythm, order, colors, lighting, shadowing, incongruity, surprise, and novelty (Groat & Despres, 1990; Lang, 1988; Wohlwill, 1976).

The second type, which is known as "symbolic aesthetics" as described also by Lang (1988), focuses on the characteristics associated with the content of a particular form. It pertains to the observer's internal representation of the structure and their perception and understanding of the meanings connected to that representation and the overall building. This aspect examines profoundly the subjective interpretations and emotions evoked by the architectural design.

The perceptions surrounding a building contribute to its overall meaning and can be categorized into two types: denotative and connotative meanings. The denotative meaning refers to the main purpose and function of the building, answering questions such as its type and intended use. On the other hand, the connotative meaning is influenced by the interpretations made by users based on the building's formal attributes and the associated meanings they ascribe to it. This highlights the significance of symbolic aesthetics, which necessitates the cognitive processing of users to understand the building's function and derive additional connotations from it. By engaging in this cognitive process, individuals are able to recognize the intended purpose of the building and uncover further interpretations and connotations associated with it. This understanding equally emphasizes the importance of users' perceptions in shaping the overall meaning and significance of a building.

Giordano (2006) cited the main differences between denotation and connotation in **Table 1-4**:

Table 1-4: *Differences between denotation and connotation (Giordano, 2006)*

Denotation	Connotation
Information	Significations, interpretations
Direct meaning	Associated meanings, “makes one think of…”
Invariant meaning, whatever the context	Meaning varies according to the context
Objective designation	Subjective expressions
Analytic	Synthetic
Representation	Emotion
Objects, products or sensible results	Signs
Practical, factual	Mythical, imaginative
Facts	Values, Opinions

According to Venturi, (1966), it was highlighted that when it comes to constructing a building, there are two crucial factors that should be taken into consideration: the selection of the site and the symbolism of the building.

Furthermore, the author elaborates on the utilization of the "both-and" concept, which pertains specifically to the relationship between individual components and the overall structure within the context of architecture, the part to the whole. This concept is deemed to possess multifaceted levels of significance among different architectural elements. Those elements as he says can be both:

- Good and awkward.
- Big and Little.
- Closed and open.
- Continuous and articulated.
- Round and square.
- Structural and spatial.

This variety of meanings in this case, produce a sensation of ambiguity. Venturi (1966) gave an example of the duality good/bad.

In this particular case, the multitude of meanings gives rise to a sense of ambiguity. To illustrate this concept, Venturi (1966) cites a statement made by Kahn: "*architecture must have bad spaces as well as good spaces*." (p.25).

Appleyard (1979) brought attention to the significance of symbolic and connotative meanings in human cognition, going beyond the mere consideration of physical attributes.

The notion highlighted here is that in order for architecture to be truly effective, it must include elements that are considered both favorable and unfavorable.

It has been observed by Verderber and Moore (1977 as cited by Devlin & Nasar, 1989) that the socio-cultural context plays a significant role in shaping the interpretations and meanings made by individuals.

The architectural design of a building provides valuable insights not only into its functionality as a structure but also into the possible characteristics and preferences of its occupants, as mentioned by Nasar (1989).

Through careful analysis of the building's architecture, one can gain a deeper understanding of the various meanings and the intended use of the space.

Nasar and Kang (1988) highlighted the contrasting symbolic meanings associated with office styles and single-family house styles, emphasizing that each architectural style carries its own distinct denotative significance. This crucial aspect should be taken into account when designing buildings of diverse functions and characters to ensure that they are easily recognizable and distinct from one another. By considering these nuances, architects can create spaces that effectively communicate their intended purposes, while also reflecting the unique qualities and characteristics of the respective building types.

Rudolph (1961) noted the combination of the old meaning (evoked by associations) and the new meaning suggested in order to create:

- New function
- New structure
- New program
- New context

This process involves harnessing the power of associations linked to the original meaning while simultaneously introducing fresh interpretations

1.27.Interpretations

"As in language, however, architectural forms and spaces also have connotative meanings: associative values and symbolic content that are subject to personal and cultural interpretation, which can change with time" (Ching, 2015: p.422).

The perception of structure varies from person to person and is influenced by the surrounding environment, as indicated by Lowenthal and Riel (1972). Each individual possesses their own unique attitudes, preferences, and inclinations, while the context and environment of a place play a significant role in shaping opinions. This suggests that the interpretation of structure is not only subjective but also dependent on the specific circumstances in which it is observed.

The act of explaining, reframing, or demonstrating one's own understanding of something is known as interpretation. It may also refer to a specific rendition or adaptation of a work, approach, or style. Interpretation is a strategy that blends factual knowledge with explanatory information.

Giordano (2006), in this regard, defines three modes of interpretation:

1.27.1. ***Priming***: what comes first in a subliminal manner influences the following perceptions

- The subliminal information prepares the perception and allows an easy recognition of figures.
- The order of information influences the successive perceptions

1.27.2. Adding new information or filling needed information

- The visual modality reconstructs the reality from the received points of light like the case of the reconstruction of the Kanizsa (**Figure 1-13**).

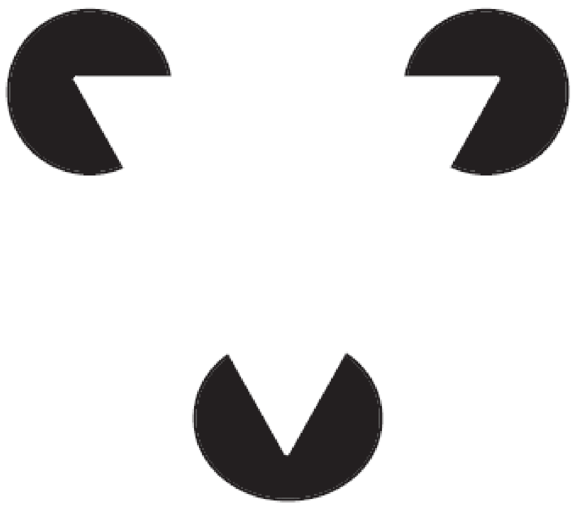


Figure 1-13. *Kanizsa illustration (Giordano, 2006).*

1.27.3. Subtraction of existing information

- Attention does not notice a detail that is irrelevant to the presented task.

1.28.Culture and perception

“The eye sees with its culture.” (Giordano, 2006: p.27)

Perception is the cognitive process that involves gathering sensory information and comprehending it through interpretation. It is a subjective and unique experience, as individuals form their own perceptions based on a multitude of factors.

Perception relies on our senses, such as sight, hearing, touch, taste, and smell, to gather information from the external world. However, the interpretation of this information is influenced by personal experiences.

Nasar (1994) emphasized that individuals from diverse cultures and subcultures, as they engage with various environments and structures, develop a multitude of understandings and interpretations regarding the functional and symbolic aspects of objects. This suggests that the interactions between individuals and their surrounding environment greatly influence the way they perceive and assign meaning to objects.

Sonnenfeld (1966) highlighted the fact that culture, society, economy and nativeness/nonnativeness as factor is important determinant of spatial and landscape preference (he defines landscape in aesthetic terms that constitutes complex imagery, it can also have a use meaning like a building for example)

1.28.1. ***Culture***: there may be differences in preference between occidental and oriental people, but those are difficult to distinguish in the case of intra-cultural diversity.

1.28.2. ***Society***: complex factors like social status and social relationships may also contribute to preference of location and periphery, centrality or isolation and the openness and closeness of space

1.28.3. ***Economy***: level of income determines people preference in terms of aesthetic and spatial qualities.

1.28.4. ***Nativeness/nonnativeness***: this factor is based on residence, unlike natives, un-tatives when arriving to a new a place they bring with them their environmental experience and this may affect their judgement regarding various encountered elements of the new environment.

The combination of previous factors poses difficulties when attempting to decide on what preference a certain population is into.

Rapoport (1990) classified human characteristics into two major aspects:

- Cultural (desire, habit, subcultural variables can also be included)
- Perceptual (characteristics that need satisfaction)

He adds that panhuman perceptual characteristics (panhuman: that relates to humanity) with idiosyncratic variation that differs from a person to another (unique habits and characteristics attached to an individual).

Culture encompasses a wide range of variables that warrant careful examination, including religion, language, tradition, values, and social norms.

On the other hand, subcultural variables are more specialized, leading to the formation of distinct subcultural groups with unique shared characteristics like identity, language, tradition, and attached meanings.

The symbolic value of an object, which can also include architectural structures, is determined by a variety of factors, such as arbitrariness, culture, and history, particularly the passage of time. Evaluating the symbolic significance of an object is inherently unpredictable, varying across regions due to sociocultural variables. Moreover, this evaluation is also subject to change over time. It is important to note that the assessment of symbolic value differs from one place to another, reflecting the influence of different sociocultural factors (Sadalla & Sheets, 1993).

Giordano (2006) says that culture is *the soul of society*; it is a large concept that touches many aspects such as:

- Customs
- Beliefs
- Languages,
- Ideas
- Aesthetic tastes
- Technical knowledge
- Organization of the human environment
- Material culture
- Tools
- Habitat
- Technologies

Silvestri (2009) stated that there are factors related to education and culture that can influence cognitive processes at different levels when treating the received information similarly there are performance measurements related to visuo-spatial information in terms of gender (male or female) where males were found to have a significant advantage regarding operations such as:

- Recalling objects mentally.
- Recognizing an object after rotation.
- Mental rotation of three-dimensional objects.

Certain elementary geometric concepts form a universal basic knowledge independently from gender, culture and level of education; however, the role of learning as a skill and the professional and educational level of influencing the perception of geometric concepts, and affecting the building of the mental representation is equally considered as subject of debate. (Silvestri, 2009).

Giordano (2006) states that there are three factors that influence the construction of the common representation of individuals:

- Culture
- Personality
- group of belonging

The way humans perceive the qualities of a space is closely tied to how they interpret the various elements that define that space. It is important to consider the subjective experience of the perceiver, including their cultural background and personal tendencies. These factors play a significant role in shaping the cognitive, emotional, and behavioral responses that individuals have towards a given space.

The perceptual aspect of any given subject is often characterized by its complex and ambiguous nature, intricately intertwined with the cultural associations specific to each nation. This means that how we perceive things is deeply influenced by our cultural background (Yazdanfar et al., 2015).

1.29.The interaction between human perception and the built environment

According to the observations made by Rapoport (1990), when it comes to studying art and the built environment, his focus on traditional architecture does not stem from a desire to merely delve into historical events. Instead, he aims to extract valuable insights and knowledge from the past for the purpose of applying in the present, benefiting contemporary data when it aligns with suitability. Rapoport's intention is not restricted to a mere examination of the past; rather, he seeks to harness the wisdom of previous experiences and adapt it to the contemporary architecture.

In addition, Rapoport (1990) stated that the primary goal of exploring the dynamic relationship between humans and the constructed environment is to formulate conceptual frameworks and theories. This comprehensive endeavor aims to develop a deeper understanding of the intricate interplay between people and their surroundings. Additionally, he highlights the significance of advancing theories concerning the environment and behavior, as this development will foster enhanced insights into the complexities of human-environment interactions.

1.30.Frequency of exposure and revisit intention

Zajonc (1968) stated the more the frequency of exposure of a person to a stimulus the more enhanced is the liking and reduced is negative effects.so people that frequently visit a building or pass by it tend to have more positive attitudes.in this case two factors can be deduced: the visit frequency and the familiarity with the building, hence the edifice function and localization can heavily affect the aforementioned factors. However, it is not always the case, some people search for novel and exiting things (Berlyne, 1960); a building with atypical design in contrast to the surroundings will receive better impressions. Kaplan (1973; 1975) propose that a balance between uncertainty and coherence to make a building interesting for the perceiver because the latter seek new information and ignore repetitive ones.

Place attachment is the result of long-term interactions between people and the place which make them develop an emotional bond (Lewicka, 2011).

When evaluating the quality as perceived by visitors, there are several aspects to consider, including the aesthetic presentation, reliability, comfort, and overall impression of the construction. The perceived architectural quality plays a vital role in determining whether visitors will return to the building or not.

This perception encompasses various elements, such as the perceived social value, emotional value, and functional value. Assessing the architectural quality goes beyond mere visual appeal and takes into account the overall experience and satisfaction of the visitors. Additionally, the perceived values associated with the building's design and functionality, including its social impact, emotional resonance, and practical usefulness, contribute to the overall perception of its quality.

1.31.Citizen participation

According to the suggestions made by Hershberger (1972), there is a need to bring about a transformation in the educational approach within the architectural field. This transformation entails teaching architects not only how to perceive forms and spaces, but also how to interpret them from the perspective of non-architects. The aim here is to equip architects with the ability to manipulate these elements in a manner that meets the needs and preferences of both architects and non-architects. Ultimately, this would facilitate effective communication and fruitful collaboration between both parties.

He adds that in the realm of architectural discourse, it is imperative to shed light on the importance of educating individuals who are not part of the architectural community, thus encompassing the general public.

This education serves a dual purpose: to cultivate a deeper understanding and appreciation of architecture as both a profession and an art form, while simultaneously affording non-architects the opportunity to gain insight into the architect's perspective. Therefore, architects must strive to empathize with the needs and demands of the users, while the users themselves must endeavor to comprehend the viewpoint of the architects. By fostering a collaborative atmosphere and establishing a symbiotic relationship between these two distinct groups, there is a potential for a truly successful architecture.

Adad, (2008), additionally, noted the importance of population participation in their habitat in the case of a new ksar in M’zab.

In accordance with Giordano (2006), it is emphasized that giving utmost importance to actively listening to the client's words is crucial for a construction professional. Addressing this demand is an absolute requirement that cannot be overlooked.

Newman (1996) demonstrated a significant aspect of residents' active participation by allowing families to choose the colors of their housing according to their personal preferences. Instead of imposing his own choices, Newman offered a unique opportunity for individuality and ownership within the project. This approach not only empowered the residents but also fostered a stronger sense of connection and investment in their homes. By involving them in the decision-making process, he recognized the importance of personalization and respecting individuals' preferences.

In his work, Lynch (1960) emphasized the significance of gathering and disseminating information from a large number of individuals to achieve widespread community acceptance. This process of information sharing is critical for developing an understanding of the sociocultural and demographic factors that shape human behavior and the intricate connection between individuals and their immediate physical environment.

By studying these factors, it is possible to effectively address present challenges, eliminate uncertainty, and move away from arbitrary decision-making. This approach ensures informed decisions that are beneficial for all stakeholders involved.

If the architect is completely dedicated to his own perspective and assumes the sole responsibility of devising solutions to problems, there is a significant risk of disregarding other crucial considerations. This approach may lead to a divide and alienation between architecture and the fundamental needs of society, as well as the lived experiences of individuals (Venturi, 1966). Consequently, such an exclusive mindset can hinder the integration of diverse perspectives and essential societal factors that contribute to the architectural outcome.

By failing to acknowledge and incorporate a multiplicity of concerns, the architect may unintentionally isolate their work from the broader vision.

According to Giordano (2006) discussion and direct contact are necessary following the principle of:

- Listen
- Observe
- Understand

1.32.Influence of Socio-demographic factors on perception

In a comprehensive experiment conducted by Bruner and Goodman (1947), the researchers examined the impact of social class on children's perception of coin sizes. The study involved two groups of children from different socioeconomic backgrounds.

The results revealed an interesting pattern: children from disadvantaged backgrounds tended to overestimate the size of the coins, while children from more affluent backgrounds were less likely to do so. This finding suggests that social background indeed plays a significant role in shaping the visual perception capabilities of children (Grütter, 2020).

Moreover, it should be noted that the visual perception and evaluation of the perceived quality of a building are not solely influenced by one's social background. There are several other factors that come into play, such as gender, age, profession, residency, and education (Coburn et al, 2017). Therefore, a comprehensive understanding of these variables is crucial in assessing the impact they have on individuals' perceptions.

According to Canter and Wools (1970), architects often fail to learn from their mistakes due to their lack of follow-up on realized projects. They neglect the importance of conducting surveys to evaluate the quality of their work, assess user feedback, and identify any errors made. This one-sided approach leaves architects disconnected from the needs and expectations of users, making them prone to repeating the same mistakes.

Canter and Wools (1970), also emphasize the significance of the tripartite relationship between the architect's intention, the physical manifestation of the building, and the feedback provided by users. By adopting this approach, future projects can be improved, users' needs can be satisfied, and architects can gain valuable experience and knowledge.

It is crucial for architects to recognize the importance of evaluating their work and learning from past experiences in order to enhance their performance and ensure user satisfaction.

In a comprehensive examination conducted by Hershberger (1972), several significant questions arose regarding the perception and understanding of architecture. The first question revolves around the correspondence between the intended meaning that architects assign to buildings and the interpretation that individuals outside the architectural profession ascribe to them. The second question explores the potential similarity in vision and representation between architects and non-architects. Moving forward, the third question delves into the impact of architectural representation on both architects and non-architects, determining if they are influenced in the same way.

Lastly, a crucial aspect under scrutiny is whether there are similarities in evaluations and behavior exhibited by these two groups.

According to the study conducted by Akalin et al. (2009), it was discovered that a noteworthy distinction exists; when it comes to gender and background (occupation) in relation to the three dependent variables, preference, complexity and impressiveness.

Sonnenfeld (1966) also noted that there are distinct preferences between males and females when it comes to their environmental choices. Males tend to gravitate towards subsistence-oriented and rugged environments, while females display a preference for vegetated and warmer environments.

Accordingly, Nasar (1989) noted that sociodemographic factors including gender, age, education, and occupation play a crucial role in influencing preference. As an illustration, older individuals with limited education and occupations leaning towards colonial style rather than contemporary style exemplify this phenomenon. This indicates that personal characteristics and societal positions have the ability to shape one's aesthetic preferences.

Zusne (1970) states that the individual differences have a major role in the perception of the labile figure-ground patterns (**Figure 1-14**).

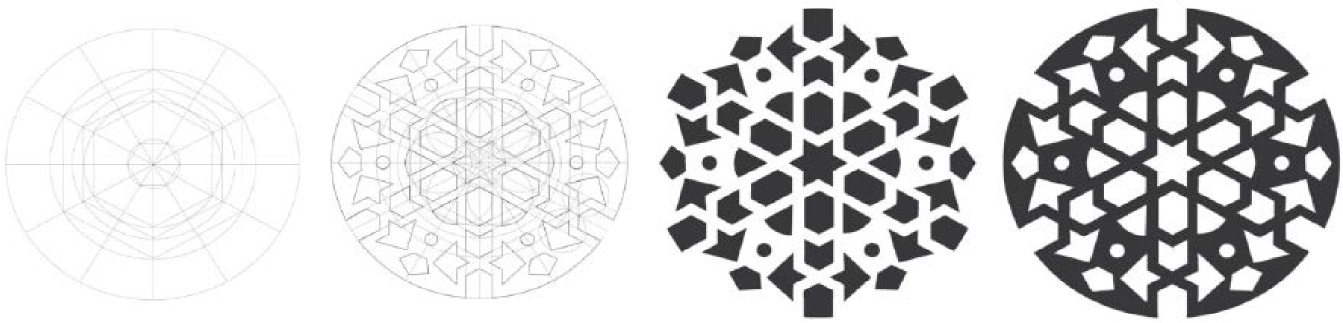


Figure 1-14. *Figure-Ground Relationship (Garofalo, 2017).*

According to Zusne (1970), it was found that there are variations in the perception of embedded figures depending on the gender of the observer. Specifically, females were observed to require more time when it came to searching for these embedded figures. This suggests that there may be inherent differences in how males and females process and interpret visual stimuli.

According to the research conducted by Evans et al (1982), it has been noted that the older population tends to exhibit a stronger inclination towards utilizing architectural structures that hold historical and cultural value, especially when these buildings are conveniently accessible from the street. The study emphasizes that elderly individuals, in comparison to their younger counterparts, exhibit an inclination to buildings with historical and cultural value.

Sonnenfeld (1966) observed that young individuals often have a preference for novelty when it comes to their surroundings. This means that young people, especially those living in flat regions, tend to favor more exotic and rugged environments compared to the elderly, who show a preference for familiarity. Interestingly, this inclination towards novelty is not limited to young people alone but is also shared by architects. In fact, architects tend to prioritize novelty and what captures public interest over the preferences of the general public (Devlin & Nasar, 1987; Purcell, 1986).

Devlin & Nasar (1989) made a comparison between 20 architects and 20 non architects in regards to ‘High’ style residential architecture (characterized by use of concrete and fewer other materials, simple forms and off-center entrances) and ‘popular' style residential architecture (characterized by variety of materials, hip roofs and centered entrances).

The result showed that there was a difference in the evaluation between the architects’ group and the non-architects group. Architects found ‘High’ style buildings to be more coherent and clearer, pleasant looking with a meaning behind it, while non-architects favored the simplicity of popular' style buildings. However, both groups found High’ style buildings to be exiting, with higher ratings from architects. Also, both groups shared the same opinion regarding curvilinear forms, off-center entries of the High’ style buildings because it represents an aspect of novelty.

The findings of the INDSCAL[1] analysis conducted by Purcell (1986) revealed that attractiveness and preference played a more significant role in influencing the interest of architecture students, while having a lesser impact on the perception of goodness of example.

On the other hand, the general student group assigned equal importance to both dimensions, indicating that architecture students specifically prioritize factors such as interest,

[1] INDividual Differences SCALing

discrepancy, and the incorporation of innovative elements in the design of buildings. This suggests that architecture students have a distinct preference when it comes to architectural aesthetics and are more inclined towards designs that evoke curiosity and showcase unique features.

According to Newman (1996), individuals from varying income and social classes have distinct preferences when it comes to housing. Middle-income individuals, for instance, tend to find high-rise apartments advantageous due to the convenience they offer.

With their financial capabilities, they are able to meet the financial demands associated with maintaining such apartments, including expenses for security measures such as doormen, elevator operators, and porters. On the other hand, low-income families face challenges in meeting these requirements, resulting in a lack of security and an increase in criminal activities.

Consequently, this leads to a diminished quality of life due to the differing implications associated with various housing options. The disparity in housing choices based on income and social class has substantial effects on individuals' well-being and overall satisfaction with their living arrangements.

According to the study conducted by Hershberger (1972), it was found that architects and non-architects exhibit distinct variations in their affective and evaluative judgments. Furthermore, this disparity extends to various dimensions such as pleasantness, novelty, excitement, and organization.

According to Le Corbusier (1986), what makes the difference between an architect and engineer is how the architects deals with two factors:

- Contour
- Profile

According to Groat (1982), it was observed that non-expert individuals tend to place greater emphasis on the visual appearance or façade of a space rather than its spatial organization. This finding, however, stands in contrast to the approach taken by experts who take multiple parameters into consideration.

1.33.Conclusion

According to Julean (2016), architectural theory plays a crucial role in the education and development of architects, serving as a fundamental tool. Without a strong theoretical foundation, architects will create designs that lack cognitive stimulation and are devoid of identity, creativity, innovation, and self-expression. It is essential for architects to have a solid understanding of architectural theory, as it not only enhances their cognitive abilities but also allows them to explore their own unique ideas and perspectives.

In the same context, he states that a comprehensive education in architecture should encompass various disciplines beyond its core focus. This includes subjects like psychology, sociology, anthropology, and geography. By incorporating these wider fields of knowledge, architects are better equipped to delve into the intricacies of concepts such as wayfinding, mental maps and personal space.

CHAPTER II: DEFINING PERCEIVED ARCHITECTURAL QUALITY AS A CONCEPT

2.1. Introduction

"*All these [buildings] should be built with due reference to durability, convenience, and beauty. Durability will be assured when foundations are carried down to the solid ground and materials wisely and liberally selected; convenience, when the arrangement of the apartments is faultless and presents no hindrance to use, and when each class of building is assigned to its suitable and appropriate exposure; and beauty, when the appearance of the work is pleasing and in good taste, and when its members are in due proportion according to correct principles of symmetry.*" (Vitruvius, 1960: p.17).

In summary, this chapter centers on achieving a comprehensive understanding of the subjective aspect of architectural quality, it is crucial to analyze how individuals perceive architectural structures and spaces. This entails examining various elements that capture the attention of the observer, such as the style, size, shape, colors, and arrangement of the building. These characteristics can be experienced and interpreted in isolation or as a cohesive whole, resulting in diverse responses and reactions. Therefore, it becomes imperative to comprehend perception as a phenomenon in order to identify the necessary qualities that can enhance architectural designs. By delving into the perception of architectural edifices, we can enrich our knowledge and gain valuable insights that facilitate the improvement of architectural structures.

The architectural building possesses the potential to influence users' satisfaction based on factors such as its design, presentation, function, and significance, which contribute to the fluctuation of its value. The characteristics inherent in the building's design and presentation play a vital role in shaping the users' overall experience.

From a subjective standpoint, it is important to acknowledge that users possess diverse viewpoints and assessments when it comes to evaluating the quality of different buildings. Consequently, the evaluation of a particular building can vary from one user to another, resulting in a wide range of perceived value estimations. It is worth noting that the perceived quality of a building is subjective in nature, and individuals are likely to have differing opinions and perspectives on the matter.

The assessment of the perceived quality of the Khenchela culture house can vary significantly, given the distinct characteristics associated with each aspect of the building. These characteristics may be subject to individual interpretation, depending on the perspective of each user. It is important to note that the perception of quality in the context of the Khenchela culture house can be influenced by various factors, such as architecture, functionality, aesthetics, and overall user experience.

To gain a comprehensive understanding of the concept of quality, it is essential to delve into multiple perspectives and explore its various dimensions.

As stated in the Danish Architecture policy, there is a consensus that the quality of architecture is derived from the convergence of three essential components: the physical form, functional aspects, building techniques, all harmoniously blending with an artistic concept. It also emphasizes the importance of considering the distinctive environment and cultural characteristics as paramount objectives to be achieved.

This policy recognizes that architectural excellence can be achieved by integrating these aspects seamlessly, thereby creating a memorable and impactful experience for individuals. By recognizing the significance of form, function, and building techniques in conjunction with artistic vision, architects strive to create structures that fulfill quality demands (Rönn, 2014).

When it comes to the architectural quality, defining its concepts precisely is a complex task, mainly due to the distinctive attributes found in each location. This uniqueness stems from the characteristics of the surrounding buildings, the geographic location, and the preexisting architectural quality within the context. Therefore, assessing and understanding architectural quality requires a comprehensive analysis that considers these factors, resulting in an enriched perception of the subject (Rönn, 2014).

2.2. Quality as notion

According to AFNOR NFX 50-120[1], the term quality is defined as: “what *gives satisfaction to the user*” and it consists of the “*properties and characteristics of a product or a service and their ability to satisfy expressed and implicit needs*” (Giordano, 2006: p.18).

Giordano (2006), in regard to the notion of quality, says that it concerns:

- Robustness
- Durability
- Reliability
- Technology
- Modernity
- Quality/price ratio

2.3. Quality as a disputed concept in architecture

The concept of quality in architecture is highly subjective and open to interpretation, with connotative values that vary among individuals and evolve over time. It is important to recognize that perceptions of quality can differ from person to person, and there is no universally accepted definition. Consequently, the understanding of architectural quality is a complex and debatable subject that lends itself to a wide range of perspectives and opinions, due to the dynamic nature of design and cultural shifts. (Rönn, 2014)

In order to comprehend the concept of perceived quality, it is vital to have a clear understanding of the term "perception" itself. Perception refers to the cognitive ability to organize and make sense of the stimuli that are received from the external environment. It encompasses the process of detecting and interpreting these sensory inputs in a manner that is beneficial and meaningful to the individual.

In a similar vein, perceived quality is an intangible parameter that is evaluated based on a diverse range of preferences and inclinations. As highlighted by Aaker (1991), this notion revolves around seven distinct dimensions (**Figure 2-2**). These dimensions serve as the yardstick against which the perceived quality; is measured and evaluated. They provide a framework for assessing and understanding how individuals perceive the overall quality of a particular offering.

[1] L’Association Française de Normalisation, defines the quality vocabulary and the corresponding English terms.

By considering these various dimensions, organizations can gain deeper insights into the factors that influence perceptions of quality and use this knowledge to enhance their products accordingly.

Architecture, viewed as both a visual and mental representation, is considered an art form centered on the perception of images (Harries, 1997).

The notion of architectural quality contains all senses, although this study focuses on specific dimensions that are integrated within the architectural model. These dimensions can be linked to parametric design and computer simulation applications, highlighting their significant role in this particular field.

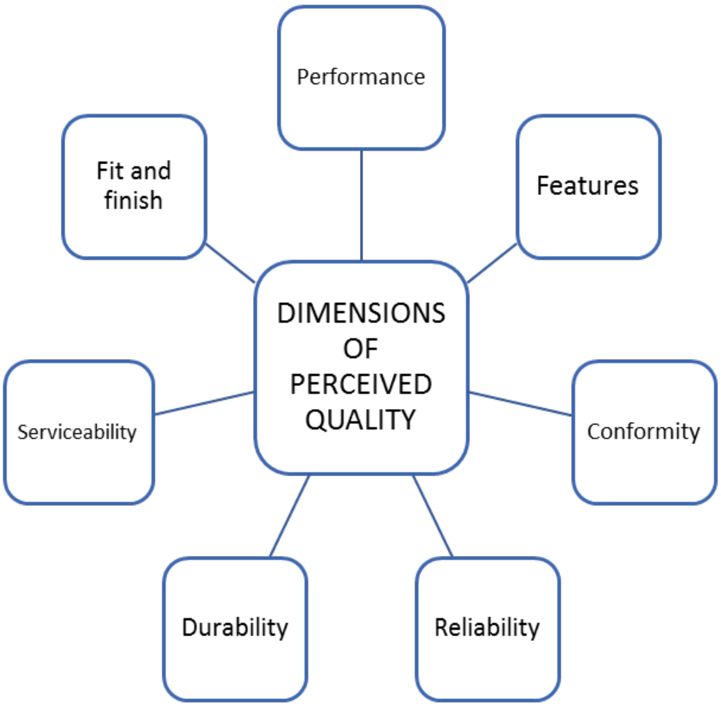


Figure 2-2. *Dimensions of perceived quality according to Aaker (1991) (Source: Hamdaoui and Adad, 2020)*

In a more ample manner, architectural quality can be described as a form of artistic expression that embodies both tangible and intangible aspects (**Figure 2-3**). It involves the creation of visual and mental representations that provoke a sensory experience. For the purpose of this study, a narrower focus is adopted, whereby architectural quality is understood as a collection of selected dimensions.

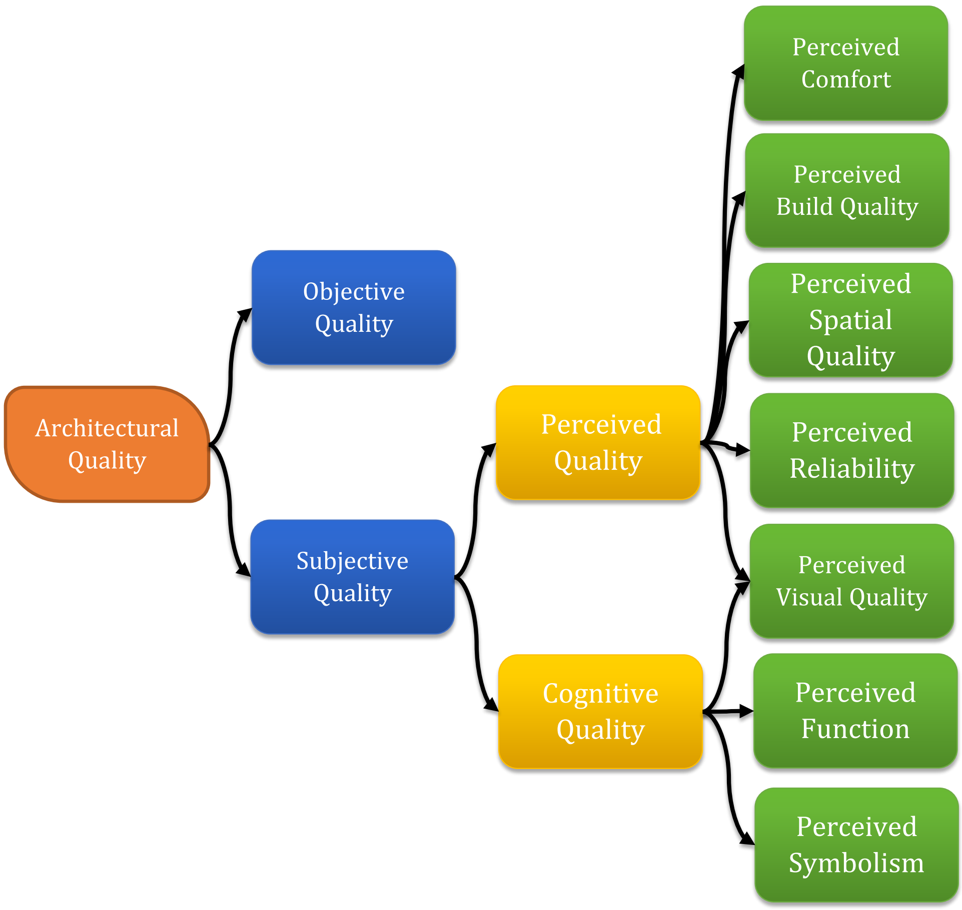


Figure 2-3. *Dimensions and sub-dimensions of architectural quality (Source: Author).*

2.4. Architectural quality and design

Caroline Lecourtois stated that assuming that quality proceeds from the cognitive phenomena of perception, it is therefore impossible to adhere to the thesis of Ph. Dehan according to which the architect would be "*the mediator in his capacity*" (Lecourtois, 2009).

Architectural quality is a concept that invites debate and can be subject to various interpretations (**Figure 2-1**). It incorporates a range of ideas that have been introduced by scholars such as Gallie in 1956 and later expanded upon by Janek in 1991, as highlighted by Rönn (2014). This contestability of architectural quality implies that there is no singular, universally accepted definition. According to Rönn (2014), quality represents:

- Something good.
- A well-designed object
- Good attributes and characteristics

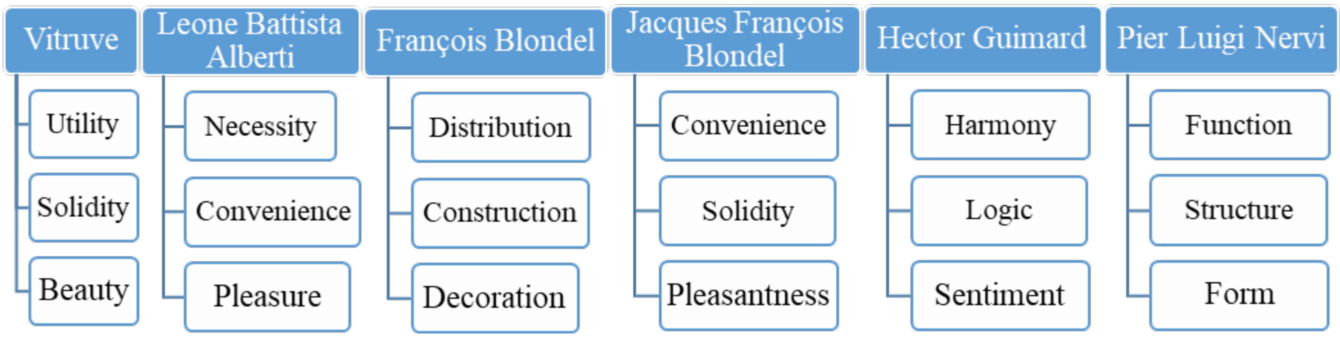


Figure 2-1. *Different definitions assigned to architectural quality (Source: Author).*

While the French urbanist and architect Christian de Portzamparc[1] states that architectural quality is divided into three categories:

- Perception: it refers to the phenomenology and the philosophy of the individual who lived the experience.
- Production: it refers to technical aspects of the construction.
- Representation: it refers to the style and aesthetic aspects.

Moreover, Rönn (2014) describes architectural quality as:

- An open concept based on knowledge
- A concept charged with values
- A concept that encourages debate due to the different views of quality.
- The controversial concept.
- A concept that is understood through value-charged design criteria (opinions, values, ideals and impressions of needed characteristics)
- A part of a learning form related to design and critical review. The design develop and expresses Knowledge
- The combination of elements that form a whole.
- A method of practicing history through benefiting from architectural history to produce models and understand design problems.
- An idea connected to interests of society and design power
- A concept consisting of an aesthetic dimension and a technical dimension.

[1] Pritzker Prize winner in 1994, born in May 5, 1944, Casablanca, Morocco. Education : Diplôme d'Architecture, École Nationale Supérieure des Beaux-Arts, Paris, 1969

Additionally, Rönn (2014) states that quality is dynamic concept that changes over time starting from the era of the philosophers in ancient Greece, where quality was trying to take position between objectivity and subjectivity due to the nature of the relationship between the object and how an individual perceive it. Additionally, the subjective aspect of quality is bound to learning and knowledge. An educated perceiver will produce credible judgments of subjective quality; hence, it is essential, to highly consider the assessments of well-educated and experienced individuals.

2.5. Expressed qualities, perception, and perceived quality

In a thorough investigation of the human perception process, which involves studying how individuals perceive and make sense of their surroundings, it becomes evident that the ability to organize sensory input into meaningful information plays a crucial role. This process not only enables to detect and interpret the environment, but also aids in the apprehension of perceived quality as a concept. Moreover, it significantly contributes to establishing a strong connection between perception and the architectural structure.

Giordano (2006) mentioned three terms related to quality:

- Expressed qualities
- Perception,
- Perceived quality

Then he proceeded to define each one of them in **Table 2-1**:

Table 2-1: *Definitions of expressed qualities, perception, and perceived quality (Giordano, 2006)*

Term	Definition
Expressed Qualities	In the age of constant change, function and appearance alone are not enough; the image of an object plays a major role through expressing other satisfying perceived qualities.
Perception	Perception is essential because it shapes the mental representations based on received sensations, which are interpreted by spirit without neglecting the important cognitive role of the brain.
Perceived Quality	The object does not only display its benefits and performance but it needs to express those attributes using different signs. It shows from the first impression that it signifies a well-done job. The notion of perceived quality lies in giving the user a sensation of confidence and satisfaction from the first look.

2.6. Perceived quality

Perceived quality is a subjective measure that covers a wide range of preferences and inclinations. As described by Aaker (1991), this concept encompasses multiple dimensions, including features, conformance, reliability, serviceability, fit, and finish. Evaluating perceived quality involves considering these different aspects and how they contribute to the overall evaluation of a product or service. It is important to note that perceived quality is an intangible parameter that varies according to several circumstances.

In the field of architecture, the connection between a building and its visual representation is often highlighted as a significant aspect. However, in order to truly grasp the meaning and significance of a building, it is crucial to delve deeper into its essence and purpose, going beyond its mere external appearance (Leatherbarrow, 2005).

Hence, the notion of perceived architectural quality encompasses not only visual appeal but also engages all senses, making it crucial to discern its various dimensions. Perceived architectural quality can be defined as the holistic assessment of the value a person derives from a built environment, considering factors such as perception, recognition, and personal experience. This multifaceted concept demands a comprehensive understanding of its diverse aspects, engaging with both the subjective and objective components of architectural evaluation.

Perceived quality of an object is predominantly determined by the users' perceptions, according to research conducted by Tsiotsou (2006) and Ariffin et al. (2016). It involves their levels of satisfaction and the trust they place in the object (Kim et al., 2008). Furthermore, it can be viewed as a construct that amalgamates various factors to form a comprehensive assessment of a building's excellence. This assessment is crucial in understanding how users evaluate and deem a building to be superior.

Zeithaml (1988) and Chaudhuri (2002) emphasized the considerable impact of perceived quality on the overall satisfaction of users and highlighted the strong correlation between user satisfaction and their perception of quality.

As observed by Tsiotsou (2006), the positive influence of architectural quality on user behavior and subsequent revisit intention cannot be overstated. It has been established that the greater the perceived architectural excellence of a building, the more frequent the visits to that particular location. This correlation between architectural quality and visit frequency reinforces the significance of design aesthetics in attracting and engaging users.

Perceived quality refers to the comprehensive assessment made by the user regarding the overall excellence of a building, at the time when the cues received based on its inherent characteristics. It is important to note that the evaluation of perceived quality is subjective and contextual, varying depending on the specific situation experienced by the user (Snoj et al., 2004).

The users' perceptions of the building undergo variations depending on factors such as the timing and location of receiving the information (Asshidin et al., 2016), along with their cognitive and affective states. These variations in perception are influenced by a multitude of factors that encompass the subjective experiences and emotional states of the users.

According to the comprehensive analysis conducted by Oude Ophuis and Van Trijp (1995), they elucidated the concept of perceived quality, emphasizing its multifaceted nature and the existence multiple dimensions.

Garvin (1984) proposed a classification system for perceived quality, identifying eight discrete dimensions that encompassed this concept. Building on this foundation, Parasuraman et al. (1988), along with notable researchers like Gronroos (1984) and Hjorth-Anderson (1984), also recognized perceived quality as a multi-dimensional construct.

Olson and Jacoby (1972) examined intrinsic cues as a means to evaluate perceived quality. These cues encompass the physical attributes of a building that are inherently linked to its overall appearance and cannot be altered without fundamentally changing its essence. In other words, they are closely tied to the structural aspects of the building itself. By focusing on intrinsic cues, researchers sought to understand how these characteristics contribute to the way individuals perceive the quality of a building.

From an alternative standpoint, one could posit that the concept of "perceived quality" refers to the evaluation of a product or service based on the subjective judgments and perceptions of the user (Steenkamp, 1990). This term encapsulates the idea that the perceived level of quality is contingent upon the individual's interpretations and assessments.

Numerous scholars and experts in the field have provided definitions for an object of good perceived quality. According to Kuehn and Day (1962), such an object is considered to be suitable and appropriate for its intended use. In addition, it is expected to fulfill the user's needs and requirements, as emphasized by Juran and Godfrey (1999).

According to Box (1983), fulfilling the intended function is the primary factor contributing to the architectural quality of an object. This notion is considered a crucial pillar within the triad of architectural quality. The concept of functionality refers to an object's ability to effectively serve its designated purpose. It encompasses the idea that an architectural element should seamlessly and efficiently perform the task it was designed for.

Numerous researchers, including Mitra and Golder (2006), Oxenfeldt (1950), Maynes (1976), Kupsch et al. (1978), and Bockenhoff and Hamm (1983), have collectively acknowledged that the perceived quality of architectural buildings hinges upon the subjective perceptions of users regarding the characteristics exhibited by the objects in question. This notion asserts that the user's perception plays a crucial role in determining the quality attributed to the building.

Perceived quality, a multifaceted concept, can be examined from a theoretical standpoint, as suggested by Olson and Reynolds (1983). This notion hinges on subjective evaluations, judgments, and attitudes shaped by individuals' perceptions. These perceptions, susceptible to alteration over time, can be influenced by diverse factors such as the acquisition of new knowledge and personal experiences (Zeithaml, 1988). Unlike objective quality, which adheres strictly to pre-established criteria, perceived quality is inherently subjective and dynamic, making it essential to consider users' changing perspectives and evolving expectations.

Lutz (1986) coined the term "cognitive quality" to describe the overall assessment of quality made by users. It refers to the users’ superordinate inferential assessment of quality. This concept goes beyond a simple evaluation of the entity's attributes and delves into a more advanced and analytical evaluation. For instance, when it comes to a building with a remarkable perceived architectural quality, it should evoke a corresponding cognitive response from those who experience it. This means that users should engage in a deep cognitive assessment that takes into account the inherent attributes associated with the perceived quality.

It must be acknowledged that the presence of consistency plays a vital role in the correlation between perceived quality and the values and expectations of users, consequently leading to the establishment of confidence (Kim et al., 2008). This principle also holds true in the context of architectural phenomena. The maintenance of consistency in various aspects, such as design, functionality, and user experience, is crucial in order to instill trust and foster a positive perception of quality.

A well-constructed edifice that displays remarkable visual cues, maintains a unified style, exhibits a coherent design, and possesses aesthetically pleasing qualities will evoke a favorable cognitive reaction. The perception of such a building is greatly influenced by its exceptional architectural elements.

The principles that contribute to the creation of a good form, such as complexity, unity, harmony, and balance, are essential in achieving an aesthetically pleasing and well-designed outcome (Arnheim, 1985). Additionally, it is important to note that there exists a significant correlation between the perceived quality and image of a building. Any efforts directed towards enhancing a building's image will inevitably lead to an improvement in its perceived quality as well (Sprott and Shimp, 2004).

Architectural quality as a concept is considered disputable (Rönn, 2014). Perceived quality, as explained by Giordano (2006), covers the meaning and value attributed to an object. It involves an assessment of all its attributes and encompasses the sensory and emotional impressions it evokes. Alongside this, perceived quality also takes into consideration the indicators that captivate the user upon initial observation and their interpretation, subsequently fostering confidence and facilitating satisfaction. It is essentially a promise of quality that aims to minimize the risk of product failure through elements such as:

- Seduction
- Confidence
- Satisfaction

In a comprehensive exploration, he goes beyond the conventional understanding of perceived quality and emphasizes that it is a subjective concept with various interpretations. The perception of quality is not solely determined by the objective signs and indicators that an object presents, but it also involves the user's subjective evaluations and experiences. This holistic perspective takes into account cognitive judgments, sensorial responses, and affective experiences associated with the object. In **Figure 2-4**, perceived quality may also represents a coexistence between:

- Objective aspects: functional and measurable.
- Subjective aspects: aesthetic, pleasure experienced, etc.

By considering perceived quality, individuals can evaluate and appreciate the overall worth and desirability of a particular object.

Figure 2-4. *Objective and subjective aspects (Source: Author).*

Giordano (2006) in the same context, proposed, from his point of view, another notion besides *perceived quality* which is *perceived qualities* and he assigned each one of them of its proper definition in **Table 2-2**.

Table 2-2: *Definitions of perceived qualities and perceived quality according to Giordano (2006)*

Notion	Origin	Definition
Perceived Qualities	American	It encompasses the perceptible, sensible, and sensorial dimensions and the characteristics that express signs of quality. It translates the satisfaction of the user and represents a global system of judgment that concerns every aspect perceived by the recipient.
Perceived Quality	European	It is based on the immediate, rational, and subjective perceptions of the hole as well as of the details. It is limited to first contact of the user with the perceived object.

In this study, the author utilizes a combination of both definitions in order to encompass a wide range of dimensions and address various perceived aspects. This approach aims to generate a thorough and detailed assessment of the building, providing a clear and comprehensive evaluation. By incorporating multiple perspectives and taking into account diverse factors, the author strives to enrich the analysis and offer an understanding of the subject matter.

2.7. Signs of perceived quality

Giordano (2006) mentions three points in relation to the signs that indicate the notion of quality:

- The signs of basic quality: that give confidence and show that the product is well made.
- The connotative expression: that represents the evoked signs when using the object like impressions and sensations induce by the building (visual richness, grandeur, quietness, etc.)
- The plus quality: besides the first two types, it refers to the novel attributes of the object and its innovative aspect that must be perceive from the first contact through the different signs and symbols attached to the object that make him noticeable.

Additionally, perceived quality may cover different notions and various content (**Table 2-3**).

Table 2-3: *Different notions of perceived quality adopted and modified by author from the work of Giordano (2006)*

General definition of perceived quality	**Definition of perceived quality limited to perception**	**Perceived quality Components**	**Perceived quality content**	**Examples of perceived quality**
All qualities It includes: • Subjective values • Objective values • Properties • Signs • Functional services	Signs of quality • Seductive • Convincing • Gives confidence • Suggests a promising features	Signs of quality perceived from the first look	• Signs expressing the design qualities of the product • Attractivene ss and seduction • Signs generating confidence	• The design of the product • The perceived image of the product • Label ,signage and other details
Qualities perceived by the user	Basic quality	• A good fit and finish • Precision and austerity	• Quality without doubt	• Well designed • Well studied • Well made • Quality of information • Exactitude

				• Fault-Free • Reliability • Durability

According to Rönn (2014), there are indications of quality such as:

- Type of material
- Technological production of the product

The category of materials and the technological processes employed have a profound influence on the caliber of design across multiple dimensions. To maintain an impeccable standard of products, meticulous attention must be devoted to the ensuing factors: In the realm of design quality, the selection of materials and the utilization of cutting-edge technology play a pivotal role. Therefore, is essential to consider aspects such as:

- Quality by Design (QbD) represents a meticulous and systematic methodology that places emphasis on a profound comprehension of the pivotal quality attributes (CQAs) and critical process parameters (CPPs) so as to ensure the consistent and reliable production of top-notch products.
- Critical material attributes (CMAs) play a vital role in comprehending the features of raw materials, excipients, and components that have the potential to influence the ultimate quality of the end product. These attributes are pivotal in the meticulous evaluation of the properties and behaviors of materials throughout the manufacturing process.

Lynch (1960) delineates several distinct categories that encompass the attributes sought after by designers. These categories serve as a comprehensive framework to define and understand the concept of quality:

2.7.1. *Singularity or figure-back ground clarity*

- Sharpness of boundary (contour)
- Closure (as an enclosed square)
- Contrast of surface
- Form
- Intensity
- Complexity
- Size
- Use

- Spatial location
- Richness of decoration
- Noticeability
- Vividness
- Recognizability
- Contrast to the immediate visible surroundings

2.7.2. *Form Simplicity*

It concerns the geometrical form, and it includes:

- Clarity
- Simplicity

2.7.3. *Continuity*

It refers to qualities that render perception of physical object easier, it includes:

- Continuity of surface
- Nearness of parts (a cluster)
- Repetition of rhythmic interval
- Similarity
- Analogy
- Harmony of surface and form (materials, patterns, openings)
- Harmony of use (similarity of activity)

2.7.4. *Dominance*

Similar to continuity, this quality simplifies the perceived image by focusing attention on dominant elements in terms of:

- Size
- Intensity
- Interest

2.7.5. *Names and Meanings*:

It refers to the non-physical characteristics that reinforces the imageability and the identity of the building such as:

- Naming systems
- Functional, social, economic, historical, and individual meanings and associations

2.8. Perceived quality levels

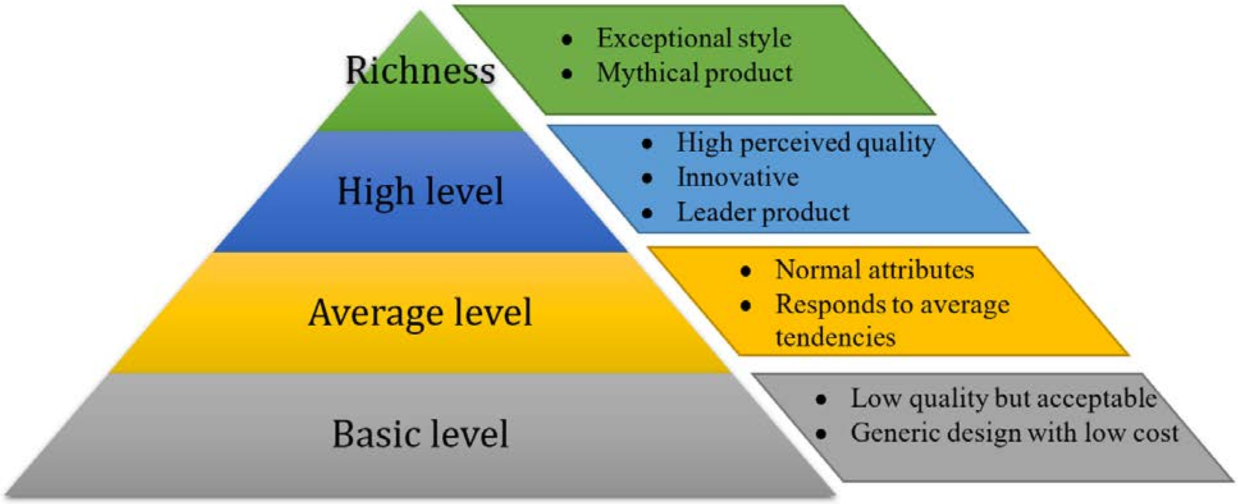


Figure 2-5. *Perceived quality levels, modified by author from Giordano (2006)*

Perceived quality, being a subjective and often ambiguous notion comprised of many levels (**Figure 2-5**), can sometimes be influenced by the nature of the information presented, as well as various factors associated with the environment in which it is received. When assessing the quality of something, individuals' personal opinions and interpretations come into play, making it a complex and multifaceted concept. The characteristics related to the environment according to Giordano (2006):

- Multiplicity
- Connectivity
- Immateriality
- Evolution

2.9. The three components of perceived quality

According to Giordano (2006), a product of a good perceived quality must possess the following components:

2.9.1. *Coherence*

It includes the following attributes:

- Unity
- Integration
- Continuity of forms,
- Perception of materials

- Coherence and homogeneity of the whole

2.9.2. *Expressivenes*

The product speaks to the user and express what it is, in accordance to the cultural boundaries and personal connotations suggested by user.

2.9.3. *Authenticity*

A product of quality is authentic and not fictitious; it does not seek to produce false impressions about its image.

2.10.Criteria related to the concept of architectural quality

Rönn (2014) mentioned some criteria in relation to the concept of architectural quality:

- Wholeness
- Durability
- Adjustment to the surroundings
- Genuineness
- Aesthetic honesty
- Beauty
- Readability
- Usefulness
- Professionalism
- News-worthiness
- Originality

On the other hand, according to Aaker (1991), the concept of perceived quality articulates around several distinct dimensions:

- Performance:

How well the product (the building) performs.

- Features:

If the product has convenient features and attributes.

- Conformance with specifications:

It relates to respecting the norms.

- Reliability:

If the product reliable each time it is used.

- Durability:

It refers to the longevity of the product.

- Serviceability:

It refers to the efficiency, competence, and convenience of the service system.

- Fit and finish:

The quality of the product in regards to its appearance and feeling.

Aaker (1991) stated that perceived quality is based on perceptions and judgments made by recipients, and is consider an intangible concept that represent the overall feeling about a product. Hence, it is different from related concepts like:

- Actual or objective quality
- Product-based quality
- Manufacturing quality

Melgaard et al (2007) in **Figure 2-6** stated that the quality of the envelope of a building does not often meet current requirements, presenting three groups, each group consists of numerous aspects:

2.10.1. ***Design aspects***

- Architectural aspects
- Land use aspects
- Planning aspects

2.10.2. ***Technical aspects***

- Building physics
- Structural aspects
- Environmental aspects

2.10.3. ***Non-technical aspects***

- Managerial aspects
- Financial aspects
- Social aspects
- Cultural aspects

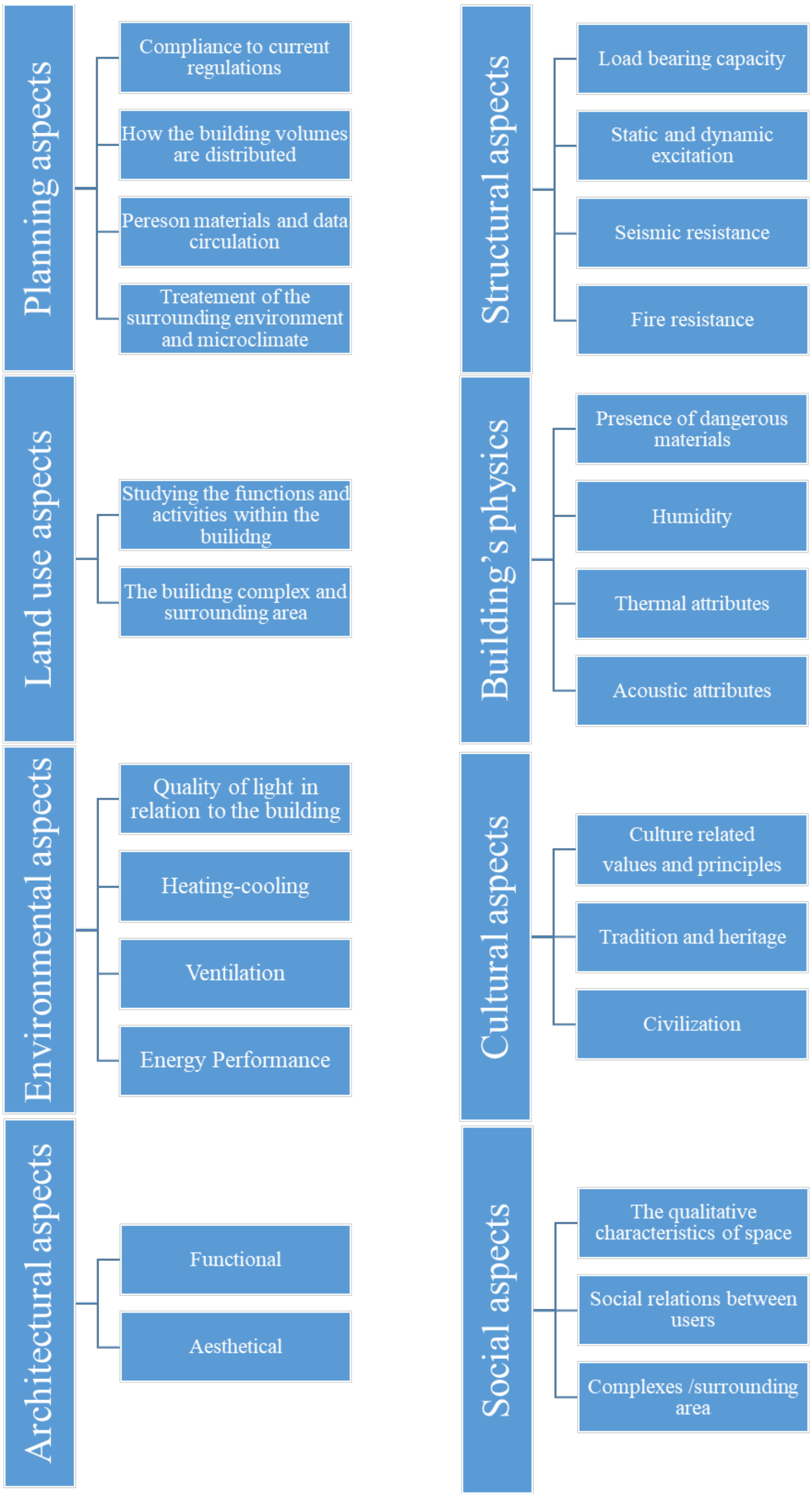


Figure 2-6. *Aspects needed to assure quality according to Melgaard et al., (2007) modified by author*

2.11.Perceived quality according to different culture

Perceived quality is a concept that is subject to variation and interpretation depending on the culture it is associated with. As a result, each cultural group may possess shared or distinct characteristics when it comes to perceiving quality. This notion of perceived quality, being subjective in nature, varies across different cultural backgrounds, highlighting the influence of cultural norms and values in shaping individuals' perspectives on what constitutes quality as Giordano (2006) indicates in **Table 2-4**.

Table 2-4: *Different definitions of perceived quality according to culture (Giordano, 2006)*

Notion	Culture	Attributes
Perceived Quality	American	• Performance and features. • Comfort. • Subtlety and fit and finish
	Anglo-Saxon	• Easiness of use. • Functional security comes before the signs of quality.
	Japanese	• Accepts mixing contradictions. • What is considered material doesn’t necessarily need to be durable. • Their pragmatism imposes the use of the object first before considering its signs. • The sign become necessary when the quality is satisfying. • A culture that highly considers the use of symbols.
	German	• Pragmatic • Security • Rigor • Quality • Robustness
	Italian	• Immediate perception (first impression). • The artistic aspect.

2.12.Material and immaterial aspects of objects

In accordance with Giordano (2006), each object possesses a collection of essential attributes that establish its unique identity and properties. Nevertheless, there exists a disparity in the interpretation of these characteristics when it comes to material and immaterial realities (**Table 2-5**).

Table 2-5: *Material and immaterial aspects of objects, inspired by Giordano (2006)*

Nature	Example	Characteristics	Interpretation by perception
Material : tangible the architectural building	• Aesthetics • Colors • Materials and textures • Space	• Character • Presence • Longevity	• Material exchange • Observing the building experiencing it ,and verifying it
Immaterial: virtual Information, concept	• Information • Cues • Signs • Symbols • Ideas • Knowledge • Cognition	• Credibility • Confidence • Label • Meaning • Learning	• Sharing information • Divergent perceptions resulting from the imaginations of each perceiver • Infinite evolutions

2.13.Objective reference points

Quality assessments are determined by evaluating the overall coherence of the design, as well as considering factors such as execution, conformity to usage codes, and attention to important details pertaining to materials, textures, and ergonomics. This comprehensive evaluation takes into account various aspects, including the overall aesthetic appeal, functional efficiency, and adherence to industry standards. Therefore, the judgment of quality is not solely based on one aspect.

2.14.Perceived modernity

Perceived modernity refers to the perception that a building has benefited from recent advancements and developments, thereby instilling a sense of credibility and perfectionism. This notion arises from the presence of signs or elements of modernity within the structure, which showcase its alignment with contemporary architecture.

Attraction plays a crucial role in capturing attention right from the initial encounter. However, according to Giordano (2006), mere physical appearance alone is not sufficient for an object to have longevity. In order for a product or building to thrive over time, it must possess additional attributes beyond its aesthetic appeal. Giordano further emphasizes that technical proficiency and functionality are not the sole criteria for success; the product or building should also showcase its unique qualities and evoke pleasurable sensations, emotional responses, and sensory experiences. Furthermore, it should instill a sense of confidence in the user, allowing them to fully engage with it.

2.15.Fundamentals of perceived qualities

According to Giordano (2006), fundamental perceived qualities are essential to ensure the whole perceived quality, and by extension, the perceived value, because it signifies qualities observed from the first impression and assure that the promises given are fulfilled and confidence is offered (**Table 2-6**).

Table 2-6: *Fundamentals of perceived architectural qualities, modified by Author from the work of Giordano (2006)*

Fundamentals	**Building components**	**Perception**	**Process**	**Reaction**
Generating a satisfying first impression	-Global form -Strong details	-Gestalt -Image emotion	First impression	Like or dislike
Satisfying the user, send him good vibes and express good ideas	Relating to the “What” and the signs of “What”	-Sensible -Sensorial	Experienced from first contact	-Fulfills the promise -Satisfies
Inferring meaning and values	-Expression -History	Cognitive	Experienced from first contact	-Gives meaning -Attracts -Suitable
Signifying technical and functional mastery	Signs of the “How”	Cognitive	Experienced from first contact	-Confidence
Providing, coherence, credibility, and durability	The whole	Need for coherence	-Global -Detail	-Confidence -Satisfaction

Giordano (2006) mentioned multiple users’ referential of perceived quality/value:

a) Comfort
- Space (habitability, accessibility, visibility, luminosity)
- Quality of use
- Ergonomics
- Level of equipment

b) Security

c) Performance

d) Aesthetics
- Design (exterior and interior)
- Style
- Expressiveness
- Coherence (exterior and interior)

e) Basic qualities
- robustness
- reliability
- durability

2.16.Perceived visual quality

The visual aspect plays a crucial role in determining the perceived quality of architecture, as it has a profound impact on the cognitive and emotional reactions of users (Kim et al., 2009). Additionally, it significantly influences the perception of usability (Tractinsky et al., 2000). When individuals observe a building, they naturally seek a visually appealing design that evokes positive emotions (Sánchez-Franco et al., 2013). The aesthetic appeal of a structure serves as a vital factor in shaping users' overall experience and satisfaction. The visual quality not only captures attention but also enhances the appreciation and connection individuals feel towards the building.

Visual quality, in the realm of architecture, is an intricate dimension comprising multiple factors that intertwine and collectively influence a user's visual perception. This perception is shaped by a combination of the individual's knowledge and experience. A comprehensive understanding of visual quality requires a deep exploration and analysis of these factors to enrich our grasp of this crucial aspect.

Forms, shapes, symbols, style, preference, beauty, and feelings (Hekkert, 2006) and other elements that involve both aesthetic judgment and aesthetic emotion (Leder, 2013; Leder et al., 2004; Nadal and Skov, 2013; Zeki et al., 2014) fall under the category of aesthetic experience (Yeh et al., 2021).

In the realm of semiotics, it is crucial to recognize that any object we encounter in our surroundings has the potential to convey multiple signs. These signs can be compared to the sign-vehicles described by Määttänen (2017), much like an architectural structure, albeit on a grander scale and with a more profound influence. Within the context of architecture, there are numerous phenomena that directly impact the user's experience. These include, but are not limited to, the interplay between the interior and exterior spaces, the contrasting nature of voids and solids, the interplay of light and shadows, and the vibrant palette of colors. Hence, it becomes evident that the architectural experience is multifaceted on a wide scale.

Based on Leder et al.'s (2004) model, the aesthetic experience is not just merely a simple act of visual perception. Instead, it is a multifaceted and ongoing evaluation that involves various factors. The perceiver's assessment of aesthetics is greatly influenced by their emotional state, perceptual analysis, and cognitive mastery. This comprehensive understanding underscores the intricate nature of the aesthetic experience, emphasizing its complexity and continuous nature.

According to Dewey (1980), an object can be considered aesthetically pleasing when it exhibits aesthetic qualities that evoke a sense of beauty and satisfaction, thereby stimulating aesthetic perception. In particular, geometric patterns have the potential to capture attention, especially when they are categorized as visually pleasing and beautiful (de Tommaso et al., 2008). This implies that such patterns have the power to captivate individuals and elicit a positive emotional response.

The satisfaction of individuals is significantly improved when a building successfully integrates aesthetic and functional elements, thereby providing clear indications of perceived excellence. An illustrative instance would be a cultural edifice that harmoniously incorporates the cultural symbols of its region while effectively meeting its intended purpose.

Such a building would equally inspire positive evaluations and favorable opinions from its users. The amalgamation of aesthetics and functionality becomes pivotal in generating a memorable user experience and fostering a sense of deep appreciation towards the architectural design.

The evaluation of aesthetics and the judgments made about the attractiveness of an object are influenced by several factors, including the user's knowledge, experience, and personal preferences (Nadal and Skov, 2013; Jankowski et al., 2018). Additionally, de Tommaso et al. (2008) suggest that the observer's appreciation of an object can stem from various aspects, such as its geometric shapes and physical attributes like colors, patterns, proportions, and symmetry.

Alternatively, the appreciation can also be influenced by the object's semantics and cultural significance, as well as the observer's own cultural background, knowledge, experience, and emotional state. Hence, the user's cognitive factors play a vital role in aesthetic evaluation.

The building's aesthetic appeal plays a crucial role in enhancing its overall value and perceived quality (Mumcu and Kimzan, 2015). This highlights the significance of visual quality in shaping cognitive response, as well as the user's perception of architectural quality (Van Rompay et al., 2012) and their evaluation of the building (Workman and Caldwell, 2007). The visual attractiveness of a building holds substantial influence over how it is perceived and evaluated by users, underscoring the importance of incorporating visually pleasing elements into architectural design. This underscores the need for architects and designers to prioritize visual quality as it significantly influences the users' cognitive response and overall evaluation of building.

A building that possesses a unique and visually captivating design has the power to make a lasting impression and significantly contribute to its perceived architectural excellence, as stated by Bloch et al. (2003). Hence, it is imperative for the design to exhibit originality and distinctiveness in order to establish a strong and recognizable identity (Jennath and Nidhish, 2016) while also facilitating easier identification (Veryzer, 1995).

By incorporating innovative and one-of-a-kind elements into the design, the building can achieve a sense of uniqueness.

The transmission of spatial information by vision, as demonstrated in the study conducted by Posner et al. (1976), highlights the intricate connection between visual perception and spatial cognition.

The assessment of architectural building space quality is significantly influenced by the external form, which is regarded as one of the foremost factors in this evaluation (Jennath and Nidhish, 2016).

2.16.1. Secondary aesthetic evaluation

The research conducted by Jankowski et al. (2018) presents a comprehensive model that sheds light on the relationship between the visual characteristics of an object and its aesthetic evaluation. According to their findings, the visual attributes of an object contribute to its primary aesthetic evaluation. However, when these visual attributes are considered in conjunction with their semantic interpretation within a cultural and personal context, a secondary aesthetic evaluation emerges.

2.17. Perceived spatial quality, cognition and perception

Architecture as the art of designing and building encompasses both the creative process of designing and constructing physical structures, as well as the profound consideration of spatial creation and the thoughtful making of space (Kahn, 1957). This discipline, often characterized as the art of building, entails the meticulous planning and execution of architectural projects.

The process of manipulating spatial information, including patterns, scale, proportions, and shape, and examining it from various perspectives and viewpoints (Rowe, 1987; Cross, 2011), plays a pivotal role in augmenting the perceived visual and functional quality (Akin, 2001). It also aids in constructing a more lucid mental representation in the mind of the observer (Berkowitz et al., 2021). This critical procedure not only enhances the overall quality of the visual experience but also contributes to a clearer understanding and interpretation of the spatial elements.

Spatial organization and configuration play an equally significant role in determining the functional quality of a building and the activities it accommodates. According to Bittencourt et al. (2015), the layout determines the building's functional quality and related activities.

The architectural features present in a space have a profound influence on the way users perceive and navigate through it. These features can effectively guide individuals to prefer one route over another, particularly if their favorite building or landmark is located in that direction (Sussman and Hollander, 2015). This preference is closely linked to the visually-oriented nature of humans and the emotional impact that such experiences can have (Hutmacher, 2019). When it comes to spatial perception, the architectural elements within a built environment play a critical role in shaping the user's navigation and path finding.

Spatial perception includes a range of assets and abilities that facilitate the examination and utilization of spatial information. These include the ability to determine location, identify positions in space, comprehend orientations, and grasp relations between shapes and sizes (Newcombe and Shipley, 2015). In the field of architecture, some architects rely on human perception inclinations when carrying out spatial planning.

They recognize the value of the connection between humans and nature, and incorporate it as a fundamental concept in their spatial configuration. A prominent example of this approach is evident in the house plans designed by Frank Lloyd Wright (Sussman and Hollander, 2015). Wright skillfully incorporated the principles of human-nature connectivity into his architectural designs, resulting in spatial arrangements that harmoniously blended with their natural surroundings.

In regards legibility theory proposed by Lynch (1960), concepts such as wayfinding, navigation, identification, recognition, and manipulation of spatial information pertaining to shape and size play a pivotal role. These ideas delve into the intricate understanding of how individuals perceive and interact with their surrounding space and its various components. Additionally, this theory posits that humans' ability to engage with their environment is closely tied to their perception and cognitive processes.

Furthermore, the capacity of human beings to engage with the environment and its various elements holds significant importance in the realm of perception. This ability allows individuals to perceive and make sense of their surroundings (Karakas and Yildiz, 2020).

The analysis of the user's spatial perception, including factors such as accessibility, legibility of space, orientation, and other spatial information, plays a crucial role in enabling effective navigation and self-location (Koseoglu and Onder, 2011; Hunt, 1991; Herzog and Leverich, 2003; Bittencourt et al., 2015).

The spatial characteristics of a building have a significant impact on both intrinsic-static and extrinsic-static skills. Intrinsic-static skills refer to how the size, shape, and spatial arrangement of elements within the building influence an individual's abilities. On the other hand, extrinsic-static skills pertain to the identification and location of the building itself (Newcombe and Shipley, 2015).

Visuospatial abilities play a crucial role in the formation and development of spatial mental models, as highlighted by De Beni et al. (2005).

Landmarks influences the wayfinding processes of individuals. They not only assist in navigation but also have a lasting impact on memory retention and recognition (Gregorians et al., 2022). This phenomenon, commonly known as landmark-based wayfinding (Balaban et al., 2014, 2017).

In line with previous research, it has been found that the presence of landmarks plays a significant role in the formation of spatial configurations, particularly in the context of route mapping; Ruotolo et al. (2018, 2021) found that individuals find it easier to create mental maps when landmarks are present. Additionally, it has been observed that the inclusion of landmarks has a positive impact on topographical memory performance (Palmiero and Piccardi, 2017).

Landmark buildings possess a distinctive spatial quality that enables users to develop spatial mental models, due to the combination of spatial and verbal information they provide

(Brunyé and Taylor, 2008). Furthermore, their significance lies in facilitating easy recollection of suitable routes and navigation paths, as proven by previous research conducted by Garden et al. (2002). By imbuing the surrounding environment with a unique sense of place, these architectural landmarks not only contribute to the overall aesthetic appeal but also enhance spatial cognition and navigation for individuals.

The significance of a building's identity is intricately intertwined with its specific location, as emphasized by the research conducted by Johnston and Pashler (1990). Thus, the act of placing a building in a well-suited location that holds substantial social, economic, and historical significance will inevitably contribute to the enhancement of its overall identity. On the contrary, if a building lacks the discernible connection to a specific location, its identity may be diminished or potentially overlooked. It is crucial to recognize that the establishment of a building's identity goes far beyond its physical structure.

The interaction between perception and long-term memory can be comprehensively explained by the process of receiving and interpreting signals and messages sent by the building, drawing upon previous experiences (Helmholtz et al., 2000) and similar situations encountered in the past that serve as a reference point for comparison (Summerfield et al., 2011).

Episodic memory, perceptual memory, and symbolic short-term memory are crucial components in the processes of perception, reasoning, situational awareness, and symbolic cognition. These memory systems not only allow us to remember past experiences and perceive the world around us but also enable us to engage in higher-level cognitive tasks such as making comparisons and forming judgments based on the integration of previously perceived information with current one (Anderson, 1983).

Semantic memory plays a crucial role in answering questions pertaining to spatial context, just like episodic memory. It accomplishes this by extracting knowledge from past experiences and situations. With its cognitive trait of parallelism, semantic memory enables simultaneous execution of operations such as visual and spatial data collection, as well as the semantic representation of symbols. This parallel processing capability, as highlighted by Anderson et al. (1977) and Anderson (1983), allows for efficient cognitive functioning. By integrating and assimilating information from diverse cognitive processes, semantic memory enhances our ability to understand the spatial context.

The level of attention that an individual allocates is influenced by their cognitive processes, perception abilities, and memory functions, as highlighted by Taylor and Brunyé

(2013). These factors are intricately connected, as discussed by Chun and Turk-Browne (2007), with their coordination playing a crucial role in the overall process.

Attention plays a crucial and influential role in the acquisition and assimilation of essential information required for cognitive processing, as highlighted by Lachter et al. (2004). The process of directing attention allows individuals to gather the necessary information to make sense of what is perceived.

The level of attentiveness exhibited by an observer significantly affects the amount of information they can gather. This assumption is contingent upon the building in question providing adequate cues and signs to stimulate spatial perception abilities. By activating this cognitive ability, individuals can effectively identify specific elements, characteristics, symbols, and other spatial information associated with the building. This process allows them to compare and contrast these observations with their previous mental representations, thereby facilitating the formation of novel interpretations and inferences (Taylor and Brunyé, 2013).

2.18.Ergonomics

The interaction between individuals and a building, or a specific portion of it, is deemed pleasant when it is characterized by simplicity and user-friendliness. The overall experience is enhanced by the absence of complexities or difficulties in navigating and utilizing the space.

There are multiple interpretations of the term ergonomics, which can be described as the utilization of human-related knowledge essential for creating tools and devices that can be comfortably, securely, and efficiently used by the majority of individuals.

Physical ergonomics pertains to the characteristics and functioning of the human body, while cognitive ergonomics focuses on the psychological and intellectual processes associated with a specific task or activity.

This comprehensive understanding of ergonomics encompasses both the physical and mental aspects, ensuring that the design and functionality of tools and contraptions are optimized for human use. By taking into account factors such as comfort, safety, and efficiency, ergonomics seeks to enhance the overall usability and effectiveness of various products and systems.

Applying the principles of ergonomics plays a crucial role in aiding the designer, specifically the architect, during the creation of concepts and designs that align with the physiological and psychological requirements of users.

2.19.Perceived comfort

Comfort, which is considered one of the fundamental aspects of perceived quality, is closely connected to other integral dimensions that contribute to the overall evaluation of a product. These dimensions include the quality of building execution, the performance of the building, the overall sense of security, the ergonomic qualities, and the connection between space and function. When assessing the comfort of a building, it is crucial to consider these interconnected aspects in order to reach the users' satisfaction.

Perceived comfort refers to how individuals interpret and translate the performance of a building, be it in terms of energy efficiency, thermal regulation, or acoustic quality. Unlike experts who possess the expertise and employ various techniques to analyze the performance of buildings, the average user lacks the knowledge and experience to conduct such evaluations. However, they can still perceive and pick up on comfort cues within the building, which can serve as indicators of its performance. It is important to note that the nature of a building differs significantly from that of a marketed product or a machine. Building performance encompasses a plethora of factors and considerations that go beyond mere functionality and aesthetics. Fully comprehending and evaluating these aspects requires a full understanding of the building's performance, something that may prove to be a challenge for the ordinary user.

Therefore, it is comparatively straightforward to assess the performance of a technology or system, in contrast to an architectural structure, which presents challenges due to its large scale and intricate design.

2.20.Thermal comfort

In terms of thermal comfort, the architectural design of a building, including the layout of its spaces, the placement of openings, and the selection of materials, plays a significant role. An all-inclusive understanding of these factors is crucial in creating an environment that is thermally comfortable for its occupants. In this regard, there are three mechanisms for heat dispersion:

- Conduction: through contact with the surface
- Convection: through thermal exchange between liquids and gas, it is related also to the movement of air.
- Radiation: through infrared radiation exchange with the walls.

2.21.Parameters related to perceived thermal comfort:

Giordano (2006), cited three parameters of thermal comfort:

2.21.1. *Temperature*

Taking account of the radiant temperature (with walls and windowpane), and the convection exchange (ambient temperature), in addition to the conditions related to them is essential to achieve thermal comfort. Generally, the temperature of the interior dry air is considered comfortable near 20 °C in summer and 26 °C in winter.

2.21.2. *Air speed*

The satisfaction of the air speed is subjective and differs from a person to another, according to their clothing, and the type of activities they do. For an air speed of 1m/s, temperature drops 4 °C, in an ambient temperature of 10 °C, while it only drops by 1 °C in an ambient temperature of 30 °C.

2.21.3. *Humidity*

Air consists of water vapor, and the amount of humidity in the air ranges from 0% for dry air to 100% for saturated air. As the temperature rises, the quantity of water vapor in the air increases proportionally. This relationship between temperature and the presence of water vapor in the air contributes to the overall humidity level.

2.22.Light and lighting, the aesthetic and affective impact

Forms and colors under light play a visual game and create an ambiance and a poly-sensory experiences evoking feelings, and emotions.

2.23.Acoustic design and the sound quality

Sound has the remarkable ability to evoke emotions and convey information, akin to a sensory experience. However, the perception of sound varies from person to person. It is interesting to note that what may be deemed acceptable in rural areas might not be considered as such in urban conglomerations. Attaining acoustic quality becomes an essential task when the sounds we perceive align with the expectations and acoustic comfort needs of the individual. Yet, it is crucial to acknowledge that achieving acoustic comfort is a subjective matter influenced by various factors such as physical attributes, personal preferences, and cultural considerations.

The evaluation of environmental quality is greatly influenced by acoustic factors. The presence of noise, such as sounds emanating from traffic, has a detrimental impact on how the environment is perceived and evaluated (Appleyard, 1981; Craik, 1983; Esposito, 1984 as cited in Nasar, 1989). This consequently, decreases the quality of life in residential streets and neighborhoods (Anderson, Mulligan, Goodman, & Rezen 1983; Appleyard, 1981; Craik, 1983; Lansing et al., 1970), and in the case of cultural establishments, the importance of acoustic quality is of utmost significance. This is particularly evident in spaces such as reading rooms and theaters, where tranquility and insulation from external disturbances are essential requirements.

2.24.Perceived quality and fit and finish

2.24.1. Notion of fit and finish

The fit and finish refers to:

- The high care for details
- The refined work and the sophisticated craft
- The quality of the used material and how they are applied
- The overall quality of the achieved construction

Fit and finish embodies a meticulously executed endeavor that takes into account all the intricacies. It is a prominent factor contributing to the perceived quality of a product, encompassing the proficiency and expertise of the creator in achieving the ultimate outcome. The meticulous attention to detail and the careful consideration given to every aspect of the work are key elements that define fit and finish. This concept underscores the significance of the constructor's skill and mastery in delivering a final product that meets or exceeds expectations. Fit and finish is determined by factors such as:

- Materials quality
- Execution quality
- The functional sophistication
- The completeness of the whole

2.24.2. Materials

According to research conducted by Kaplan & Kaplan (1989) and Nasar (1983, 1984), individuals generally show a preference for natural materials as opposed to artificial ones. This preference stems from the fact that natural materials establish a connection with nature, offering a sense of relaxation and tranquility. Furthermore, such materials convey an impression of authenticity, confidence, long-lasting durability, and a touch of luxury (**Figure 2-7**).

According to Le Corbusier (1986), the elements of the site influence the sensation (like wood, marble, and grass) by their:

- Volume
- Density
- Quality of materials

Buildings that exhibit uncommon and distinctive features in comparison to their surroundings are often favored by individuals, as they evoke a sense of intrigue and fascination. These novel elements, whether they consist of expertly arranged components that are unique in their composition or familiar elements arranged in an unconventional manner, tend to capture people's attention. However, it is important to note that the degree of preference for such buildings ultimately relies on individual tastes and preferences, as well as various contextual factors that warrant further investigation and analysis.

In a study conducted by Sadalla and Sheets (1993), it was found that when it comes to influencing the perceptions of individuals, one of the distinguishing factors is the expression of creativity, particularly in the comparison between artistic and non-artistic forms. The participants' perceptions were significantly influenced by the use of different materials, such as flagstone, concrete block, and red brick.

Interestingly, the participants who identified themselves as having artistic tendencies categorized the use of flagstone as an artistic expression, whereas concrete block and red brick were not considered as such.

Gifford et al., (2000) in the discussion of his findings stated that architects were more interested in buildings with:

- Rounded edges and corners.
- Elements that are more triangular.
- Fancy metal-clad buildings.

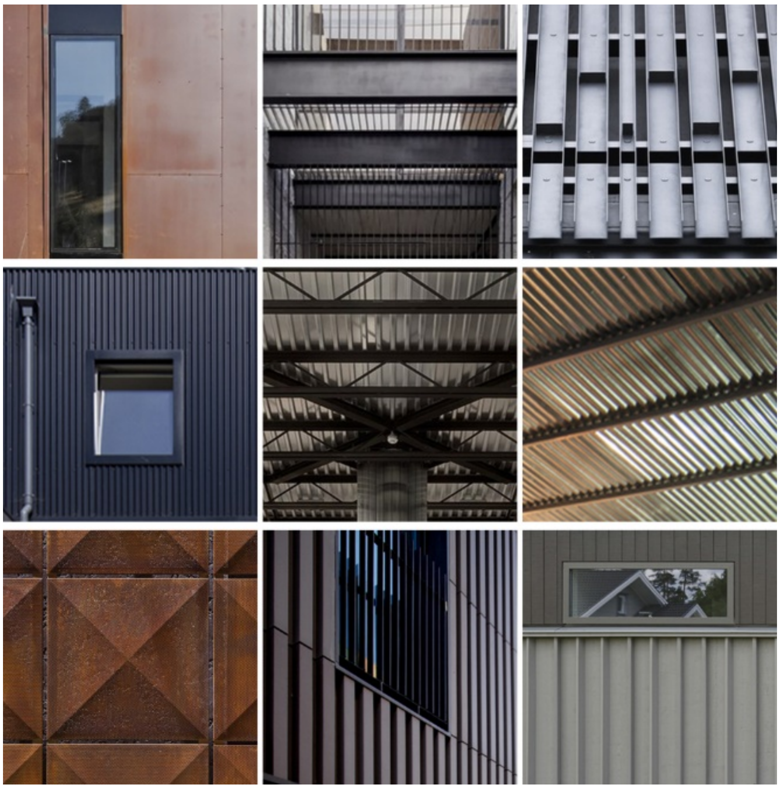


Figure 2-7. *Metal-clad usage in buildings. (Source: Gallery of 15 details of metal structures and facades for residential projects - 1. ArchDaily. (n.d.). Retrieved April 27, 2023, from https://www.archdaily.com/799868/15-details-of-metal-structures-and-facades-for-residential-projects/580a7b13e58ece844400003e-15-details-of-metal-structures-and-facades-for-residential-projects-image)*

Furthermore, as stated by Gifford et al. (2000), a structure with metal cladding creates the perception of a higher-end aesthetic and conveys a sense of modernity. This design choice suggests a level of sophistication and visual appeal that is associated with greater expense.

The meanings ascribed by individuals to certain concepts are prone to undergo modifications and shifts as time progresses (Akalin et al., 2009; Sadalla & Sheets, 1993). In particular, when it comes to building materials, they possess the capacity to hold diverse symbolic connotations. It is noteworthy to mention that the selection and integration of distinct materials on a building's façade can effectively communicate pertinent information about the people inhabiting it. The use of different materials on the building’s exterior can convey information about the occupant such as:

- Creative expression
- Interpersonal style
- Social class

2.25.Imageability and perceived quality

According to Nasar (1989) imageability contribute to enhancing perceived quality but doesn’t determine if the quality is satisfying or not, a building may be imageable because its location is remarkable but it lacks in other aspect like uniqness of the architectural style, denotative and connotative meaning, naturalness, thus the evaluation always relies on the perceived quality of the imageable component.

According to Lynch (1960), there are elements that contribute to strengthening the image such as:

- Spatial qualities
- Tall buildings
- Special facade characteristics

Without forgetting the importance of continuity and visibility

Giordano (2006), highlighted the importance of image, and how the form invoke mental images, given that fact the image has the ability to evoke emotions, and suggests associations with certain events, and memories. The forms (the physical images) generate initially an effective response, and they take shape from the first impression. The image is accompanied by a polysemic interpretation and other additional significances.

Giordano., (2006) mentioned three aspects of the image:

Denotation: it refers to the description of something and its literal reading, the image is perceived immediately as a hole, and every individual has his own denotation for an image according to his knowledge and attention.

Connotations: they refer to the interpretations and the meanings associated to the objects. Wide varieties of meanings are given according the sociocultural codes.

Technical elements: they represent the elements that define the image such as contours, colors, etc. certain elements can reinforce the connotations, like expressing aspects related to the past.

Lynch (1960), referred to the adaptation of the environment itself to the individual perceptual patterns and symbolic processes. Buildings (especially landmarks) are a part of the urban environment; therefore, their design and visual identification need to adapt to perceptual requirements of the perceivers and the wishes of occupants, and to equally enhance the imageability of the surroundings.

.

Giordano (2006) mentioned other aspects related to perceived quality and image:

- Coherence: the parts goes “well together”.
- Integration: the components do not seem to be forcibly added but they are melted into the whole.
- Completeness: the features are complete.
- Homogeneity: the whole forms a single consistent and balanced element.

2.26.Evaluation scales for measuring buildings quality

When we talk about judging architecture, we are actually discussing the act of perceiving architecture rather than the architecture itself.

This means that we are focusing on how people interpret and evaluate architectural phenomena (Julean, 2016). Measurable parameters can be used to determine quality as a concept (Rönn, 2014).

The assessment and determination of architectural quality are contingent upon various factors, particularly those associated with the individual such as:

- Personal capacities
- Knowledge
- Inner characteristics

Garvin (1984) identified eight self-contained and distinct dimensions that represent basic aspects of quality:

- Performance:

It refers to the primary characteristics; in the case of a building, it signifies comfort, thermal and acoustic performance.

- Features:

It refers to the supplementary characteristics that enhance the basic quality and improve it eventually

- Reliability:

It refers to the probability of failure of a product (building) within a specified period of time.

- Conformance:

It refers to the correspondence of the characteristics of a product design to pre-established standards and specifications. Both conformance and reliability are close dimensions of quality.

- Durability:

It refers to the longevity of a product before it starts deteriorating.

- Serviceability:

It refers to the speed and of repairs, maintenance, and the frequency of preserving the overall condition.

- Aesthetics:

It is considered as a subjective dimension related to personal judgments; it refers to the product's aesthetics, how it looks and how it feels.

- Perceived Quality:

The concept pertains to the individual's personal evaluations of quality, which are formed by the information and data available to them regarding the item, even if this information is limited, as these assessments depend on indirect indicators.

Therefore, the quality of judgments made by users are heavily influenced by the knowledge and data provided.

Gifford et al. (2002) in his evaluation of the aesthetic quality of buildings proposed in his model that consists of six cognitive properties:

- Complexity
- Friendliness
- Ruggedness
- Originality
- Clarity
- Meaningfulness

The results of complexity, originality and, meaningfulness between architects and laypersons (non-architects) in regards to physical cues of the building were the following (as indicated in **Table 2-7**):

Table 2-7: *Results of complexity, originality and, meaningfulness between architects and laypersons according to Gifford et al., (2002)*

Cognitive Properties	**Group**	**Significant Physical Cues**
Complexity	Architects	More Articulated Facades More Canopies More Ornamentation Less Landscaping
	Laypersons	More Articulated Facades More Ornamentation More Sides To The Building More Stories More Rounded Sides More Stepped Facades
Originality	Architects	More metal cladding More stone or brick cladding Less Landscaping
	Laypersons	Roundness Ornamentation
Meaningfulness	Architects	More metal cladding
	Laypersons	Roundness Ornamentation Landscaping

The results also showed that the lay judges were in agreement with the architects that original buildings have a great overall aesthetic quality.

In his experimental design, Hershberger (1972) aimed to rate thirty cognitive meanings of twenty-five buildings such as simplicity/complexity, uniqueness/commonness, comfort/ comfortlessness, ambiguity/clearness, and chaos/order.

Hershberger (1972) used the "semantic differential," scale developed by Osgood et al (1978) as measuring technique to assess connotative meanings. The scale consists of seven steps to rate bipolar attributes like good/bad, extremely good, quite good, slightly good, neither good nor bad (neutral), slightly bad, quite bad, extremely bad. The scale is similar to the Likert scale.

Akalin et al. (2009) also used a five-point semantic differential to rate three dimensions: preference, complexity and impressiveness. His research took interest in house facades that have been altered and personalized by users themselves to give personal identity and ascertain the freedom of expression.

In their research, Lowenthal and Riel (1972) utilized a comprehensive approach to evaluate the characteristics of varied environments. They employed a 5-point scale to assess the attributes of these environments, taking into consideration the perspectives of observers with diverse educational backgrounds and different residential locations.

Herzog & Shier. (2000) explored three aspects of urban buildings: scale, visibility of entrance, and the visual richness of the building. They found that buildings were preferred if they were characterized by:

- Visual richness
- Far view
- Visible entrance

In architectural parlance, possessing an aesthetically pleasing exterior and a clearly defined silhouette that provides a comprehensive view of the structure while offering sufficient information, together with a conspicuous and identifiable entrance that minimizes any potential confusion, significantly increases the likelihood of garnering significant preference. This implies that buildings exhibiting these features not only captivate the attention of observers but also facilitate a seamless and intuitive experience for its occupants.

Also, in the findings of Herzog and Shier (2000) (**Table 2-8**), regarding the adjusted preference means for modern and old buildings, they found that modern buildings surpass old building in the following covariates:

Table 2-8: *Adjusted preference means for modern and old buildings (Herzog and Shier, 2000)*

Covariate	Modern Buildings	Old Buildings
Visual richness	3.22	2.40
Coherence	2.99	2.63
Nature	3.03	2.59
Ornament	3.19	2.42
Curves	3.08	2.54
Contoured walls	3.12	2.49
Columns	3.09	2.52
Color variation	3.07	2.54
Texture variation	3.16	2.46

It can be noted here that modern building significantly exceeded old buildings in factors that relate to perceived complexity such as visual richness, ornament, curves contoured walls, and both color and texture variations.

Frewald (1989) also proposed other visual richness factors, such as:

- The presence of external ornamentation
- Perceived color and texture variety
- Curved forms
- Column prominence

Evans et al. (1982) mentions five characteristics adapted from research done by Stephen Kaplan (Kaplan 1973; 1975) which are complexity, naturalness, mystery, coherence, and spaciousness.

- Complexity: the diversity in forms, shapes, colors and texture of the building's exterior
- Naturalness: the number of green spaces surrounding the building.

  "Landscaping surrounding a building increases attractiveness and may make buildings more noticeable, . . . can provide distinctiveness, visually separating one structure from an otherwise homogeneous set of facades." (Evans et al., 1982:p.238).
- Mystery: the amount of information received about the building function and appearance.
- Coherence: refers to organization of patterns of the external façade of the building
- Spaciousness: relates to the size and scale of the building and how much space it occupies.

According to Nasar (1994) some professional involved in buildings construction and renovation create public eyesore instead pleasing designs and this due to the existence of hole between architects' propositions and people liking and this difference become more distinctive in the case of large-scale projects when the designer has limited contacts with the user. The exterior of building should go in accordance with what psychologists suggest in matter of aesthetic response, which represents the positive evaluation resulting from the perceiver's enjoyment of the building attributes.

Nasar (1994) proposed a probabilistic model for aesthetic response where the observers (of different personalities, emotional states and cultures) receive through perception the buildings various attributes ,these attributes are judged by cognition to make evaluations, meanings and connotation and they equally produce emotional reactions,. The previous combination leads to forming an aesthetic response that affects, by extension, the behavior.

Gimblett et al. (1985) in his research (**Table 2-9**), proposed five physical attributes of mystery based on the following mean rating: low (1.00-2.00), moderate (2.00-3.90), high (4.00-4.50). The physical attributes are:

Table 2-9: *Physical attributes of mystery according to Gimblett et al. (1985)*

Physical attributes	Definition
Screening	Refers to how much the views of a landscape are visually obscured by elements that generate mystery like vegetative screening (trees and shading). The concept of visibility in a landscape pertains to the extent to which our perception of the surroundings is hindered by elements that create a sense of intrigue and concealment, such as the presence of dense foliage and shading.
Distance of View	The distance between the observer and the forest stand (a uniform composition of trees), mystery decreases as the distance of view increases. The observer's distance from a forest stand, which is a group of trees with a uniform composition, affects the level of mystery perceived. As the observer moves further away, the sense of mystery gradually diminishes. This phenomenon can be attributed to the increasing ability to view the forest.
Spatial Definition	Refers to how many elements of the landscape (vertical elements that define the limits of a space) surround the observer. The special definition is determined by *openness* and *enclosure*. Mystery increases as the spatial definition increases. The concept of spatial definition in the context of landscape refers to the number of vertical elements that enclose and define a particular space as observed by an individual. This can include trees, walls, buildings, or any other structures that outline the boundaries of the landscape. The degree of spatial definition is influenced by the level of openness or enclosure within the space.
Physical Accessibility	Refers to the ability of the observer at exploring landscaping and gaining information by the means of distinct and well-defined paths, and textured surfaces. Mystery increases as the physical accessibility increases. It is about the capacity of an individual to navigate through landscapes and acquire knowledge through clearly designated paths and textured surfaces. The element of intrigue intensifies as the level of physical accessibility expands. When individuals have more opportunities to explore and interact with their

	surroundings, the sense of mystery becomes more profound. The act of exploring becomes a means of uncovering hidden treasures and discovering new insights.
Radiant Forest	Concerns the case of wooded environments, as the further observed area in the woods is brightly lit in contrast to the shaded immediate foreground. In reference to the scenario involving wooded environments, an intriguing observation pertains to the contrast between the brightly illuminated further expanse within the woods and the shaded foreground that occupies an immediate vicinity. This significant difference in light distribution showcases an interesting interplay between the illuminated and shaded areas.

It is worth mentioning that the physical characteristics mentioned earlier can have a significant impact on how individuals perceive and understand space. Moreover, these attributes can be closely associated with spatial cognition, which refers to how people mentally process and navigate through physical environments.

The physical attributes, such as the screening and distance of view, are related to the level of visibility of a building and the extent to which the surrounding elements can hinder the view. These attributes play a crucial role in determining how easily the building can be seen and observed.

Spatial definition, in its broadest sense, can be defined as encompassing not only the physical dimensions and layout of a building but also the various elements and factors that contribute to defining its overall form. Also might refer to the contour of the building and the elements that contributes in defining it

Physical accessibility, as the term suggests, encompasses various aspects related to the ease of accessing a building or facility and the visibility and prominence of entrances and pathways.

Radiant forest, in the context of external lighting for buildings, are a concept that adds a charm to architectural structures. This phenomenon involves the strategic use of illumination to accentuate and draw attention to key features of the building

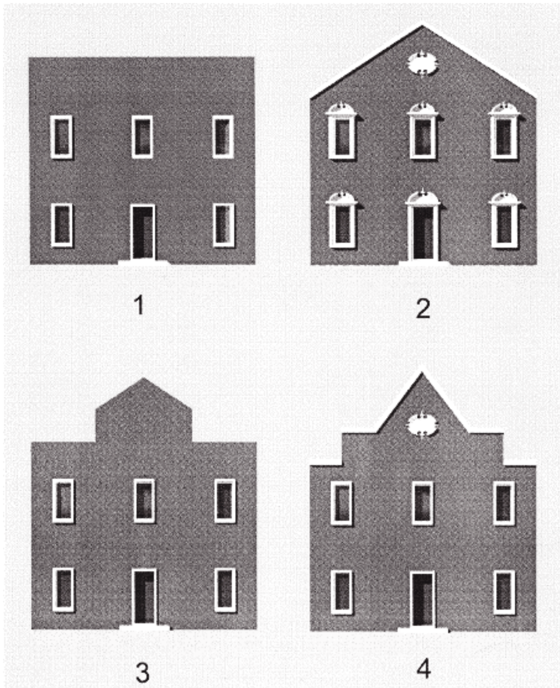
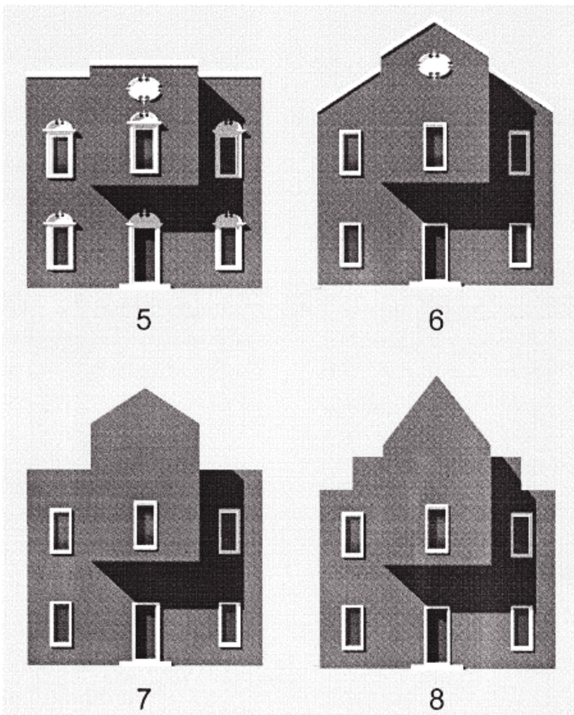
Stamps (1999) suggested three factors for the evaluation of the architectural facades:

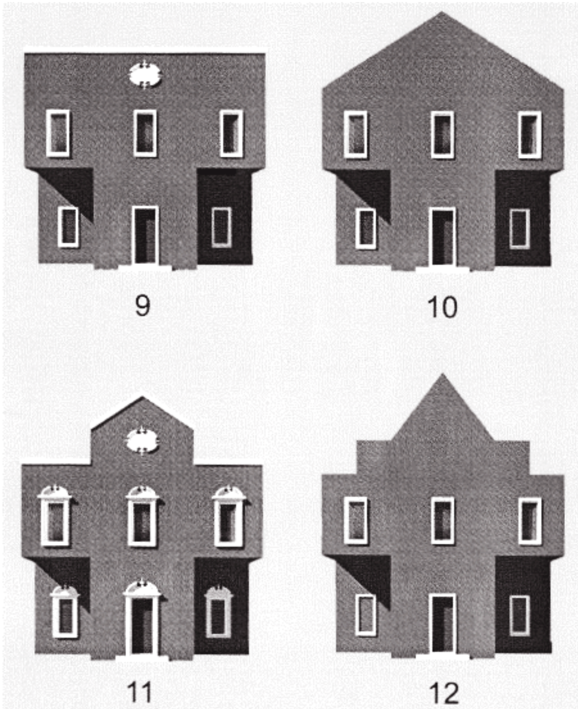
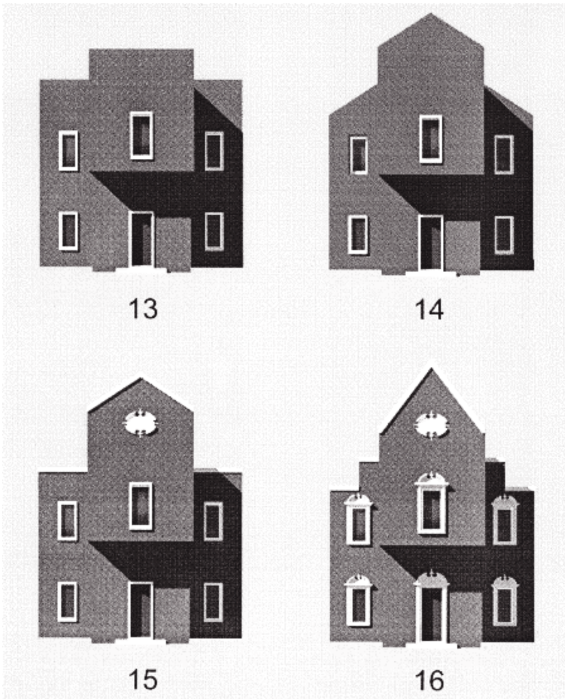
- Surface complexity: the number and complexity of elements that decorate the façade.
- Silhouette complexity: refers to how many turns there are in the shape of the building, which means the number of the lines that define the shape.

- Facade articulation; the expressivity of the façade with bays and recessed sides.

The 56 respondents in Stamps (1999) experiments (**Table 2-10**), evaluated different levels of stimuli:

Table 2-10: *Stimuli for Articulation Levels and respondents preference according to Stamps (1999)*

Level	Stimuli	Preference	Stimuli
1	1	2.00	
	2	4.87	
	3	3.00	
	4	4.17	
2	5	4.23	
	6	4.37	
	7	3.28	
	8	3.76	

3	9	2.46	
	10	3.01	
	11	3.73	
	12	2.91	
4	13	2.94	
	14	3.00	
	15	3.76	
	16	4.32	

The stimulus 2, 6, 16, 5, and 4 had the highest preference, 4.87, 4.37, 4.32, 4.23, and 4.17, respectively.

The results indicated that the preference effect for surface complexity was far superior to both the preference effects of silhouette complexity or facade articulation. Elements like doors and window trims, and a gable or a fancy gable roof increased preference by d = 1.31, and *d*= 0.90, 0.88, respectively. Therefore, adding elements to the façade enhances complexity and consequently increases preference.

Gimblett et al. (1985) in **Table 2-11**, mentioned and defined four factors that affect the environmental preference:

Table 2-11: *Factors affecting the environmental preference according to Gimblett et al. (1985)*

Factor	Definition
Coherence	The unity level of the scene (he describes as “hanging together”, via the repetition of elements that render the process of comprehension easier such as textures, and structural elements.
Complexity	The perceived diversity and variety of the scene, and the needed amount of information to keep interest high.
Mystery	The amount of information gradually gathers as the observer explores the scene.
Legibility	A legible environment seems recognizable and invite for an easy exploration without being concerned with getting lost, because its legibility as an environment makes sense.

Gimblett et al. (1985) research was based on two qualitative methods that are both related to perception:

- The determination of the level of agreement of observers in regards to their perception of mystery,
- The definition of physical attributes contributing to these perceptions.

Following the aforementioned findings, it can be inferred that the evaluation of perception plays a crucial role in the successful delivery of architectural projects that aim to achieve utmost satisfaction. Recognizing the significance of assessing perception is paramount for architects who seek to achieve most highlighted objectives.

Lowenthal and Riel (1972) in their research discovered an impressive 59 strong correlations among 10 distinct attributes out of a total of 25.

These attributes, which had a significant impact on the perception of environments, included beauty, order, freshness, smoothness, richness, vividness, pleasantness, cleanness, likability, and lighting.

Moreover, their findings revealed that observers tend to associate the quality of newness with environments characterized by elements such as freshness, order, and richness.

Groat (1988) in her research, took interest in people's evaluations of contextual relationships among buildings, in addition to aesthetic quality of the built environment. Moreover, she used a 7-point scale to define three components ***(Figure 2-8)***:

- Site organization:

Refers to interior and the exterior spatial organization and the spatial pattern imposed by the building, landscaping patterns, and circulation.

- Massing:

Refers to volumetric composition of the building (complexity of form, height and shape).

- Facade design:

Refers to the planes' surface treatment that define the building's shell, in addition to the proportion of the openings, materials and color, and ornamentation.

I. Givens: issues typically beyond the architect's control
1. Site location: ______________________________
2. Building type: ______________________________
3. Size: ______________________________

II. Design parameters: issues partially under the architect's control
4. Prominence:
minimum 1—2—3—4—5—6—7 maximum
5. Definition of context:
adjacent 1—2—3—4—5—6—7 regional

III. Design strategy: issues typically under the architect's control

Figure 2-8. *Conceptual framework by Groat (1988) for the analysis of contextual-design strategies.*

Furthermore, the study conducted by Watson et al. (2014) delved into the correlation between post-occupancy research that assesses the quality of building design and the concept of 'social value' as it has gained traction, particularly in its application to public space matters. In their investigation, Watson et al. (2014) analyzed existing research on design quality concerning buildings with a specific focus on users and their social environment. Here, the term 'social context' encompasses the dynamics among building user groups, encompassing various aspects such as organizational cultures, management methodologies, and social norms and interactions. This research underscores the interconnectedness between architectural design, user experiences, and the broader social dynamics that shape and influence the perception of built environments. The exploration of these interrelationships sheds light on the nuanced interplay between physical design attributes, user behaviors, and the social fabric within which buildings operate.

2.27.Satisfaction and dissatisfaction

In the realm of user satisfaction, there exists a middle ground that lies between contentment and discontentment, satisfaction and dissatisfaction. It is important to recognize that just because a user is not dissatisfied with the quality of a particular building, it does not necessarily mean they are satisfied either. Instead, they fall into what can be classified as the neutral zone, where their level of satisfaction remains impartial as illustrated by Giordano (2006) in **Figure 2-9**.

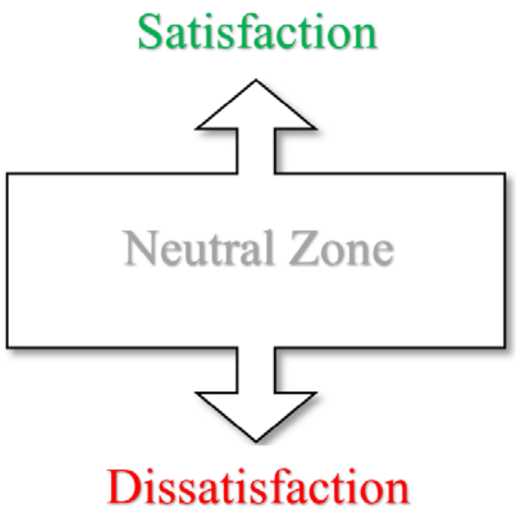


Figure 2-9. *Satisfaction and dissatisfaction, modified by author from Giordano (2006)*

According to Giordano (2006), it is crucial for new products (in this case, it is the architectural buildings) to not only meet the current needs but also anticipate future aspirations. It is essential to consider the future ambitions and hopes of the users in order to create a design that is efficient and will stand the test of time. Looking ahead and understanding the evolving desires and requirements of the users is imperative in producing a design that is forward-thinking and durable. By taking into account the future aspirations, the architectural buildings can fulfill the changing needs of the users.

2.28.Measuring loyalty

In order to fully comprehend the concept of loyalty in architecture, it is essential to explore various approaches that can be employed to measure it. Unlike the business and commerce sectors, where loyalty can be assessed through tangible indicators such as gains and profitability, the evaluation of loyalty in architecture relies on intangible data and requires a different set of assessment methods. In this study, we have chosen to utilize two methods.

Firstly, we examine the behavior of the user, including their revisit intention, the frequency of their visits to the building, and their level of emotional attachment to it. These factors provide valuable insights into the user's loyalty towards the architectural structure. By delving into these aspects, we aim to offer a comprehensive understanding of loyalty in architecture, enriching our knowledge in this field.

The second approach involves evaluating the user's satisfaction with the building from various perspectives, encompassing aesthetics, functionality, performance, and durability.

Two methods were conducted for measuring loyalty following what Aaker (1991) proposed:

2.28.1. Behavior measures

To comprehensively evaluate behavioral loyalty, one effective approach is to examine the actual intention of revisiting and the frequency of visits within the population under study.

2.28.2. Measuring satisfaction

In this particular study, one important aspect that was examined to assess user loyalty towards a building was the measurement of satisfaction and dissatisfaction. To comprehensively capture the level of user contentment, a survey questionnaire was administered as a means to measure satisfaction. This allowed for a quantitative analysis of users' perceptions and experiences. Additionally, to delve deeper into the negative aspects and identify sources of dissatisfaction, interviews were conducted with two functionaries of the culture house.

2.29.Responsibilities of the expert and the user

Both experts and users have their own approaches and interests in regards to the evaluation of quality, Giordano (2006), for example says that experts take interest in discussing:

- Features
- Specifications
- Quality
- Solutions
- Technique

On the other hand, users take interest in discussing matters related to:

- Benefits
- Services
- Needs
- Problems
- Dissatisfaction (or satisfaction)

Despite the advancements in society, the responsibility of construction fell upon user, albeit with the guidance and support of an advisor or a skilled artisan (the architect). This collaborative approach aimed to enhance the quality of housing produced by the user. Over time, as society evolved, this practice persisted, wherein users sought the expertise and assistance of these knowledgeable professionals to ensure the construction process was executed effectively and efficiently (Adad, 2004) (**Figure 2-10**).

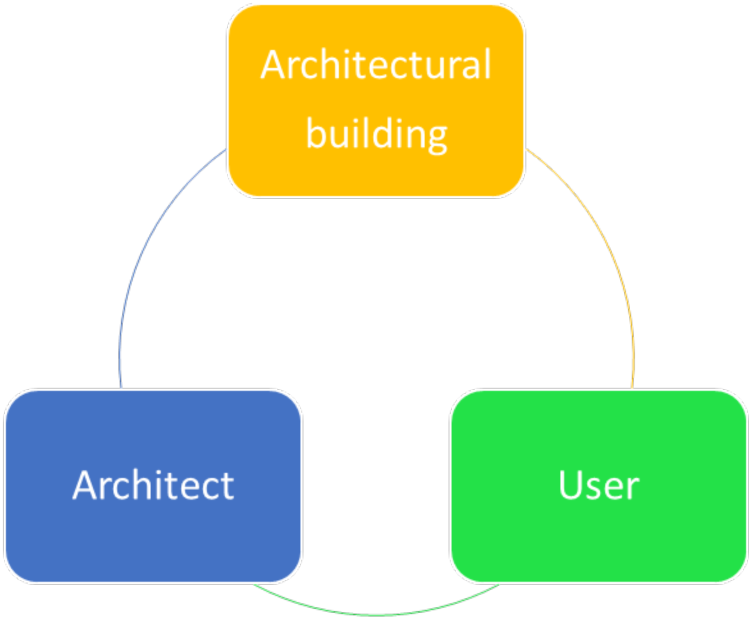


Figure 2-10. *In traditional production, the relationship between architect and user is very strong and friendly (Adad, 2004, modified by author).*

2.30.Important points that need to be considered by the architect

Based on remarks made by Giordano (2006) concerning the perceived quality, the architect needs to take account of certain points related to the building considered for design:

- Perceived quality helps increasing the building's visit frequency and the quality of services, because it expresses itself.
- Conducting a diagnostic/evaluation of the building is essential to determine its quality.

- Assuring that the building fulfills the promise made, that its appearance is adequate to is symbolic value and spatial quality.
- Offering functional features that are expressed by a strong and meaningful design.
- Providing the necessary demands according the immediate environment and the probable evolutions that may occur in the future.
- Taking great care of each detail of building through the process of its design.

2.31.The user's different needs

Giordano (2006) says that human beings need to satisfy three fundamental needs:

- Material
- Relational (social ties)
- Spiritual (symbolic)

Giordano (2006), additionally, notes that the work of the psychologist Abraham Maslow leads to establishing the personality theory that classifies the needs of human beings whether they are physical, spiritual, or psychological **Figure 2-11**.

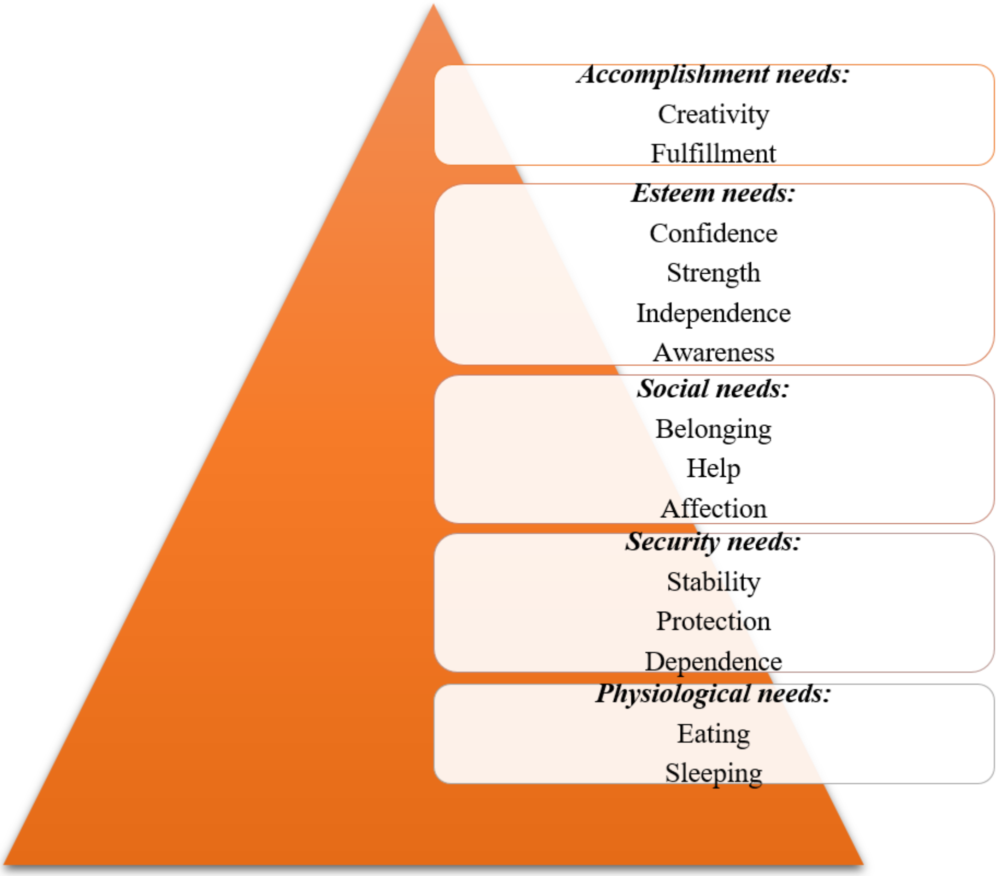


Figure 2-11. *Maslow's hierarchy of needs as mentioned by Giordano (2006), modified by author.*

To thoroughly assess the user's reaction to the structure and subsequently enhance its architectural excellence, it is imperative to possess empirical data (Canter &Wools, 1970). These factual and observable pieces of information play a vital role in evaluating the architectural quality.

According to Canter and Wools (1970), a recommended approach for understanding user behavior and comprehending their feelings and thoughts towards various aspects of a building is through direct inquiry. The use of verbal measures, such as questionnaires, is considered a convenient and straightforward method for conducting architectural evaluations.

However, it is crucial to ensure that complex concepts are communicated with accuracy and simplicity to minimize any potential biases or confusion. Additionally, conducting consistency and reliability tests is essential to validate the credibility of the obtained results. This comprehensive approach allows for enriching the evaluation process and gaining valuable insights into user perceptions.

2.32.Responding to social tendencies

The architectural structures must possess the requisite perceived quality in order to effectively address the evolving social needs and preferences of the users. It is crucial that these buildings are capable of adapting to the changing societal trends and accommodating to current demands and tendencies. In this context Giordano (2006), cites some points regarding the subject:

- Perceived quality gives the user the possibility of personalization.
- It responds to the needs related to *image* and *information transfer speed* through the received signs from first contact.
- It offers a seductive product (the term product refers to the building) that provides the user with the pleasure that he wishes for.
- It gives sense and significance to the product through signs, symbols and images allowing it additionally to express its function.
- It generates confidence and reassurance.

2.33.Conclusion

Henceforth, the elucidation of perceived architectural quality as per prior research shall encompass the comprehensive assessment of the architectural excellence of a building, taking into account the user's discernment and perspectives that articulate their requirements and desires. This notion is multifaceted (multidimensional), situational (contingent upon the situation), and susceptible to the influence of an individual's experiences, knowledge, and personal inclinations. In order to enrich our understanding, it is imperative to delve deep into the various dimensions that contribute to the overall assessment, such as aesthetics, functionality, sustainability, and cultural relevance.

Nasar (1989) emphasized a crucial matter that often goes overlooked by professionals and experts. They tend to disregard subjective factors, deeming them "unquantifiable." However, it is important to recognize that the user's satisfaction is inherently tied to these subjective elements. Therefore, the individual's sensitive decisions, whether they are the users themselves or anyone involved in the project, play a vital role in the pursuit of excellence in architectural design. By examining the user's perspective and considering their opinions and preferences, architects can create projects that are compatible with present demands.

According to Yazdanfar et al. (2015), it is crucial for designers to effectively communicate with users in a manner that is easily understandable and perceptible. This requires both the designer and the user to possess the necessary tools and understanding to decode the environmental cues and signals.

CHAPTER III: FORM AND DESIGN IN RELATION TO PERCEPTION, CONCEPTS AND PRINCIPALS

3.1. Introduction

The significance of form and design in multiple domains, such as architecture, cannot be underestimated.

Considerations such as the arrangement of elements, the visual structure, and the consistent patterns employed all contribute substantially to the overall user experience. This approach ensures that the design not only meets aesthetic requirements but also optimizes functionality and usability. Referring to form design best practices, it is essential to highlight the importance of simplicity, straightforwardness, and the incorporation of visual elements to enhance the intuitiveness of the user experience.

In relation to design, the interaction between form and function holds dominant importance, for they are interdependent constituents that cannot be disentangled. The relationship between form and function is all-encompassing, as it touches upon various aspects of design.

It is crucial to acknowledge that although certain professionals may place a greater emphasis on a specific element, the harmonious integration of form and function remains indispensable throughout the entire design process.

3.2. Approaches of perception of form

The visual form realm demonstrates multiple complexities and has many ways of describing it such as the shape of a solid object, the values of coordinates in objectless space, and other philosophical definitions.

According to Zusne (1970), there is no precise definition for form and there are many assumptions concerning it. It can be:

- The physical quality of a three-dimensional object.
- The objects projection on a two-dimensional surface.
- A two-dimensional pictorial representation.
- Contours represented nonrepresentational way (abstract) in a plane.
- The coordinates values in Euclidean space.

Zusne (1970), Bingham (1914), Bartley (1958), and Alluisi (1960) gave distinctive designations for form and shape (**Table 3-1**).

Table 3-1: *Distinctive designations for form and shape*

Author	Form	Shape
Bingham (1914)	The physical contour of an object.	How the object looks when rotated.
Bartley (1958)	Refers to the visual target.	Refers to its perception (how this visual target is perceived).
Alluisi (1960)	Response dimension.	Stimulus dimension.

On the other hand, it is worth noting that other psychologists designate the same meaning for both form and shape.

Zusne (1970) stated that the term “pattern” has two connotations:

- A configuration consisting of multiple elements (points, lines, and adequate small shapes).
- A single or closed contour.

Ancient Greek and Roman architects held a significant interest in the visual form and its perception. However, it is important to note that neither of these architectural traditions fully addressed the intricacies of perceiving visual form. Their focus primarily revolved around the physical appearance and overall aesthetic qualities of their structures (Zusne, 1970).

The perception of the visual form depends on the perception of the space. According to Zusne (1970), James (1890) states that there are three theories that concerns the space:

- Sensations have no spatial quality, with space being a symbol of succession.
- An extensive quality is produced in certain sensations.
- Space is inborn, intuitive that impose on sensations from within.

Perceptions, being more intricate than mere sensations, encompass a multifaceted process that is comprised of various sensory elements. In fact, perceptions are made of elements of sensation (Zusne, 1970).

3.2.1. Form quality school

Christian Von Ehrenfels based on Mach's systemized concepts presented in the concept of form quality in 1890, any change in direction, temperature or relations is considered to be a form quality; a square for example is more than the sum of its elements, it is perceived as new element composed of a certain relationship of four lines (Zusne, 1970).

According to Zusne (1970), both Meinong and Cornelius and Schumann gave their opinions in regards to the subject of form quality. Meinong (1891, 1899) (Alexis Meinong the leader of Austrian school at the University of Graz) gave a philosophical explanation to how the combination of the sensory elements makes the unitary whole when introduced the idea of "*higher psychic power*".

Also, Cornelius (1892, 1893) (Johannes Wilhelm Cornelius, a German philosopher and psychologist) proposed his opinion and said that form is not a founded content but a founded attribute, however the latter could be destroyed when experienced as a whole if one paid attention to the parts, while Schumann (Friedrich Schumann, German psychologist) arrived to the following findings:

- Figures that are incomplete have tendency to be perceived as complete.
- Components that are near to each other form a group of components which perceived as a whole.
- Vertical symmetry prefers perceptual connectedness.
- Ambiguous figures tend to be perceived as good figures.

3.2.2. Gestalt psychology school

Zusne (1970), states that Max Wertheimer is the one from whom originated the gestalt school and was considered to be the brain behind it while wolfgang kohler was the *front man* of the school.

After the gestalt school, J.J Gibson (James Jerome Gibson, an American psychologist) asked the question "*what is form?*"

3.2.3. Contemporary Psycho-physical approach of form

According to Zusne (1970), Shannon (1948) in the communication field and in the cybernetics field Wiener (1948) entered the scene through the formulation of the theory of information which was applied on psychological problems.

Miller and Frick (1949) supported the adaptation of information theory psychology and proposed some concepts such as the quantifiability of patterning and organization for form is composed of elements that are organized in a certain way Zusne (1970), also highlighted the importance of the work of Attneave, F and Arnoult, M. D. (1956) entitled "*The quantitative study of shape and pattern perception*" that proposed the following points:

- The contour of the two-dimensional shape contains the information especially at any point of change in the contour (vertices, corners, curves).
- The segmentation of a straight line permits the approximation of the vertices of a curved shape.

Gestalt psychologist stated that *good figures* are better remembered than *poor figures* because good figures are attributed with organization, and repetition, therefore, they have less independent information (Zusne, 1970).

Zusne (1970) noted that Helson and Fehrer (1932) arrived to the following definitions in regards to the Gestalt theory:

- The form of the apprehended whole. (Concerns the visual form)
- The existence of certain factors within the group dominating the whole.
- The totality of conditions determines perception, memory and behavior.
- Physical structures. (Concern the visual form)
- Physiological structures. (Concern the visual form)
- Biological structures.
- Logical structures.
- Psychological structures. (Concern the visual form)
- Purpose
- The necessity and sufficiency of conditions.

Zusne (1970) also adds that the definitions that concerns the visual form refers to:

a) The object's visibility of the form in general.

b) The physical parameters that relate to the visual form.

c) The neurophysiological equivalent (counterpart) of the form in the brain.

d) The form and how it is structured or restructured, which results from the activity of the brain.

Kohler established the relationship between physical and psychological systems, as indicated in the principle if isomorphism that states the following: "*the dynamic events that occur in a physical configuration, such as a physical form, are paralleled by the dynamic events of the brain and in perception*" (Zusne, 1970: p.109). This principle here indicates the parallel interaction between the occurring events of a physical form that can be represented by the architectural building and the counterpart processes in the perception of the observer.

Zusne (1970) noted that under certain conditions *good* form could become *better:*

- Short exposure time.
- Low intensity.
- Small size, in the representation of the form from memory.

Accordingly:

- Irregular forms will be perceived as regular.
- Complex forms will be perceived as simple.
- Asymmetric forms will be perceived as symmetric.
- Interrupted contours will be perceived as continuous.
- Irregular forms will be perceived as regular.
- Random patterns will be perceived as organized.
- Grouped elements will be perceived as a larger whole.

In the realm of visual representation, the amalgamation of simple forms has the potential to give rise to intricate and multifaceted structures. Notably, any alterations or modifications that take place within one aspect of the form intricately intertwine with the other interconnected elements.

Visual forms that incorporate after effects are more conducive to memory retention compared to entities lacking a defined structure.

Attention has the potential to affect the arrangement and layout of the visual field within an organization (Zusne, 1970).

3.2.4. Form according to Hebb's neurophysiological theory

Hebb's in regards to Gestalts theory stating that form is perceived as whole or a unit without learning or recognition, he counters this argument by saying that forms that are considered elementary and simple are actually complex such as squares and triangles and their apparent simplicity is the result of a long process of learning, recognition and identification, also, perceived patterns are reconstructed later according to previous experience (Zusne, 1970). Therefore, learning and experience are essential factors in the perception of the visual form.

The perceived structure of an object is constituted of two distinctive components (Hochberg, 1968 as cited by Zusne, 1970):

- The features observed in momentary glances.
- The schematic map (the storage structure affected by previous experience) the fit those features.

3.2.5. Perception of visual form according to J.J Gibson's theory

According to Gibson (1956b as cited by Zusne, 1970) says that the visual space is the space perceived and the elements and objects it contains within staring from primary elements such as edges and surfaces, in addition to this, he thinks that complex and simple visual perceptions possess a stimulus counterpart in the physical world, a visual surface for example has distinctive properties like:

- Color.
- Degree of brightness.
- Degree of slant.
- A certain distance from the observer.
- A closed contour.
- A contour characterized by a certain shape.
- A certain size.

Zusne (1970) says that form is never experienced in two dimensions, hence, it is an attribute of three-dimensional objects and as a result, the form is a *form in depth.*

That is probably because two-dimensional forms do not offer the full information for the observer, therefore, he need to experience the object in its three-dimensional aspect to gather the maximum amount possible of information.

According to Zusne (1970), Gibson (1951) proposed many definitions for the term form, and he grouped them into three classes (**Table 3-2**).

Table 3-2: *The three classes of ten kinds of form according to Gibson (1951)*

Class	Designation	Kind
1	*The real kind*, that belongs to the three-dimensional visual world.	• Solid form • Surface form
2	*The pictorial form*, characterized by abstraction and unreality.	• Outline form • Pictorial form • Plan form • Perspective form • Nonsense form
3	*The ghost,* characterized by pure mathematical abstraction.	• Plane geometric form • Solid geometric form • Projected form

Moreover, each kind had its proper definition (**Table 3-3**).

Table 3-3: *The 10 kinds of form and definitions according to Gibson (1951)*

Term	Definition
Solid form	Refers to the physical surface constituting the interface between a mass of substance and another. Seeing a solid form means seeing a form in depth.
Surface form	Objects are surrounded by surfaces with edges. Surface forms are characterized by slant (inclination or slope) that means that they exist in a certain spatial orientation.
Outline form	Refers to paint, and pencil representations and by extension the representation on the surface edges of a solid form in other words "*outline forms*". Edges of a surface are one dimensional without thickness.
Pictorial form	Refers to objects' representations on a surface such as: drawings, photographs, paintings, and projections characterized by color, texture and perspective.
Plan form	Plan form refers to edges plan projection on a surface form, it is obtained through the object's geometrical and perpendicular projection on a flat surface.
Perspective form	As the term indicates it refers to the object's perspective view where edges and surfaces are demonstrated in perspective form.
Nonsense form	Refers to the tracings of an object which are not considered as a representation of the recognizable object because the nonsense form is not intended to truly represent the object or it didn't succeed in doing that.

Plane geometric form	Refers to abstract geometric form like squares, circles, and triangles. A Plane geometric form can be represented mathematically by an equation
Solid geometric form	Like the plane geometric form, it refers to the abstract portion of a three-dimensional space that is enclosed by imaginary surfaces. Solid geometric form can bot be actually seen however they can be imagines
Projected form	Refers to the plane geometric form that corresponds with another plane, point to point. Transformations can occur on this projection; it can get bigger or smaller.

3.2.6. Form according to Le Corbusier

The modern movement generated new perspectives in regards to forms via the use of materials like steel, concrete and glass, it was an expression of both utopian sentiments and polemical attitudes, in addition to shared qualities of individual buildings which were the result of diverse styles of different artists where searching for what lies behind the form leads to understanding its meaning, Le Corbusier was an example of an artist and an architect who had a vast imagination, a vision of the ideal city, and strong sentiments for classical tradition (Curtis, 1987) (**Figure 3-1**).

Figure 3-1. *Le Corbusier (Charles-Édouard Jeanneret), 1920, Still Life, oil on canvas, 80.9 x 99.7 cm. (Source: Museum of Modern Art, New York, 2023 https://www.moma.org/collection/works/79312?artist_id=3426&page=1&sov_referrer=artist)*

Curtis (1987) stated that, Le Corbusier has simplified the geometrical shapes of the bottle and the guitar with crisp and distinctive outlines and colors, he introduced visual tension through the use of spatial ambiguities following the regularized cubist principle (the cubic principles is based on merging different views of a certain object), for example the bottle top is represented by a pure simple circle that signifies *the heroic qualities* of simplicity.

Le Corbusier give emphasis to tradition and highlighted its role as an example from which lessons could be taken to make contemporary transformations (Curtis, 1987).

3.2.7. Modern movement and new ideas

The modern movement in architecture has led to the emergence of artistic creations by individual artists, each with their own distinct ideologies and buildings that showcase their unique styles. This movement exhibits a remarkable range of regional diversity and encompasses a wide spectrum of architectural quality.

Curtis, (1987) asked important inquiries in regards to the adaptation of new ideas:

- Whether to fully accept modern design ideas and get rid of old ones.
- Whether to make a fusion between the best old and new ideas.

In the same vein, the second point appears to be more reasonable and appropriate, owing to its flexibility in various cultural, social, and geographical settings. Moreover, it has the ability to empower the local identity of individual regions by offering them novel and revitalizing outlooks. This adaptability to diverse contexts not only enhances its logical consistency but also contributes significantly to the enrichment of local cultures and identities.

According to Le Corbusier (1986), modern buildings present challenges that require geometric solutions. This implies that the complexities of contemporary structures demand alternative problem-solving approaches.

3.3. Form

Ching (2015) provides an expansive definition of the term "form." According to Ching, form encompasses multiple meanings, including being a recognized external appearance and serving as an indicator of an object's manifestation under specific conditions. In the realm of design, form refers to the deliberate arrangement and organization of elements within a composition to create a coherent and visually engaging image. This comprehensive exploration of form highlights its multifaceted nature and emphasizes the importance of thoughtful arrangement in the creative process. He refers to the aspects and the visual properties that govern the form:

3.3.1. ***Shape***:

An aspect that represents the outline or the surface of the form and render it identifiable and categorizable.

3.3.2. ***Size***:

It represents the form's three dimensions that determines its proportions: length, width, and depth. On the other hand, the scale of form is the result of comparing its size to other forms in its surrounding.

3.3.3. ***Color***:

It is the visual attributes that help distinguishing a form from its environment, it is also a phenomenon governed by both light and the visual perception of an individual, and it is characterized with hue, saturation, and tone.

3.3.4. ***Texture***:

The visual and tactile quality of a surface perceived by the size, shape and arrangement of its composing parts. The reflection or absorption of light is determined by the nature of texture itself (and its surface).

3.3.5. ***Position***:

Every form has its proper location in relation to the environment that it makes a part of.

3.3.6. ***Orientation***:

A propriety that represents the direction of the form in relation to a point of reference (another form, the ground plane, or the perspective of the viewer).

3.3.7. ***Visual Inertia***:

It refers to the level of stability and concentration of a form, and that depends on its geometry, orientation (in relation to the ground) and the line of sight of the observer.

3.4. Regular forms and irregular forms

In the field of architecture, it is not uncommon to find regular forms that incorporate irregular elements and vice versa. This interplay between regularity and irregularity can be observed in various architectural structures. For instance, let's consider the Mosque of Sultan Hasan in Cairo, Egypt, which was built between 1356 and 1363. While the overall form of the mosque may appear irregular, upon closer examination, one would find that the planning within the mosque follows a regular pattern (as depicted in **Figure 3-2**. Another example highlighting this juxtaposition of regular and irregular forms is the Courtyard House Project conceived by the renowned German-American architect Ludwig Mies van der Rohe (**Figure 3-3**) (Ching, 2015).

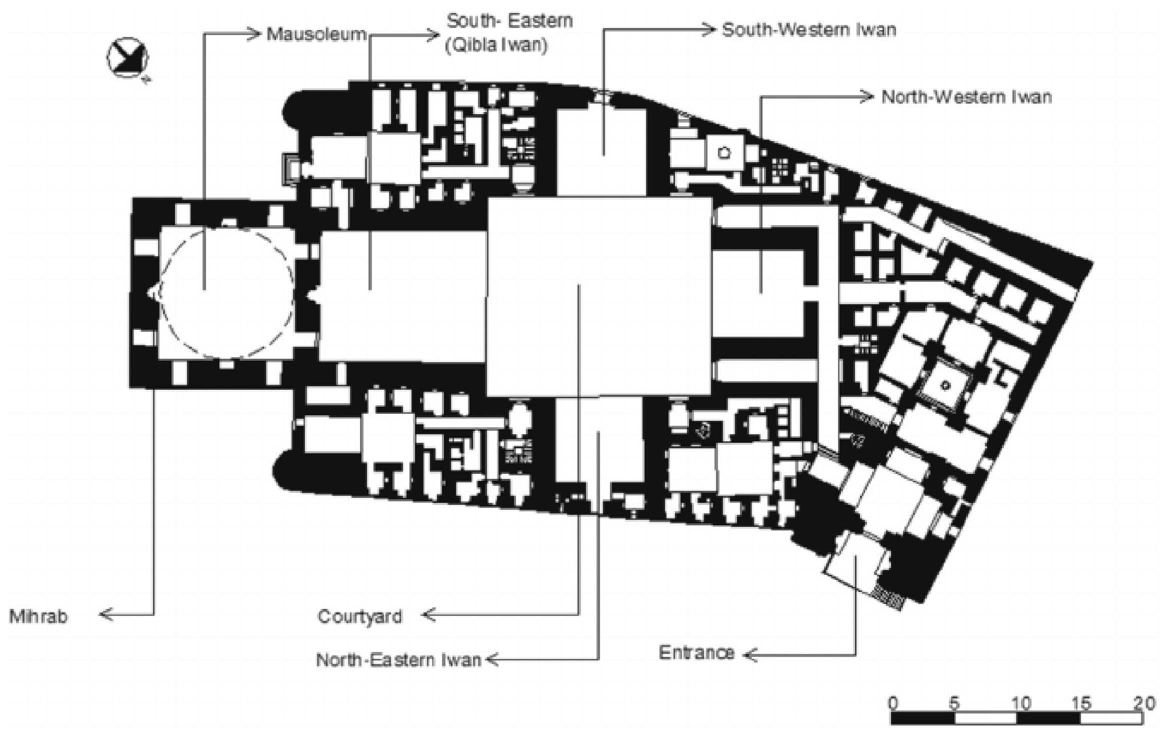


Figure 3-2. *Mosque of Sultan Hasan, Cairo, Egypt (Malhis, 2016)*

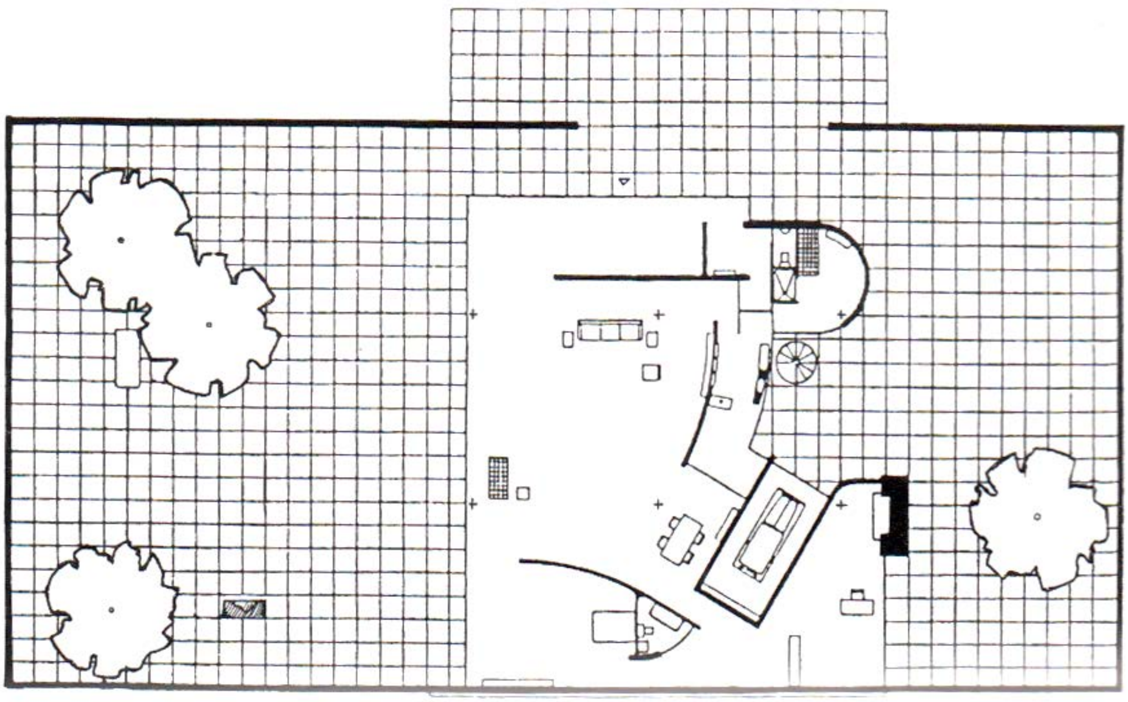


Figure 3-3. *Courtyard House Project by Ludwig Mies van der Rohe*
(*Source: Ludwig-Mies-van-Der-rohe-court-house-project-1934.jpg*. Are.na. (n.d.). Retrieved April 12, 2023, from https://www.are.na/block/1054652***)***

3.5. Gestalt quality principles and perception

A building can be considered to possess a commendable Gestalt quality when it displays a well-organized structure with a distinct outline and is distinguished by a harmonious composition of elements that mutually enhance one another, resulting in a heightened visual appeal. The arrangement of these elements is thoughtfully designed to achieve a sense of visual gratification.

According to the Gestaltists, who adhere to the principles of Gestalt theory, perception can be understood as a comprehensive and holistic understanding of reality. It involves the recognition and organization of forms, which are perceived as unified and whole structures governed by specific principles and laws (Giordano, 2006). The Gestaltists emphasize that perception goes beyond simply perceiving individual elements and instead focuses on the perception of the entire configuration or pattern.

In the 1920s, a group of German psychologists, namely Max Wertheimer, Kurt Koffka, and Wolfgang Kohler, put forth a collection of principles known as the "Gestalt Principles" to explain and comprehend human perceptions and the associated meanings. The term "Gestalt" has multiple interpretations in the German language, and it encompasses the concept of an organized or cohesive form, shape, composition, or structure that is perceived to be more than just the mere combination of its individual components, according to the Oxford dictionary. These principles, which encompass the notions of unity and organization, serve as a framework for understanding how humans perceive and interpret various stimuli.

These principles play a crucial role in elucidating the mechanisms by which the observer comprehends intricate visuals and simplifies them by identifying and categorizing comparable elements and objects. The perceiver's ability to interpret complex images relies on recognizing and grouping analogous elements and objects.

Architects can employ these principles not only to gauge the perceptions of their clients but also to enhance the visual appeal and allure of a building. By strategically arranging the architectural elements, they can create a sense of clarity, orderliness, and optimal configuration, ultimately achieving what is referred to as a "*good gestalt quality*." This comprehensive approach allows architects to delve into the clients' perspectives, gain a deeper understanding of their preferences, and effectively translate them into tangible design elements. Moreover, it empowers architects to elevate the overall aesthetic quality of the building.

These principles will be carefully examined and explained through an architectural lens, taking into account the building itself and the various elements that serve as stimuli.

3.5.1. Figure-ground articulation

In accordance with the principle of human perception, objects are categorized as either belonging to the foreground or the background. This means that objects that possess unique and distinguishable characteristics will be prominently highlighted in the foreground, while objects that are uninteresting, plain, or large in size will be relegated to the background. This principal sheds light on how our minds prioritize and perceive different elements within a visual composition.

In an architectural context, when observing the exterior of a building, such as its façade, the viewer's attention is drawn to a variety of visual elements. These include decorative features, intricate patterns, and the presence of windows, all of which occupy the foreground of the viewer while the large wall will be in the background (**Figure 3-4**).

Details in the building can be perceived as foreground because of their distinguishability as figures as stated by Chan (1998). According to Ching (2015), an important aspect of human perception involves classifying positive elements as figures and placing them in the foreground. Conversely, negative elements are often categorized as the background to these figures. It is crucial to note that this interpretation is dependent on the interaction between positive and negative elements. This perspective emphasizes the relative nature of how we perceive and make sense of our surroundings.

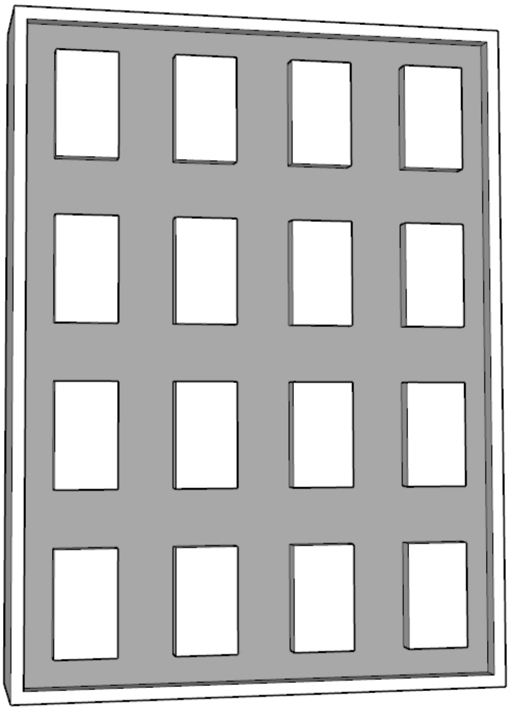


Figure 3-4. *The salient windows are in the foreground where the grey wall is the background (Source: Author).*

3.5.2. Proximity principle

The principle of proximity (**Figure 3-5**) revolves around the perception of elements as a cohesive unit, determined by their proximity and spatial arrangement (how close they are to each other). This principle serves to highlight the connection between these elements while also indicating a sense of separation through distance. To illustrate this, let's consider a building façade adorned with various decorative elements. When these elements are close in proximity, the observer tends to establish a stronger relationship and association between them. The closer they are, the more pronounced and interconnected their relationship appears to be (**Figure 3-6**).

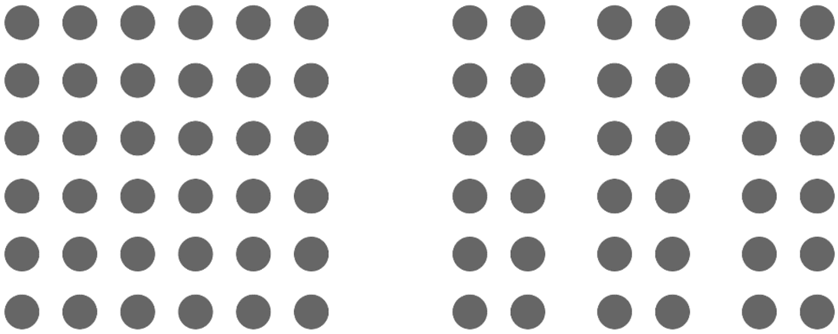


Figure 3-5. *Proximity principle (Source: https://assets.toptal.io/images?url=https%3A%2F%2Fuploads.toptal.io%2Fblog%2Fimage%2F125751%2Ftoptal-blog-image-1522045543251-5aab914f146872587eaadc733b640512.png).*

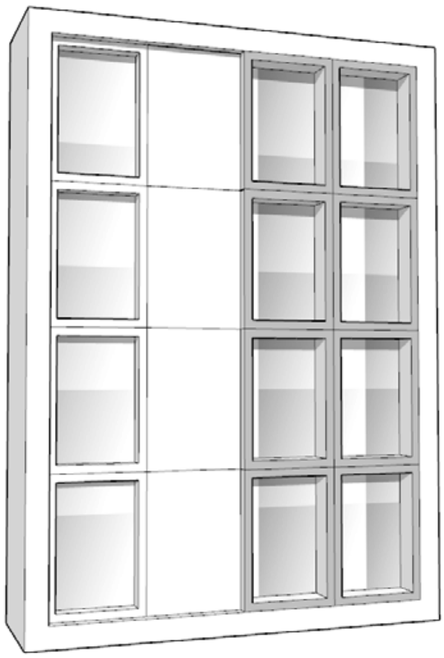


Figure 3-6. *The adjacent windows give impression that they have similar function (Source: Author).*

3.5.3. Common fate / Common region principle

Objects that are moving in the same direction tend to be perceived as a cohesive group (**Figure 3-7**). This concept is commonly applied in architecture, where the common region principle is favored. According to this principle, objects that are enclosed within a specific region or boundary are perceived as a group with similar characteristics and functions. For example, if an architect divides the façade of a building into three distinct parts, the observer will naturally categorize the prominent elements within each part as belonging to separate groups, characterized by their shared attributes. Consequently, all the elements within the façade can be classified into three distinct groups based on their respective regions. This principle not only helps to organize and comprehend the various elements of the building's façade but also facilitates a more comprehensive analysis and understanding of its design (**Figure 3-8**).

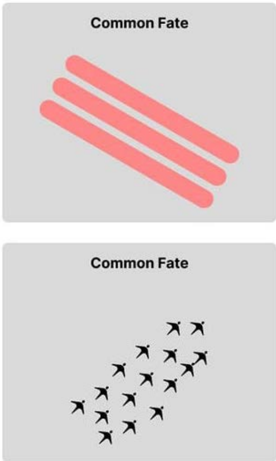


Figure ***3-7.*** *Common fate / Common region principle*
*(Source: https://miro.medium.com/ v2/resize:fit:720/format:webp/1*yLGaZ6Ez2UMtoesPzSTBGQ.jpeg).*

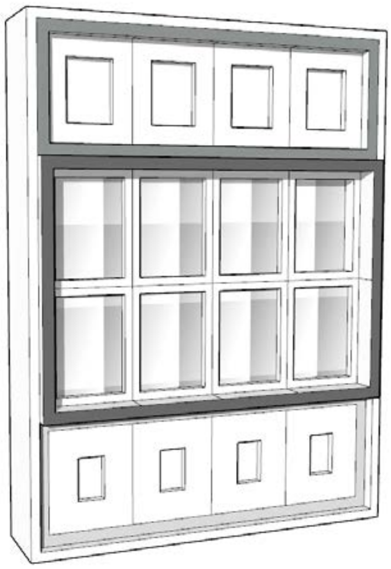


Figure ***3-8.*** *The grouped windows seem to share comparable traits (Source: Author).*

3.5.4. Similarity principle

The similarity principle (**Figure 3-9**) pertains to the way in which human perception utilizes the capacity to organize and group elements with similar attributes, such as shape, color, size, and orientation. This principle suggests that elements that share more characteristics tend to be grouped together, resulting in a more discerning grouping process. By applying this principle, individuals are able to visually organize and make sense of the surrounding environment, and identifying patterns and relationships.

When the recipient observes a building adorned with windows of diverse shapes and sizes, they naturally tend to categorize them based on their similarities. This process entails grouping together those windows that share common characteristics, while attributing unique functions to each distinct group. By adding a prominent element to a group of similar components, the architect intentionally introduces a touch of dissimilarity and distinctiveness. This artistic technique serves the purpose of emphasizing the significance and importance of a particular architectural element, thereby enhancing the overall visual appeal and conceptual depth of the structure (**Figure 3-10**).

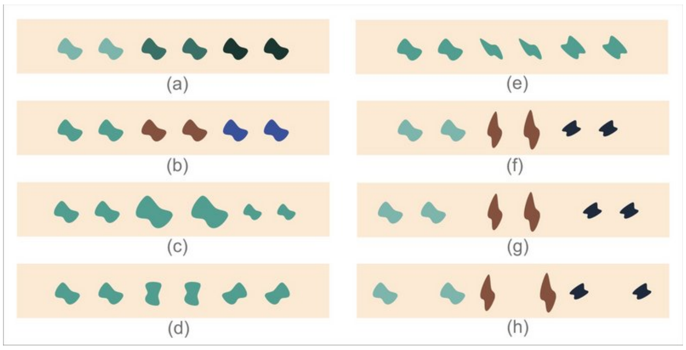


Figure 3-9. *Similarity principle (Source: Author).*

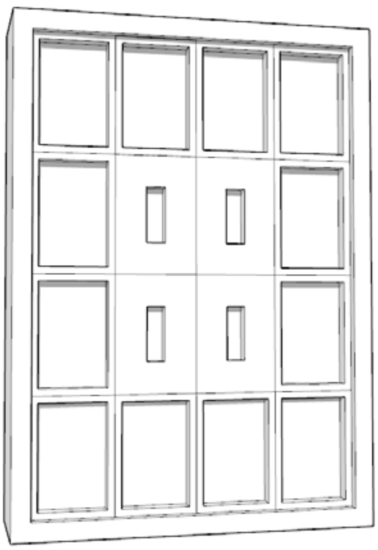


Figure 3-10. *Similar windows are grouped together (Source: Author).*

3.5.5. Continuity principle

The principle of continuity is a fundamental concept that clarifies the interconnectedness of elements arranged in a linear or curved fashion (**Figure 3-11**). It finds application in architecture, where it guides the design of various building elements and patterns. By employing continuity, architects strive to establish coherence, rhythm, and specific relationships within the overall structure. Additionally, continuity helps in seamlessly integrating the building into its surroundings, allowing it to harmonize with the environment as a whole (**Figure 3-12**).

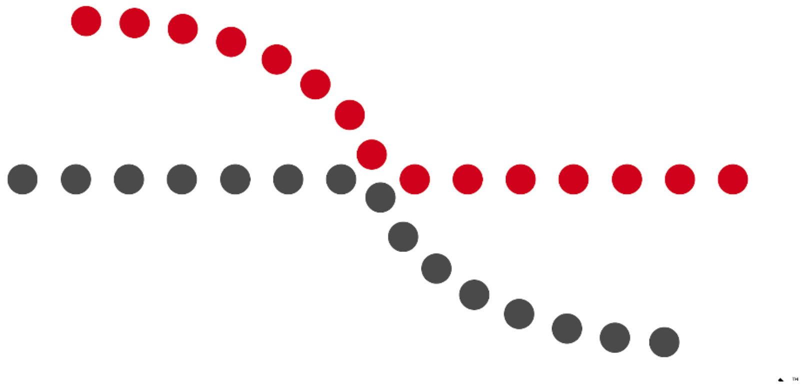


Figure 3-11. *Continuity principle (Source: https://assets.toptal.io/images?url=https%3A%2F%2Fuploads.toptal.io%2Fblog%2Fimage%2F125749%2Ftoptal-blog-image-1522045527423-29ef6bc680c8c526755e30e417215ad4.png).*

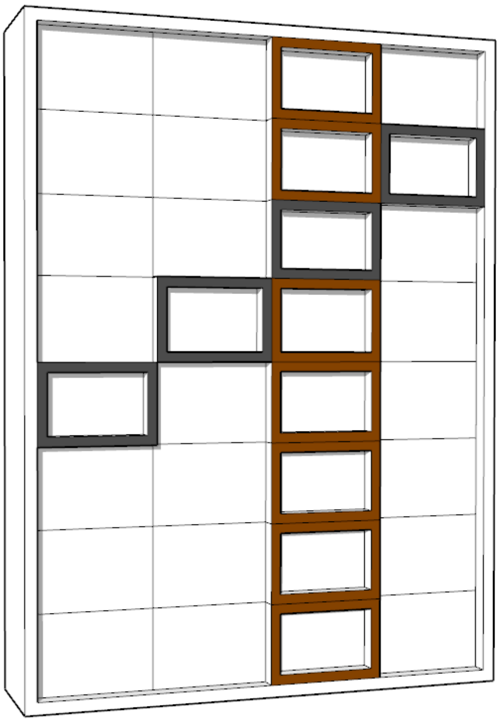


Figure 3-12. *The continuity of the windows gives a sense of relation (Source: Author).*

3.5.6. Uniform Connectedness

This principle refers to the perception of connected elements as a single entity by the human mind (**Figure 3-13**). By connecting certain elements together, a designer has the ability to convey a powerful message to the viewer, indicating specific relationships between these elements. In other words, when elements are physically or visually linked, they are seen as a cohesive unit, influencing how they are interpreted and understood (**Figure 3-14**).

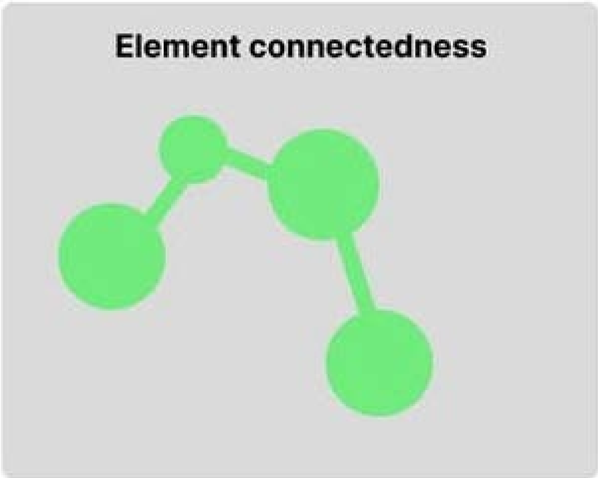


Figure *3-13.* *Uniform connectedness (Source: https://miro.medium.com/ v2/resize:fit:720/format:webp/1*yLGaZ6Ez2UMtoesPzSTBGQ.jpeg).*

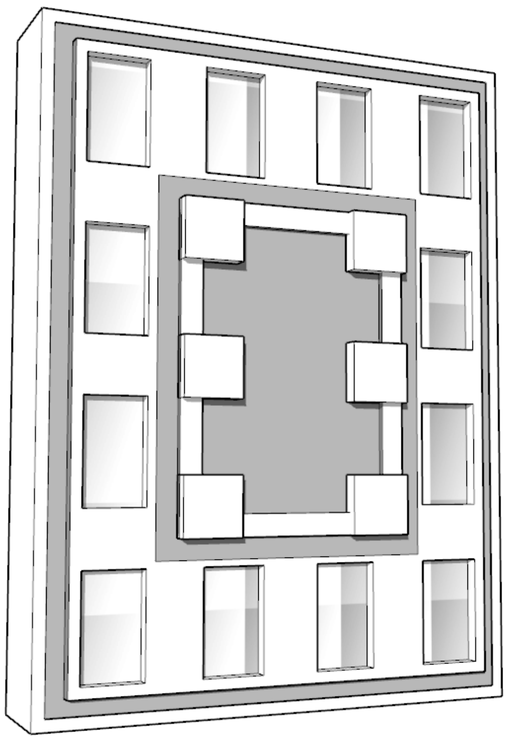


Figure 3-14. *The connected central elements form a specific relation (Source: Author).*

3.5.7. Closure principle

The concept of closure (**Figure 3-15**) pertains to the remarkable capability of the human brain to construct coherent visual representations and assign them a distinct visual identity, relying on the arrangement and organization of perceived elements, regardless of their simplicity or intricacy. In the context of architecture, this principle empowers architects to create or symbolize an image on the exterior of a structure through the harmonious collaboration of various architectural elements. By harnessing the power of closure, architects can design visually captivating buildings that evoke a sense of wholeness and unity, engaging the observer's perceptual faculties and inviting them to discern and appreciate the underlying artistic intention (**Figure 3-16**).

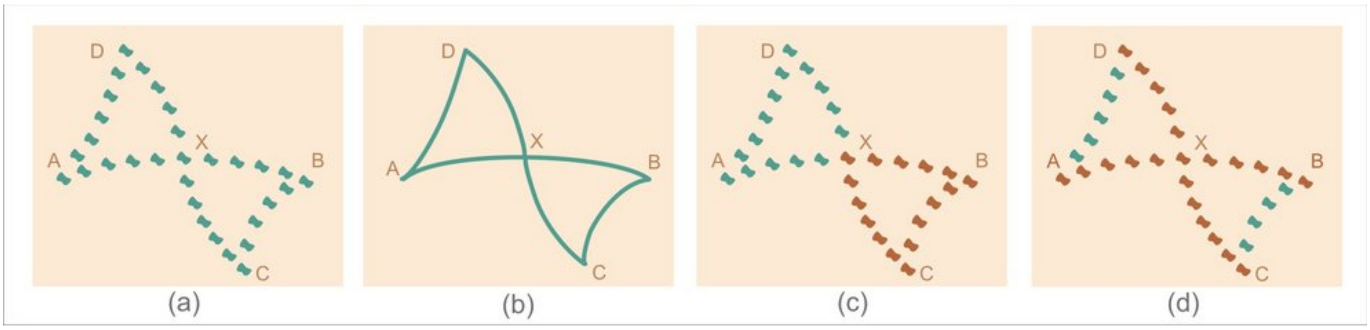


Figure 3-15. *Closure principle (Source: http://www.scholarpedia.org/article/File:Todorovic-Gestalt_principles-Figure_5.jpg).*

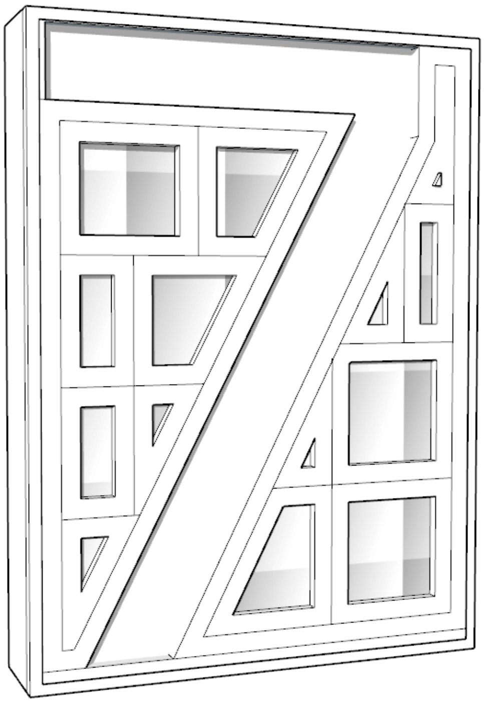


Figure 3-16. *The arrangement of the windows gives perception of number seven (Source: Author).*

3.5.8. Principle of Focal Point

The concept of the focal point principle (**Figure 3-17**) suggests that a prominent and a salient element, distinct from its surroundings, has the ability to attract attention. This principle emphasizes the importance of creating a visual element that stands out and catch attention.

In architecture, contrast plays a crucial role in adding uniqueness and generating intrigue. By incorporating elements that deviate from the norm, it captures the viewer's attention and compels them to ponder its significance. This contrast sparks questions in the observer's mind, such as the reason behind its distinctiveness and how it differs from other architectural elements. Thus, it stimulates curiosity and encourages a deeper exploration of its purpose and intention (**Figure 3-18**).

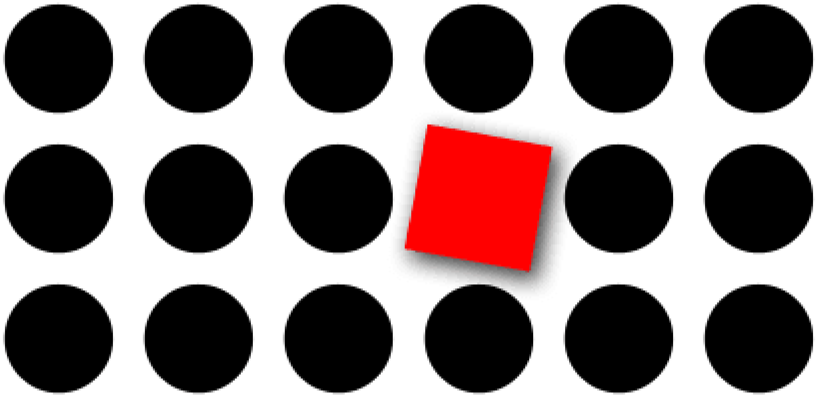


Figure 3-17. *Principle of Focal Point (Source: https://www.usertesting.com/sites/default/files/inline-images/focal-point.png)*

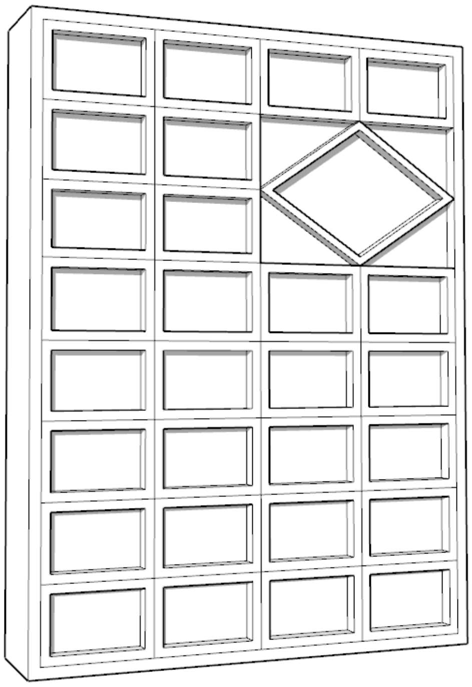


Figure 3-18. *The element with distinctive shape is the focal point (Source: Author).*

3.5.9. Good gestalt principle “law of Prägnanz”

A form that exhibits a "good gestalt" is characterized by its balanced and orderly nature (**Figure 3-19**), as well as its simplification. Human perception naturally seeks the simplest interpretation when confronted with complex combinations of elements, aiming to minimize cognitive effort during the process. This principle is demonstrated in minimalistic architecture, which is renowned for its simplicity, utilization of basic forms, incorporation of plain and unadorned materials, and a restricted color palette. The emphasis lies on creating a harmonious unity, where each element complements and enhances the overall design, ultimately resulting in a comprehensive and enriched visual experience for the observer (**Figure 3-20**).

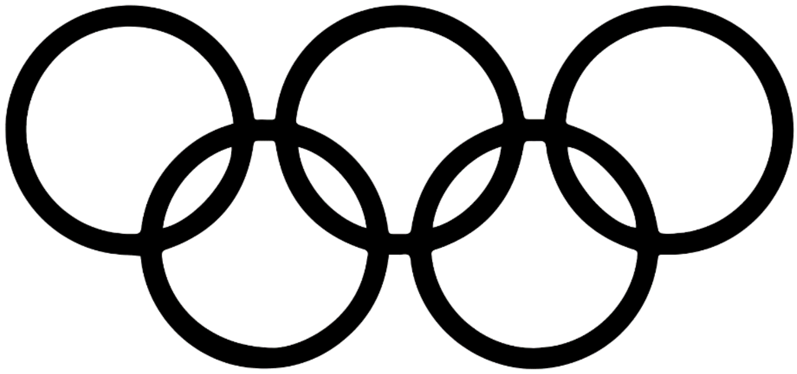


Figure 3-19. *Good gestalt principle “law of Prägnanz” (Source: https://assets.toptal.io/images?url=https%3A%2F%2Fuploads.toptal.io%2Fblog%2Fimage%2F125756%2Ftoptal-blog-image-1522045584412-2c2f0a5837a65f4fb61afb5a3a6c73db.png).*

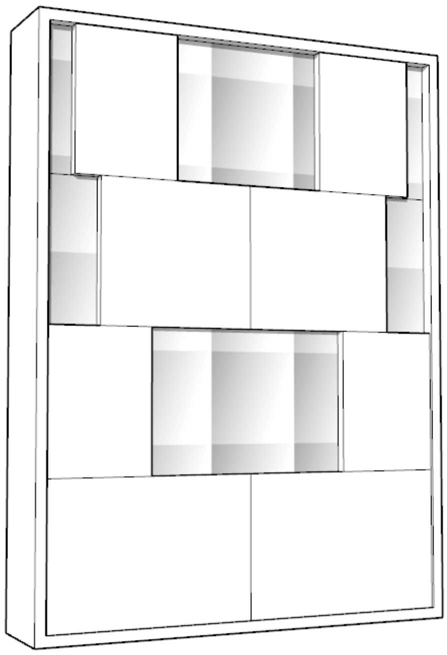


Figure 3-20. *Elements with simple configurations are sought after by perception (Source: Author).*

3.5.10. Symmetry principle

Elements that are organized in a symmetrical way tend to be perceived as one group. In nature and design, the presence of symmetry plays a significant role in how we perceive and interpret visual elements. Symmetry, which refers to the balanced arrangement of elements, can be categorized into the following main types: translation symmetry, rotational symmetry, reflection symmetry, and glide symmetry (**Figure 3-21**).

In the field of architecture, the use of symmetry and order plays a significant role. This is because, as observers, we are naturally inclined to prefer and appreciate symmetrical and organized elements. Our brains tend to group these elements together to create a simpler interpretation (**Figure 3-22**).

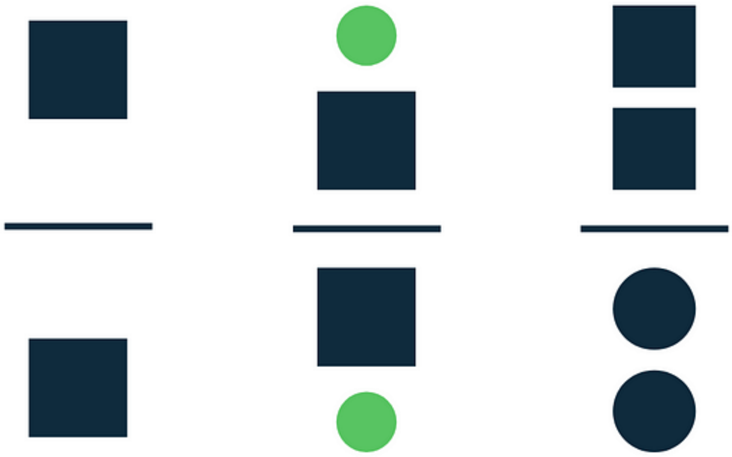


Figure 3-21. *Symmetry principle (Source: https://miro.medium.com/v2/resize:fit:720/format:webp/0*YoKtkQN-Z9-qvgQe.png).*

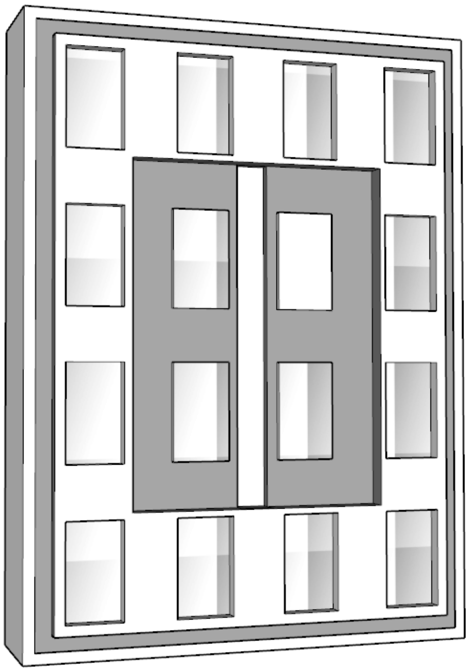


Figure 3-22. *Symmetrical arrangements are more appealing (Source: Author).*

3.5.11. Past experience principle

The concept of the past experience principle (**Figure 3-23**) revolves around the way in which human perception acknowledges and attributes significance and meaning to objects by drawing from familiarity and previous encounters, resulting in each individual forming their own subjective interpretation. In architecture, colors play a pivotal role as they can convey various messages, such as indicating functional aspects (for instance, blue and yellow representing Algérie Poste, and green representing the national gendarmerie force). Furthermore, the utilization of symbolism within architectural design has the potential to generate diverse meanings and connotations, further enriching the visual language and depth of the architectural expression (**Figure 3-24**).

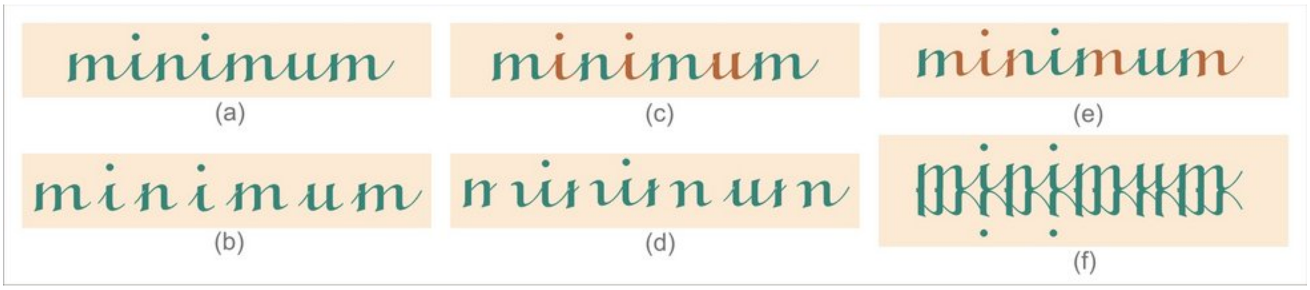


Figure 3-23. *Past experience principle (Source: http://www.scholarpedia.org/article/File:Todorovic-Gestalt_principles-Figure_9.jpg).*

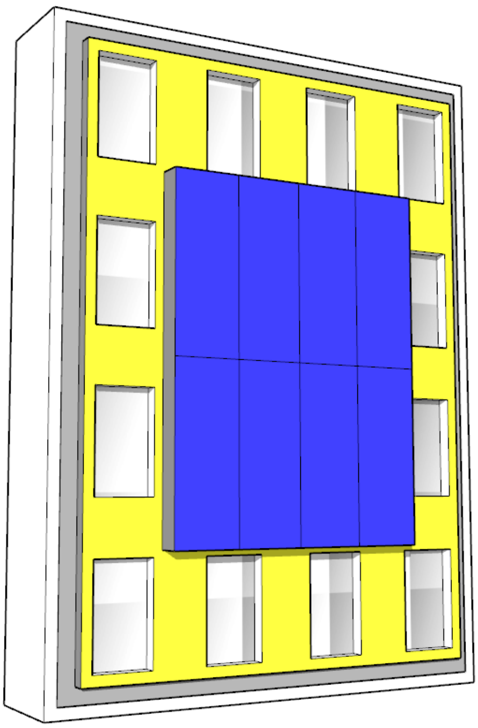


Figure 3-24. *Algérie Poste blue and yellow color pattern (Source: Author).*

Rudolph (1961) mentioned that according to the Gestalt psychology, the perception is influenced by elements and parts regarding their:

- Nature
- Number
- Position

The nature of the architectural element itself affect human perception, the elements may be structural and give sense of strength and rigidity or ornamentation that evokes emotions and think. In addition to this, the number of the elements also plays a major role, the bigger the number the larger the information and cues perceived and this also refers to multiplicity as a part of complexity, also the presence of the appropriate number of elements gives a sense of visual richness.

The arrangement and position of elements contributes also to influencing the human perception, how an element is positioned can determine if it is perceived well or not. In the end, the mixture of the previous factors produces a complex and intricate experience that the perceptual apparatus has to analyze and decipher, and surly subjectivity in this case is one of the determining factors.

In one particular instance, it is possible to observe multiple principles. However, the way in which each individual perceives and interprets these principles will rely on their own unique perspective, personal preferences, and the significance of each principle in question. It is important to note that certain Gestalt principles may either override or strengthen one another, leading to a multitude of diverse interpretations when combined.

In essence, the interplay between these principles creates a rich tapestry of possibilities and understandings.

3.6. Learning and geometry perception

According to a study conducted by Silvestri (2009), the issue of the significance of learning in the realm of geometric perception remains open to debate. While some research indicates that certain geometric principles are inherently present and not influenced by learning, education, or culture, there is still much to explore and understand. This raises intriguing questions about the interplay between innate abilities and the impact of external factors on the understanding of geometries. This relates to certain geometric principles such as:

- Proximity
- Inclusion
- Openness and enclosure

3.7. Alvar Aalto's take on geometries

The main lecture theater in the Otaniemi Institute of Technology (**Figure 3-25**), designed by Alto, exhibits a striking resemblance to his sketch of the amphitheater at Delphi in Greece, dating back to 1953 (**Figure 3-26**). The architectural form of the theater was executed in a bold and audacious manner, despite the challenging nature of the site and the slight incline of the terrain. Within the ensemble of buildings, the prominent main auditorium serves as a focal point, effectively bridging the gap between the surrounding rectangular structures. (Curtis, 1987). This design choice not only adds coherence to the overall composition but also enhances the connectivity and integration of the various architectural elements.

Figure 3-25. *Alto's main lecture theater in the Otaniemi Institute of Technology (Source: The University of Technology main building. Aalto University. (2018, June 17). Retrieved April 29, 2023, from https://www.aalto.fi/en/locations/undergraduate-centre)*

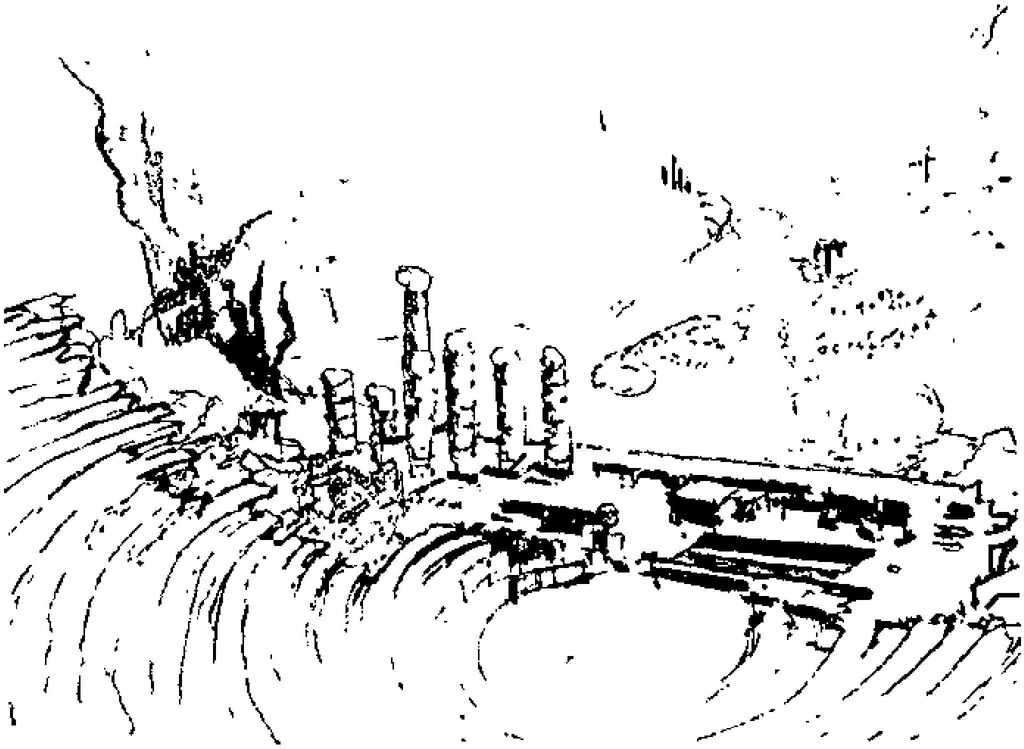


Figure 3-26. *Alvar Aalto's sketch of the amphitheatre at Delphi.Greece. (Curtis, 1987)*

3.8. The symbol and the metaphor

3.8.1. The symbol

Sadalla and Sheets (1993) noted the importance of symbols as mediators of self-definition and performance, as the symbolism (in case of materials as example), depend on two aspects: social meaning and functional utility, building materials like stucco, wood and stone can suggest a variety of social meanings. The higher the type and quality of the used material, the higher the social status of the occupants is conveyed.

Architects can use symbolism as a significant tool to influence the recipient and convey information about character and identity (Sadalla & Sheets, 1993). Moreover, they can get involved in Semantic[1] and Semiology (Semiotics)[2].

Sadalla and Sheets (1993) conjectured that occupants have preference for houses that possess symbolic attributes compatible with dimensions like self-concept (what the occupant thinks about himself, about his attributes) and social identity. Following this, it can be assumed

[1] ***Semantic***: A field of linguistics that studies the meanings and significations of words and the attribution of a certain signification to a certain sign.

[2] ***Semiology (Semiotics)***: A discipline that studies the significance of signs inside the social life. It is interested in the signification of the signs system such as codes, and images, etc.

that this preference can extend to other buildings with different types and functions; hence, the perceiver favors the presence of symbolic attributes of various kinds, because they represent a new source of information and that creates interest, uniqueness, and shape a distinctive identity that conforms to the social context, appeasing its individuals.

It represents something according to an analogic correspondence, the symbol reveals what is hidden, it rests exclusive in regards to its content and meanings, it is not a simple analogy; hence, the symbol reunites and signifies the pertinence, and the value of a certain group, if an object is possessed by two individuals; the possession makes them joined. The symbol concretizes the intangible and render it sensible. In this regard, the symbol differs from the sign: the sign distinguishes, while the symbol connects and joins.

It is a specific aspect for humans to translate information into symbols. The symbol requires collective learning since childhood, it allows for the classification and the arrangement of environment by attributing meaning and value to it. The symbol is characterized by ambivalence and ambiguity, and in this aspect, it is close to metaphor.

Aaker (1991) suggests that symbols (symbols rich in associations and visual images) create:

- Awareness.
- Associations.
- Produce liking or feelings.
- Affect loyalty and perceived quality.

That is because the nature of the symbol makes it easier to be perceived and understood. Besides the role of symbols in generating associations, they can be indicators for culture and identity (**Figure 3-27**).

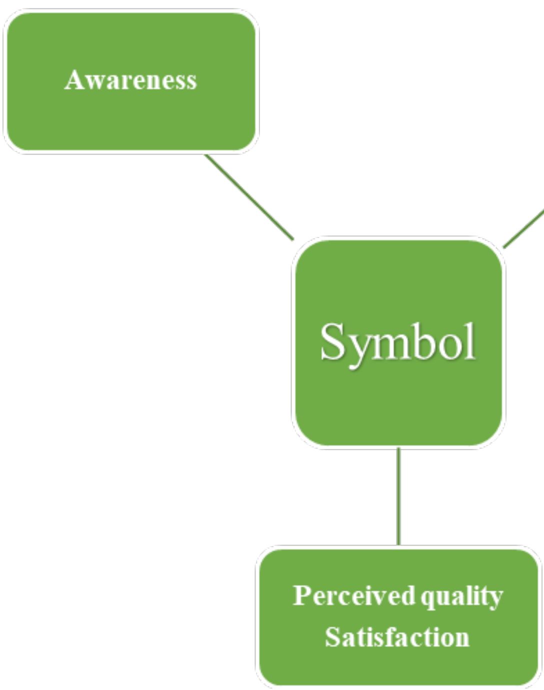


Figure 3-27. *The role of symbol according to Aaker (1991)*

Sadalla and Sheets (1993) highlighted the significant connection that exists between symbols and identity. They emphasized that architects should incorporate symbols into their creative works as the absence of symbols may result in depriving the building of a vital identity boost. This linkage between symbols and identity goes beyond superficial aesthetics and plays a crucial role in enhancing the overall meaning and identity.

Le Corbusier, renowned for his immense contributions to the field of architecture and urbanism, is widely regarded as a visionary plastic artist with a strong inclination towards visual aesthetics. His groundbreaking work not only introduced novel visual concepts but also offered profound symbolic insights.

The close relationship between visual quality and symbolism is evident as they mutually reinforce each other in numerous ways. The concept of symbolism goes beyond the mere utilization of simplistic and straightforward symbols; it encompasses the intended message that the architect aims to convey to the user or observer. This message can encompass artistic, cultural, social, and historical dimensions. The visual appeal of a design is enriched through the incorporation of symbolic elements, which adds depth and meaning to the overall experience. Symbolism plays a vital role in evoking emotions, stimulating thoughts, and creating a sense of connection and resonance with the audience.

The Arc de Triomphe possesses two distinctive functions depending on the vantage point from which it is observed. When viewed from a diagonal perspective, it serves as a remarkable sculptural termination, showcasing its grandeur and artistic beauty. Conversely, when observed perpendicular to the axis of the prestigious Champs-Élysées, it assumes a spatial and symbolic significance. This iconic monument not only impresses with its architectural magnificence but also holds deeper meanings that resonate with the viewer (Rudolph, 1961).

3.8.2. The metaphor

In relation to the metaphor, Giordano (2006) presented the following definition:

The metaphor is method of transferring a word's intended meaning to a meaning that only suits it by virtue of an implied comparison (works only for it when compared implicitly). Besides aspects related to aesthetics and memory, metaphor includes two supplementary significations:

- Denotation (literal).
- Connotation (emotional).

Lynch (1960) states that form and design should reinforce the meaning instead of negating it. Therefore, the meaning can be reinforced through powerful cultural, social and historical associations.

3.9. Landmarks

Landmarks are defined as a point-reference and frequently used signs of identity. landmarks observed from outside (an external point of view), a landmark can be a simple physical object (like a building, a sign, mountain, etc.), furthermore, distant landmarks can be seen from a long distance and from numerous angles, considered as radial references, while, local landmarks existing within a city serves many reasons like symbolizing a direction (tours, domes) (Lynch, 1960).

In this regard, he also adds that viable landmarks are more identifiable and significant, if:

- They have a clear form
- Characterized by singularity
- They have some richness of detail or texture
- They are in contrast with their background and context (Figure-background contrast is a major factor).
- If their spatial location is prominent.
- If they are visible over an extended range of time or distance

In urban environments, individuals develop their ability to cope with the overwhelming influx of information by constructing mental models that rely on significant elements such as landmarks (distinctive structures) and pathways. This process of adaptation enables city dwellers to navigate through the complexity of city life, making sense of the multitude of information that bombards them on a daily basis. (Herzog et al., 1976).

There are physical characteristics that determine districts and that include a variety of components (Lynch, 1960):

- Texture
- Space
- Form
- Detail
- Symbol
- Building type
- Use activity
- Inhabitants
- Degree of maintenance
- Topography

Users when navigating are in need of source of information for orientation and wayfinding, hence, buildings with distinctive character and identity dotted with what‘s called “imageability” (Lynch, 1960) are necessary to fulfil the role of a landmark. The role of landmark here is salient because it affirms and strength the identity of the place that it makes a part of, being a district, a small town or a large city. This becomes clear in the case of people who visited a new city for the first time without having a prior navigational and path related information, they tend to depend on big structure and notable as references and around them, they build their own mental spatial map. Hence, the role of building as a landmark is of great essentiality (Harrison and Howard, 1972, Evans, Marrero, & Butler, 1981; Heft, 1979 as cited in Nasar, 1989). The exterior of the building, function and localization are among the elements that denote the “imageability” of a building. This supported by studies (Appleyard 1969, Evans, Smith, & Pezdak, 1982 as cited by Nasar, 1989) that noted some factors that help improving the building’s recallability such as:

- Form (shape complexity and maintenance quality)
- Visibility (size and visibility of contours)
- Use (function, frequency of use and symbolic significance)

3.10.Identity and Identification

Identification can be reinforced by considering some basic elements such as (Lynch, 1960):

- Façade material
- Modeling
- Ornament
- Color
- Skyline
- Fenestration

Pursuant to Newman (1996), an effective way to enhance the image and identification of a building is by resurfacing its exterior using a diverse range of colors and materials. This approach not only improves the overall appearance but also adds depth and meaning to the object. Colors play a significant role in conveying messages and associations. For instance, the color red symbolizes vitality and energy, while blue evokes notions of the sky. (Giordano, 2006) By incorporating color, the form of the building is further emphasized, creating the illusion of depth and enhancing the impact of a particular style. It is essential to recognize the expressive power of color and its ability to enrich the visual experience of architectural structures.

The identity and identification of a building can be enhanced through the identity and patterns of its windows and how they are arranged and structured, for example (Lynch, 1960). Additionally, he states the intensity of use produces distinctive visual shapes and enhances as a result the identity.

3.11.Contextual compatibility and environmental aesthetics

Groat's (1988) discussion on "*contextual compatibility*" highlights an important aspect of environmental psychology, also referred to as "*environmental aesthetics*." Groat also draws attention to the existence of empirical research pertaining to the perceived compatibility between the built form and the surrounding landscape. This notion of contextual compatibility within the field of environmental psychology not only captures the aesthetic aspects but also delves into the deeper understanding of how the built environment and the natural landscape can harmonize together.

3.12.Extrinsic changes

Extrinsic changes (refers to changes made on the outside, opposite to intrinsic changes that concerns the inside space), which pertain to alterations made on the exterior rather than the interior of buildings, may be imperative in enhancing both the visual appeal and the overall size and proportions of the structure. These adjustments are aimed at improving the aesthetic aspects of the building, encompassing its appearance and various constituent dimensions. By undertaking necessary extrinsic changes, the building's external features can be enhanced, resulting in an enriched visual experience.

3.13.Elements' juxtaposition

The juxtaposition of elements contributes to noticeable differences, the relationships between elements can be more essential the elements themselves (Rapoport 1969e as cited in Rapoport 1990). The architect needs to take account of the relationships between architectural design elements such as size and contour, proportions and symmetry, lighting and colors, textures and materials, structural and ornamentation elements. The previous elements must be treated in relation to each other to achieve complementarity, compatibly and harmony. Focusing on one element independently from other will affect the balance of the perceived image. Some patterns can be enhanced in presence of the right conditions like the use of suitable colors and convenient lighting and well-chosen perspective. On the other hand, the same pattern can be overshadowed and unnoticeable under different circumstances like inappropriate choice of textures and materials, bad lighting and badly-chosen points of view.

The clearer and stronger the contrast in the variations is, the bigger the possibility of their noticeability (Rapoport, 1990).

Elements are systematically arranged and organized based on their inherent structural and functional characteristics. Additionally, the visual attributes of these elements play a crucial role in determining their placement and ordering within a given context. The visual properties, such as color, shape, size, and position, are carefully considered when organization is needed.

According to Rudolph (1961), it is suggested that a building lacks a perfect part if it does not possess any imperfect parts. This idea highlights the notion that dissimilarity and contrast between elements can create fascination and enhance the perception of perfection. In other words, imperfections in a structure can serve as a means to accentuate what is what is considered as perfect. The city of Berlin is enriched by the captivating interplay of unusual and distinctive shapes, as exemplified by Sigmund's visionary urban plan. This innovative approach not only introduces visual diversity, but also enhances the overall quality and character of the cityscape. Through the deliberate juxtaposition of these unconventional shapes, Berlin becomes a testament to architectural creativity and artistic expression.

3.14.Noticeable differences between elements

Rapoport (1990) classifies the noticeable differences between elements into three categories:

- Physical differences
- Social differences
- Temporal differences

3.14.1. Physical differences

He divided the physical differences into four kinds: Vision, Kinesthetics, Sound, Smells.

3.14.1.1. Vision: includes the following elements:

- Characteristics related to the objects like its shape, size and height, color, materials and texture and other details.
- The quality of space itself and its attributes such as shape, size, the presence of barriers, transitions.
- The duality of Light and shadow, the intensity and quality of light in addition to temporal changes (how lighting changes at different times**)**.
- Man-made green spaces, contrasted with natural Greenery.
- Perceived density in relation to visual aspects.
- Contrast between newness and oldness.
- Contrast between order and variety.
- Good maintenance /bad maintenance.
- Scale and urban grain (the finesse or the coarseness of an urban area).
- Pattern of roads.
- The type of topography either natural or affected by human intervention.
- The choice of location (prominent, situated on a hill)

3.14.1.2. Kinesthetics

- Changes that occur in regards to the perception of body motion like, speed of movement, changes in levels and curves.

3.14.1.3. Sound

- Contrast between quietness and noisiness.
- sounds induced by human activities (talking and laughter, industrial sounds, sound

of traffic) against naturally induced sounds like the sound of the wind, trees, chirping of birds, burbling of water, etc.

- Quality of reverberation.
- Sound and its changes at different times.

3.14.1.4. Smells

- Smells created by humans or natural smells like flowers and plants.

3.14.1.5. Movement of Air

3.14.1.6. Level of Temperature

3.14.1.7. Tactile

- Texture felt under underfoot.

3.14.2. Social differences

He divided the social differences into the following elements:

- Characteristics and tendencies of people in relation to the differences in spoken languages, difference and behavior and physicality and other inherent traits.
- The variations of Activities and their nature like in the case of restaurants, markets, and other similar places with similar activities.
- Uniformity versus mixedness of uses like residential, shopping and industrial.
- The use of different means of travel like people who use cars versus pedestrians, it also about the state of movement or quietude.
- The different use of objects for either signage, advertisements or decorations.
- How different parts of the city are used, like the used versus non-used streets; the distinction between private and public space, Introversion contrasted with extroversion.

  These factors are related to culture and the rules obeyed that determine the behavior of the individual.
- Hierarchy, symbolism and meaning, and signs that indicate social identity and status.

3.14.3. Temporal differences

He divided the temporal differences into the following elements:

- Long term:

  It refers to the changes that occur over time from a state to another, these changes can happen to people, uses, etc.

  It is based on two opposing concepts: change versus continuity (stability). Both positive and negative changes are still considered as a change.

- Short term:

  It relates to the rate of activities and the intensity of use over time (day and night, daily, on weekends).

3.15.Successiveness of components

In the context of architectural structures, the extent to which individual components are arranged in a successive manner gives rise to distinct types of details, characterized by a decreasing size and an increasing quantity. Consequently, there exists a spatial correlation between the viewer and the building, which in turn influences the predominant range of details that occupy the observer's visual field. This interplay between spatial relationships and varying degrees of detail plays a significant role in the overall perception and aesthetic experience of the architectural composition (Chan, 1998).

From a long distance, the observer perceives the contour (silhouette) of the building and only large parts of the building are seen as details. When the distance between the observer and the building gets closer, his perception of details changes and previous details get replaced by smaller details like openings, signage and decoration elements (**Figure 3-28**). Then, when the distance is really close (< 1 m) the details get even smaller and the observer take notice of the grains of textures and materials, the smoothness of the wall paint. In this context, Chan (1998) gave an example of Frank Lloyd Wright's Heurtley House located at Oak Park where different levels of details are seen from different distances.

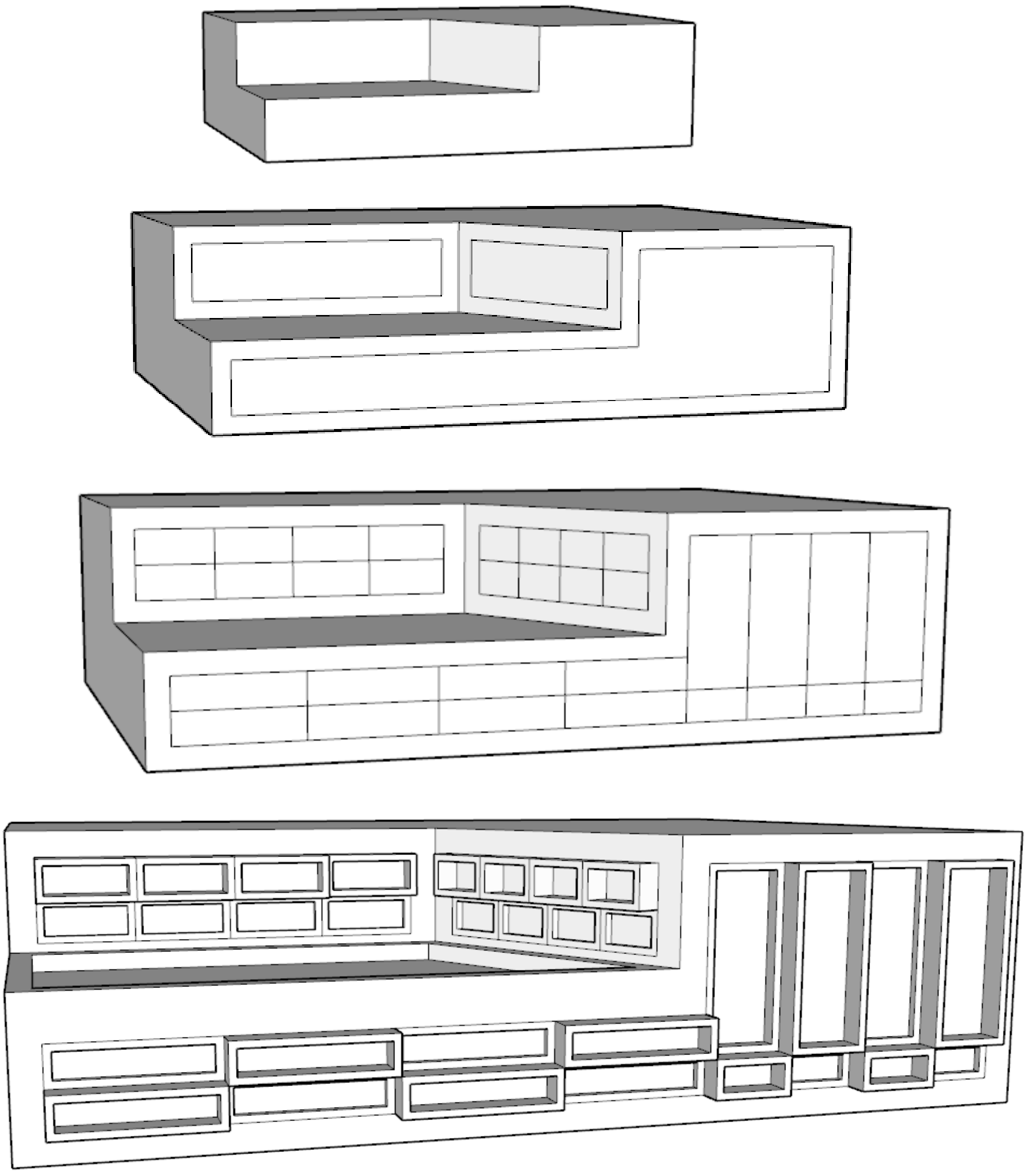


Figure 3-28. *Gaining more details with distance and absence of visual obstructions (Source: Author).*

Rudolph (1961) emphasized the utilization of distinctive elements and architectural forms employed by Frank Lloyd Wright, shedding light on his distinct personality and innovative approach within the field of architecture. Wright's incorporation of unique design elements and forms reflected his pioneering spirit and unconventional mindset.

In regards to patterns, the identification of individual elements becomes more pronounced when they exhibit qualities of repetition, organization, and relative sparsity, as explained by Chan (1998). This distinctiveness allows the prominent elements to attain a prominent position in the foreground, while the surrounding elements that lack vigor and strength fade into the background.

3.16.Minimalistic architecture

According to Chan (1998), there other methods used in minimalistic architecture (**Figure 3-29** and **3-30**) to reduce details and achieve simplicity like:

3.17.1. ***Eliminating irregularities and differences***:

The concept here is to remove differences and dissimilarity between elements and disguise details to achieve uniformity.

3.17.2. ***Arranging individual details into a larger detail***:

Combining many smaller details into one-grouped details. The key here is how those details are arranged and similar in characteristics to each other to be perceived as one entity.

3.17.3. ***Avoiding the use of elements containing concentrated information***:

The use of simple and basic forms like straight lines, plain patterns and surfaces, and flat textures and completely evade the use of highly aesthetic elements of decoration and ornamentation.

Figure 3-29. *The Heydar Aliyev Center by Zaha Hadid (Source: Baan, I., (2013). Heydar Aliyev Center. www.archdaily.com. Retrieved August 21, 2023, from https://www.archdaily.com/448774/heydar-aliyev-center-zaha-hadid-architects.)*

Figure 3-30. *Dupli Casa / J. Mayer H. Architects (Source: https://www.archdaily.com/11807/dupli-casa-j-mayer-h-architects)*

Excessive ornamentation in architectural design can often overwhelm observers with an inundation of intricate details, making it challenging to analyze and appreciate the important elements of the building. To tackle this issue, architects must employ decorative elements thoughtfully and judiciously, ensuring that they are not used haphazardly or in excess.

Instead, these embellishments should be purposefully integrated into the overall design, imbuing them with meaning and significance while maintaining harmony and complementarity with the building's overall form. Striking the right balance is crucial, as a complete absence of decoration can result in a monotonous and unengaging aesthetic.

Therefore, it becomes the responsibility of the architect to achieve a harmonious equilibrium between decorative elements and the overall architectural composition. By doing so, they can create an environment that is visually compelling, intellectually stimulating, and emotionally captivating.

On the other hand, Venturi (1966) said, *"Forced simplicity results in oversimplification"* (p.17). Excessive simplification will result in a bland, boring, and monotone architecture.

Rudolph (1961) alludes to the famous phrase coined by Ludwig Mies van der Rohe, "*Less is more*." This phrase encapsulates the notion that simplicity and minimalism can bring about a greater impact and effectiveness in design. Rudolph further emphasizes the myriad of challenges that architects encounter in their pursuit of resolving complex issues.

It is not merely a matter of creating visually pleasing structures, but also integrating various elements such as aesthetics, spatial configuration, functionality, structural integrity, performance, and user comfort. Moreover, architects must also consider the cultural and social significance of their designs, adding another layer of complexity to their work. Achieving this delicate balance and harmonizing these multifaceted aspects requires a great deal of effort and dedication on the part of architects.

3.17.Modern architecture requirements

In accordance with Venturi's (1966) perspective, the demands and requirements placed upon contemporary architecture are now diverse and often contradictory and conflicting, surpassing the conventional Vitruvian principles of commodity, firmness, and delight. he mentions four needs:

- Program
- Structure
- Mechanical equipment

- Expression

Rudolph (1961) said, *"All problems can never be solved, indeed it is a characteristic of the 20th century that architects are highly selective in determining which problems they want to solve. Mies, for instance, makes wonderful buildings only because he ignores many aspects of a building. If he solved more problems his buildings would be far less potent." (p.51).*

In his work, Rudolph (1961) meticulously examines the characteristics of modern architecture, specifically focusing on the concepts of separation and articulation in relation to various architectural elements. According to him, modern architecture is adept at effectively distinguishing between the structural aspects and the sheltering components. In regards to flat plate constructions, he says that:

- Form follows function.
- Substance follows structural function.
- Profile follows spatial function.

3.18.Multifunctioning building

According to Rudolph (1961), the concept of a "multifunctioning building" refers to the intricate interplay between a building's program, form, and structural integrity as a unified entity. In his discourse, Rudolph provides illustrations of such multifunctioning buildings, including Le Corbusier's Convent of La Tourette. This term encapsulates the notion that a building can serve multiple purposes, and accommodate diverse programs (**Figure 3-31**).

Figure 3-31. *Convent of La Tourette / Le Corbusier (Source : Gonzalez, M. (1960). Convent of La Tourette / Le Corbusier. www.archdaily.com. Retrieved August 21, 2023, from https://www.archdaily.com/96824/ad-classics-convent-of-la-tourette-le-corbusier.)*

The P.S.F.S building serves as a prime exemplar of a modern architectural building that encompasses a multitude of intricate programmatic elements. With an emphasis on comprehensiveness, this edifice encompasses a diverse range of functions and scales. On the ground floor, you will find a vibrant retail outlet that caters to various needs. The second floor houses a prestigious bank, showcasing the building's adaptability to accommodate financial institutions. Le Corbusier (1986) characterizes the house as a functional apparatus designed for human habitation. Thus, a structure transcends being a mere physical entity and becomes a sophisticated assemblage comprising various components, each deserving careful consideration. It is not just a simple shelter or a stack of blocks, but rather an artistic creation that encompasses visual splendor while harmoniously integrating functional, technical, and symbolic elements. By emphasizing these multifaceted dimensions, the building attains an elevated status that goes beyond its utilitarian purpose and assumes a role as an enriched expression of human creativity and ingenuity.

Rudolph (1961) gives other examples of multifunctioning buildings such as:

- Le Corbusier's Algerian project (apartment house and a highway) (**Figure 3-32**).
- Wright's late projects for Pittsburgh Point and Baghdad.
- Kahn's viaduct architecture (**Figure 3-33**).
- Fumihiko Maki's "collective form”.

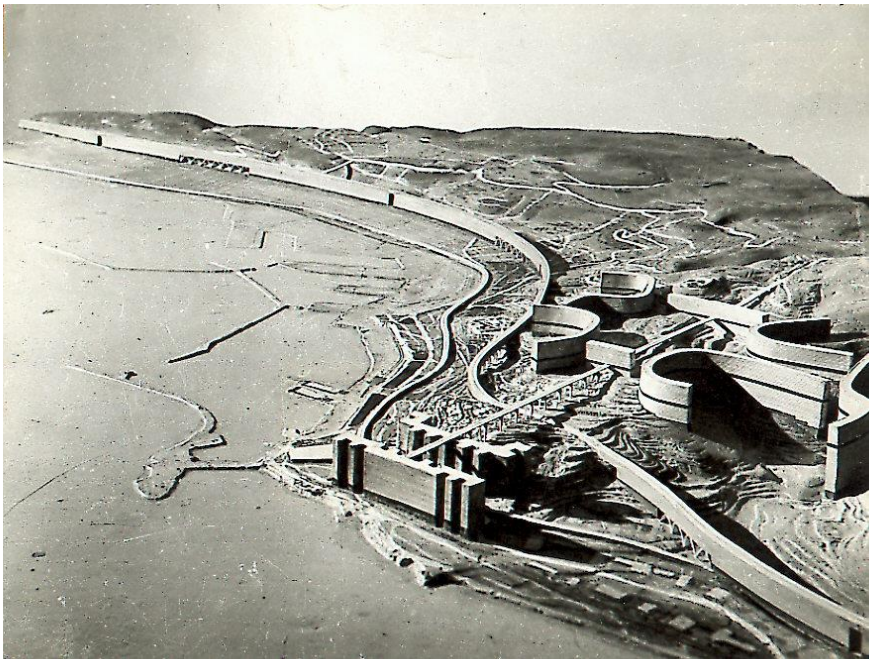


Figure 3-32. *Le Corbusier's unrealized project. (Source: Hervé , L. (n.d.). Urbanisme, projets A,B,C,H, Algiers. http://www.fondationlecorbusier.fr. Retrieved August 21, 2023, from http://www.fondationlecorbusier.fr/corbuweb/morpheus.aspx?sysId=13&IrisObjectId=6259 &sysLanguage=en-en&itemPos=6&itemCount=215&sysParentName=&sysParentId=6.)*

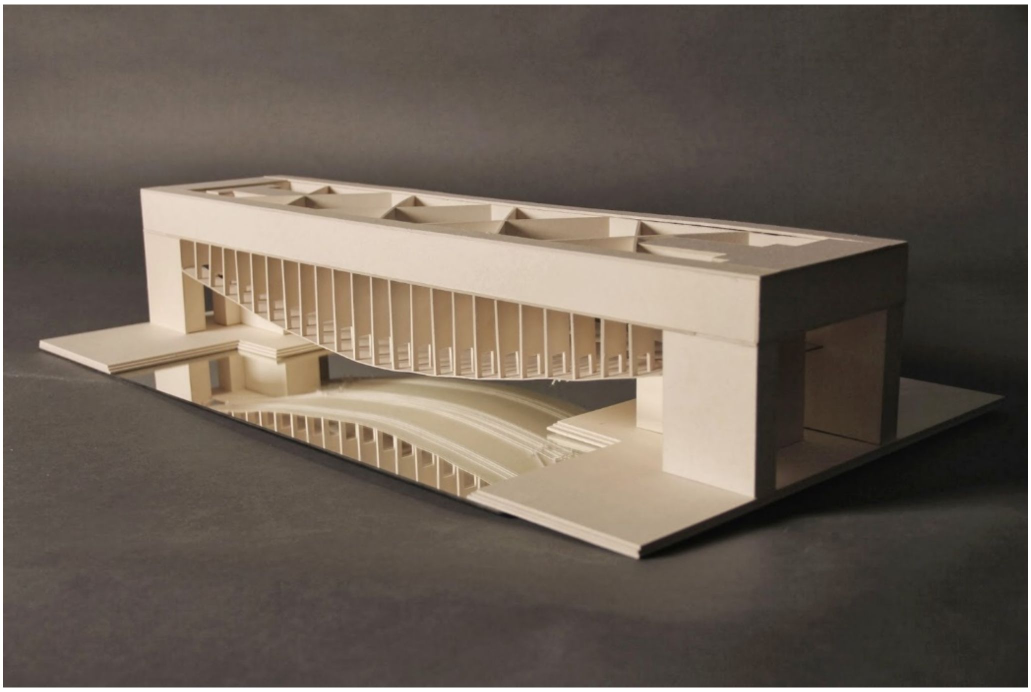


Figure 3-33. *Model of Palazzo dei Congressi / Louis Kahn. (Source: Fiederer, L. (n.d.). Palazzo dei Congressi / Louis Kahn. www.archdaily.com. Retrieved August 21, 2023, from https://www.archdaily.com/789021/ad-classics-palazzo-dei-congressi-louis-kahn.)*

Kahn has said: "*It is the role of design to adjust to the circumstantial*." (Venturi, 1966: p.51). Adapting to unforeseen situations and unique scenarios is an integral aspect of the architectural profession. While encountering budget and time constraints, as well as potential technical limitations, architects are required to intervene and strike a balance among various variables. This entails addressing any potential challenges that may arise during the design and construction process, ensuring that the final outcome meets the necessary requirements while accommodating the limitations and constraints inherent in the project. By doing so, architects navigate the intricate landscape of their profession, making informed decisions to achieve an optimal equilibrium between all relevant factors.

3.19.Duality of form and substance

According to Venturi (1961), architecture encompasses a complex interplay between form and substance. It is a harmonious blend of abstract concepts and tangible elements that derive their significance from the interior attributes and contextual factors.

He also adds in the same context that in architecture, elements are perceived as form and structure, texture and material.

3.20.Mass

The plan determines masse and surface and through them architecture manifests itself. (Le Corbusier, 1986).

According to Stamps (1999), the concept of mass can be elucidated by utilizing techniques such as the manipulation of volume through the incorporation of additive or subtractive elements, or by carefully considering the articulation of the façade.

According to Le Corbusier (1986), the perception gets satisfaction of the highest order from:

- Formal masses without unsuitable variations.
- The arrangement of masses expresses a clean rhythm.

The relation between masse and space is proportional.

3.21.Contrast

Contrast, within architecture, can be interpreted as a noticeable disparity between the internal and external aspects of a structure. In the context of the twentieth century, there was a belief in the seamless connection and coherence between the interior and the exterior, wherein the external facade should effectively convey the essence and characteristics of the internal space, and vice versa.

However, in the realm of contemporary architecture, the incorporation of modern, technologically advanced techniques has presented a viable solution to this matter at hand. It has granted designers a newfound sense of flexibility, freedom, and creativity in their pursuits. Particularly, the outer shell of a building, known as the exoskeleton, possesses the capacity to convey a myriad of ideas that may diverge from the spatial arrangement observed within. This contrast between the internal and external facets of the structure generates a profound sense of intrigue and prompts cognitive stimulation. It fosters an environment ripe for profound thought and intricate contemplation, thus encouraging individuals to explore for more.

3.22.Architectural composition

(Ching, 2015) proposed an architectural system where architecture is composed of three commonest:

- Space
- Structure
- Enclosure

Architecture, along with the three previously mentioned components, is perceived and understood through the dynamic experience of movement in space and time. It is imperative for architecture to not only respond to the functional requirements of a program but also harmonize with its surrounding context. Achieving this delicate balance necessitates the utilization of technology as a valuable tool. By incorporating cutting-edge advancements, architecture can evolve and adapt to the ever-changing demands.

In the same context, Le Corbusier (1986) mentions four architectural elements:

- Light
- Shade
- Walls
- Space

3.23.Primary elements and solids

According to Silvestri (2009), elementary geometry encompasses the fundamental geometric principles employed in visual reasoning. It involves the application of abstract geometrical rules that serve to organize and structure visual information. These principles play a crucial role in the logical and systematic comprehension of organizational function.

A building has a form that consists of lesser primary elements (**Figure 3-34**). Ching (2015) mentions the four primary elements:

- Point:

Simply represents a position in space.

- Line:

An extended points characterized with: length, direction, and position

- Plane:

Similarly, to a line, the plane is an extended line characterized with: length and width, shape, surface, orientation and position. Shape is distorted by perspective unless it is viewed from the front.

- Volume:

Volume is an extended plane characterized with: length, width and depth, form and space, surface, orientation and position. The volume can be a mass (solid) or a space (void).

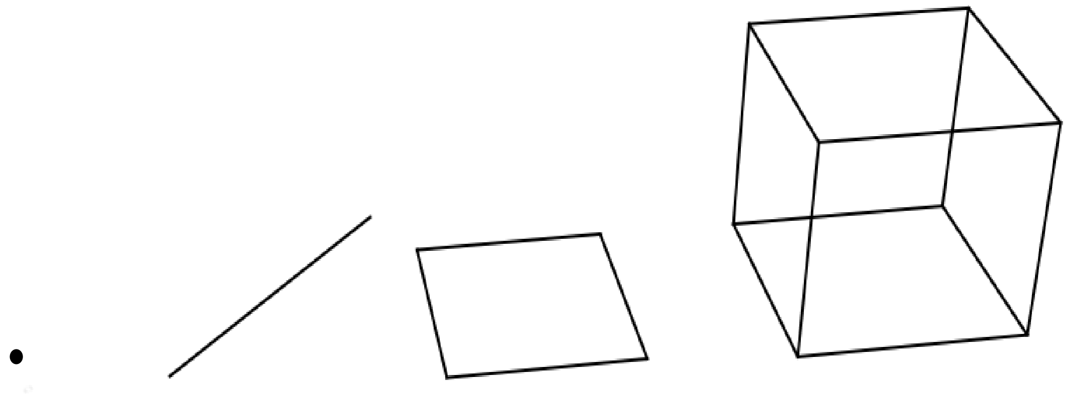


Figure 3-34. *The four primary elements (Source: Author).*

In addition to primary elements, (Ching, 2015) also defines five primary solids (**Figure 3-35**), which are the result of extending and rotating primary shapes:

- Sphere:

By revolving a semicircle over its diameter, a self-centered sphere is generated, each point on the surface of the sphere has same distance from its center.

- Cylinder:

A cylinder is an axis centralized solid form that results from revolving a rectangle over one of its sides. It can be extended over its axe. Stable when positioned on its circular base, unstable when positioned on a horizontal axis.

- Cone:

A cone is solid form that results from revolving a triangle over one of its sides. It can be extended over its axe. Stable one positioned on its circular base, unstable one positioned on a horizontal axis.

- Pyramid:

A solid with polygonal base (triangle, square, octagon) with triangular surfaces that meet at the same point. The pyramid stays stable when resting on any of its faces.

- Cube:

A solid formed of six square faces of equal surfaces, each two adjacent faces form a 90-degree angle. The cube stays stable when resting on any of its faces. Unlike when it is resting on its sides or corners.

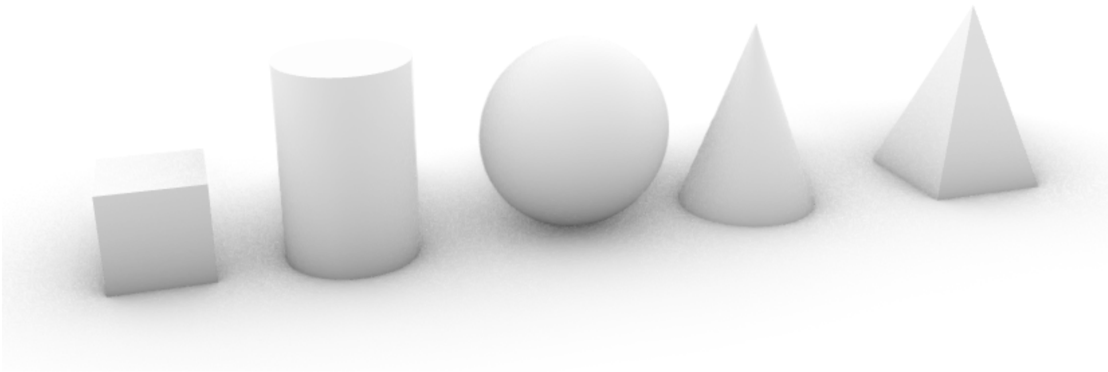


Figure 3-35. *The five primary solids (Source: Author).*

According to Le Corbusier (1986), primary forms are not only aesthetically pleasing but also easily discernible, particularly when illuminated with light and shadow. To illustrate his point, he provides examples from ancient Egyptian, Greek, and Roman architecture.

The global form of any object or entity is formed by a combination of primary elements and solids. These components are essential in enabling the observer to visually perceive and comprehend the information conveyed. It is worth noting that the combination of these elements can result in different characteristics of the form. For instance, the form can be distinctive or unremarkable, tangible or intangible, clear or ambiguous, depending on how these primary elements and solids are combined. This rich diversity in the arrangement and interaction of the components allows for variations in form generation. The possibilities for combinations are vast and can be explored through various transformations (**Figure 3-36**) such as:

- Resizing:

Changing the solid dimensions (height, width, or length) without altering its geometry.

- Union (Addition):

Two solids are added to each other to create joint geometry.

- Subtraction:

One solid (A) is subtracted from another solid (B), the resulting geometry is the remaining of solid (B).

- Intersection:

Represents the geometry resulting from the intersection of two solids.

- Extrusion:

Refers to increasing the dimensions of solid by extruding one of its faces.

- Slicing:

Consists of cutting a solid along a certain plain.

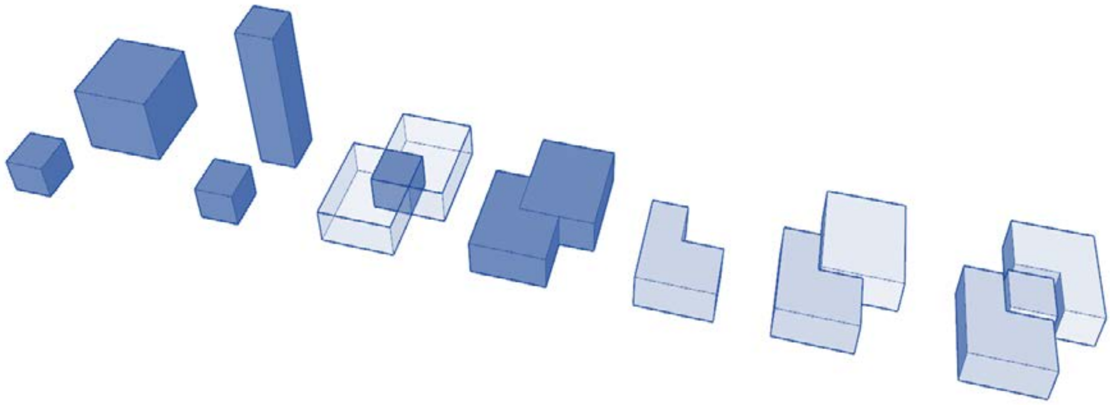


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Figure 3-36. *Different operations applied on solids (Source: Author).*

3.24.The plane

Architecture is recognized as a visual art that encompasses the manipulation of space, mass, and three-dimensional volumes. The fundamental element in architectural design is the plane, which plays a crucial role in defining these volumes and determining the quality of space, as well as the visual attributes associated with it. By effectively utilizing planes in the design process, architects are able to create structures that engage viewers and evoke a sense of aesthetic appreciation.

3.25.The plan

The plan plays a crucial role in maintaining order and preventing disorder. Without a well-thought-out plan, there is a risk of confusion and shapelessness. A plan acts as a generator that generates structure, providing a framework for organization and ensuring that things progress smoothly. (Le Corbusier, 1986).

3.26.Surfaces in architecture

Ching (2015) stated seven types of surfaces (**Figure 3-37**):

3.26.1. *Cylindrical surfaces*:

This type of surfaces is the result of sliding a straight line along a curve. The cylindrical surface can be circular, elliptic, or parabolic according to the curve followed.

3.26.2. *Translational surfaces*:

A translational surface is resulted by sliding a curve along a straight line or another curve.

3.26.3. *Ruled surface*:

The motion of the straight line is what generates a ruled surface.

3.26.4. *Rotational surfaces*:

A rotational surface is the result of rotating a curve an axis.

3.26.5. *Paraboloid surfaces*:

A paraboloid is quadric surface generated by the intersection of the surface with parabolas (a curve resulting from point that is equidistant from a fixed line and a fixed point that is not pertinent to the line) and ellipses or parabolas and hyperbolas (a curve resulting from the intersection of circular cone with plane cutting both of its halves (the cone)).

3.26.6. *Hyperbolic paraboloid surfaces*:

This is surface is generated using two types of parabolas: with downward curvature and with upward curvature, it is formed by sliding the first one along the second one. On the other hand, it can be a combination ruled surface and surface translational.

3.26.7. *Saddle surfaces*:

Characterized by the existence of two curvatures: an upward curvature and a downward curvature, the first one is following one direction and the second one follows a perpendicular direction.

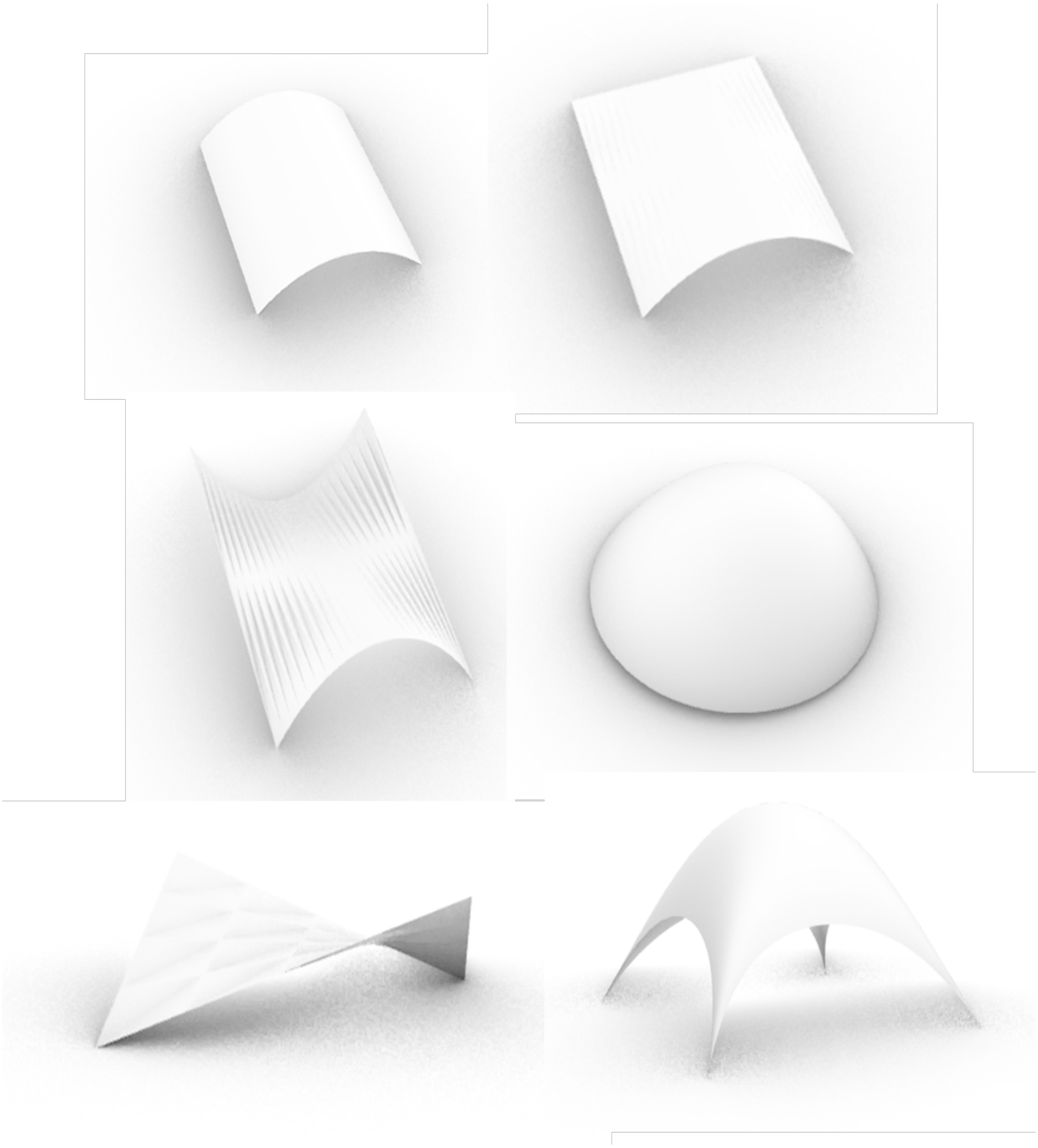


Figure 3-37. *Different types of surfaces (Source: Author).*

3.27.Architecture and technological solution

The field of architecture has witnessed significant advancements in technology, particularly in relation to the divergence of building form (the outer shell) from its structural components. This separation has opened up a realm of possibilities, allowing for a diverse range of designs to be realized. One prime example is the implementation of structural glass facades, which serve the dual purpose of providing both structural integrity and the much-needed transparency in architectural design. Additionally, the translucent panels that surround the building have their own independent supporting structure, distinct from the primary building structure.

This innovative separation of structure bestows a sense of artistic freedom upon designers, liberating them from the constraints imposed by the traditional support systems. It empowers them to explore new avenues of creativity and push the boundaries of architectural design. By breaking away from the limitations of the foundational structure, architects can amplify their imaginative capacities and unleash their innovative potential. This remarkable symbiosis between technology and architecture allows for enriched and dynamic built environments that captivate both the eye and the mind.

Silvestri (2009) has identified two geometric characteristics and considered them as emergent in the field of the non-standard architecture which are:

- The curvature as continuous variable.
- The highly irregular geometric configurations.

3.27.1. Structural solutions

3.27.1.1. Gridshell structure

The architect has the opportunity to leverage the diverse range of surfaces available to them in order to propose unique structural solutions and develop innovative designs for building exteriors. This can be exemplified by the Restaurant Los Manantiales in Xochimilco, Mexico, built in 1958 by Felix Candela (**Figure 3-38**), as well as the Olympic Velodrome in Athens, Greece, constructed in 2004 by Santiago Calatrava.

The gridshell structure is an exemplary architectural innovation, originating from the ingenious mind of the Russian engineer, Vladimir Shukhov, in the 19th century. This particular type of structure is constructed using a framework consisting of interconnected grid elements, which can be made of either wood or steel. The gridshell's strength is derived from its unique feature of embracing a double curved geometry (Ching, 2015).

Gridshell structures offer designers the flexibility to create unconventional, non-linear forms, particularly when using advanced 3D modeling software and computer-aided design (CAD) tools. By leveraging these technologies, intricate and complex forms that would otherwise be arduous and time-consuming to construct manually can be efficiently computed and produced. The use of gridshell structures, coupled with the power of CADs, empowers designers to overcome the challenges inherent in shaping irregular geometries.

Figure 3-38. *Restaurant Los Manantiales, Xochimilco, by Felix Candela (Source: Eugenio, E., & Parachini, M. (2011). Restaurante Los Manantiales / Félix Candela. www.archdaily.mx. Retrieved August 23, 2023, from https://www.archdaily.mx/mx/02-95859/clasicos-de-arquitectura-restaurante-los-manantiales-felix-candela.)*

Gridshells are architectural structures that exhibit a unique and dynamic quality. These structures are known for their ability to actively respond to environmental changes, making them adaptable and resilient. A distinctive feature of gridshells is their double curved geometry, which serves as both the load-bearing element and a source of stability. This is achieved through the use of prestressed cables, which provide structural integrity and support. Gridshells also offer versatility in their applications, as they can be utilized to create enclosures for various building types, including vaults and domes. The intricate interplay between form and function in gridshells makes them an intriguing and innovative solution in the field of architectural design. As observed in the case of London City Hall and 30 St. Mary Axe, London, UK, 2001–2003, Foster + Partnersby Foster and Partners, Macquarie Bank Building at 1 Shelley Street, by Fitzpatrick and Partners (**Figure 3-39**), and TOD's Omotesando Building, by Toyo Ito and Associates (**Figure 3-40**), that has an oak structural design composed of intersecting concrete braces and glass that imitates how elm trees branches line on the street.

Figure 3-39. *Macquarie Bank Building at 1 Shelley Street, Australia, 2009, Fitzpatrick + Partners(Source: Home. GradAustralia. (n.d.). Retrieved April 13, 2023, from https://gradaustralia.com.au/interviews/macquarie-shelley-street-sydney-office-tour)*

Figure 3-40. *TOD's Omotesando Building, Tokyo, Japan, 2002–2004, Toyo Ito and Associates (Source: 1TOD. AEWORLDMAP.COM (3,000+ posts). (2010, August 31). Retrieved April 13, 2023, from https://aeworldmap.com/2010/08/30/tod%e2%80%99s-omotesando-tokyo-japan/1tod/)*

3.27.1.2. Curved surfaces

Curved surfaces, with their characteristic fluidity, differ from angular and rectilinear forms, and they bear a resemblance to shell structures that are employed for enclosing purposes. It is worth noting that symmetrical curved surfaces, such as domes and barrels, exhibit stability and a sense of balance. On the contrary, asymmetrical curved surfaces exude expressiveness and energy, while their dynamic shapes offer a multitude of viewpoints to be explored. This distinction between symmetrical and asymmetrical curved surfaces not only highlights their various characteristics but also emphasizes the impact of their form on the overall aesthetic and functional aspects. (Ching, 2015). Moreover, in contrast to symmetrical surfaces, asymmetrical curved surfaces possess a level of intricacy that captivates the viewer's attention. These surfaces offer diverse viewing angles, enabling the observer to gather fresh information with each perspective. Consequently, this prompts cognitive processes that evoke a profound sense of curiosity and interest, urging individuals to delve into the subject matter and explore its intricacies further.

3.27.1.3. Additive form

According to Ching (2015), the additive form, which arises from the process of addition or union transformation, is generated by connecting multiple objects together (**Figure 3-41**). This particular form can be categorized into three distinct categories:

- Spatial Tension: the forms are proximate to each other and maintain a certain distance.
- Edge-to-Edge Contact: the contact between the objects is done through their edges.
- Face-to-Face Contact: the objects are in contact with each other via their faces.
- Interlocking Volumes: the forms share a relationship of intertwine as they are interweaved together.

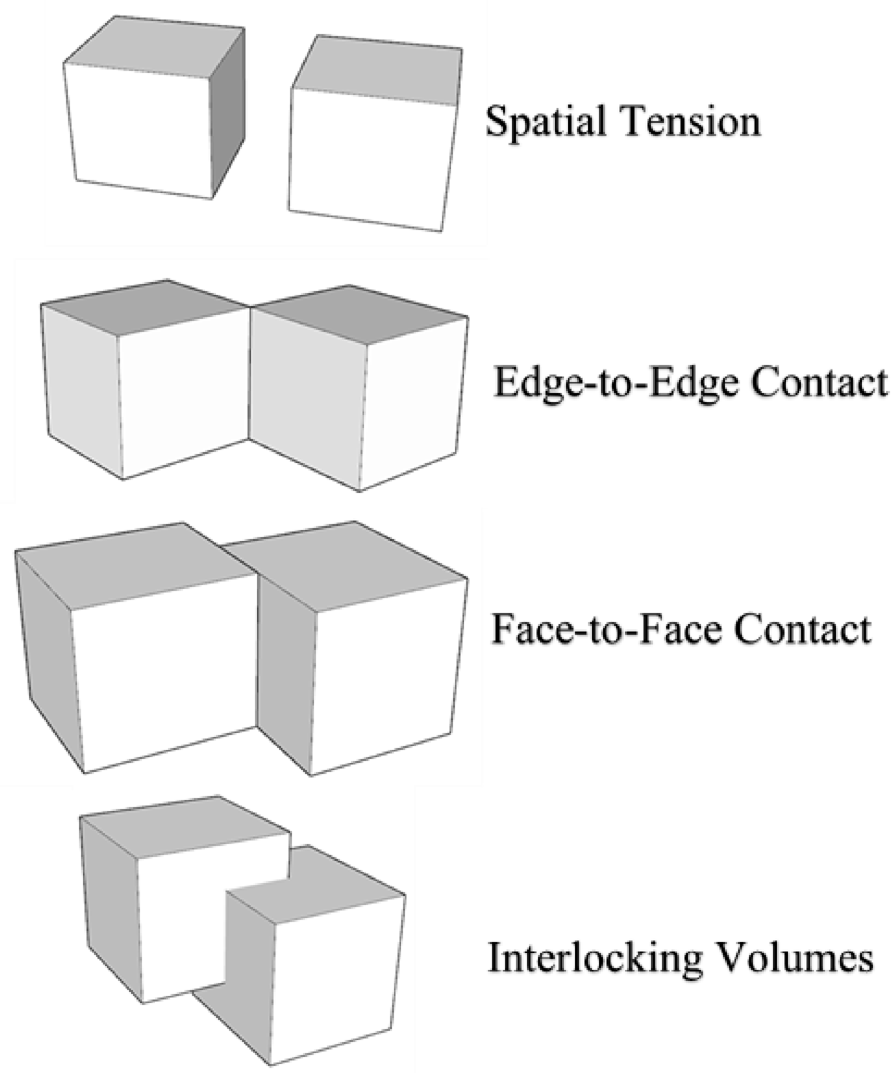


Figure 3-41. *Additive form transformations according to Ching (2015), modified by Author.*

According to Silvestri (2009), there exists a connection between specific elementary concepts of geometry and the perception laws of organization. These concepts have the potential to influence the logical geometries that are employed in spatial and formal problem-solving activities during the design process. This correlation between geometrical principles and perception laws can significantly affect the way in which designers approach and solve complex design problems.

3.27.1.4. Clustered form

Ching (2015) noted that a clustered form is known for its flexibility and is developed by considering factors such as function, shape, size, and proximity. This form also incorporates elements from additive forms, such as interlocking, proximity, and attachments. In a clustered organization, the constituent elements typically exhibit resemblances in terms of their shape, size, and visual coherence. It can be observed that this type of organization allows for an amalgamation of diverse elements while still maintaining a cohesive and harmonious whole (**Figure 3-42**).

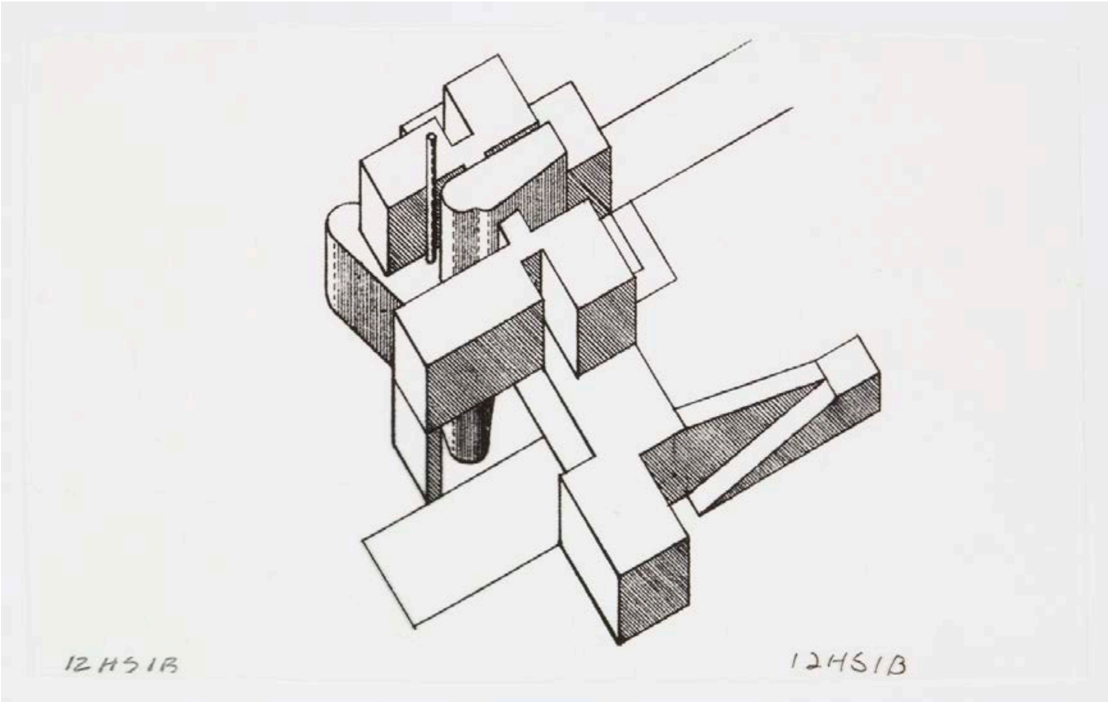


Figure 3-42. *House Studies: axonometric by Stirling and Gowan (Source: https://www.are.na/block/1054652).*

3.27.1.5. Grid form

The grid form is a systematic arrangement that emerges when parallel lines intersect at equal intervals, creating a diverse range of geometric patterns such as squares, lozenges, and other rhombus forms. This visually organized system offers a comprehensive structure that allows for an in-depth exploration of various spatial configurations and design possibilities (**Figure 3-43**).

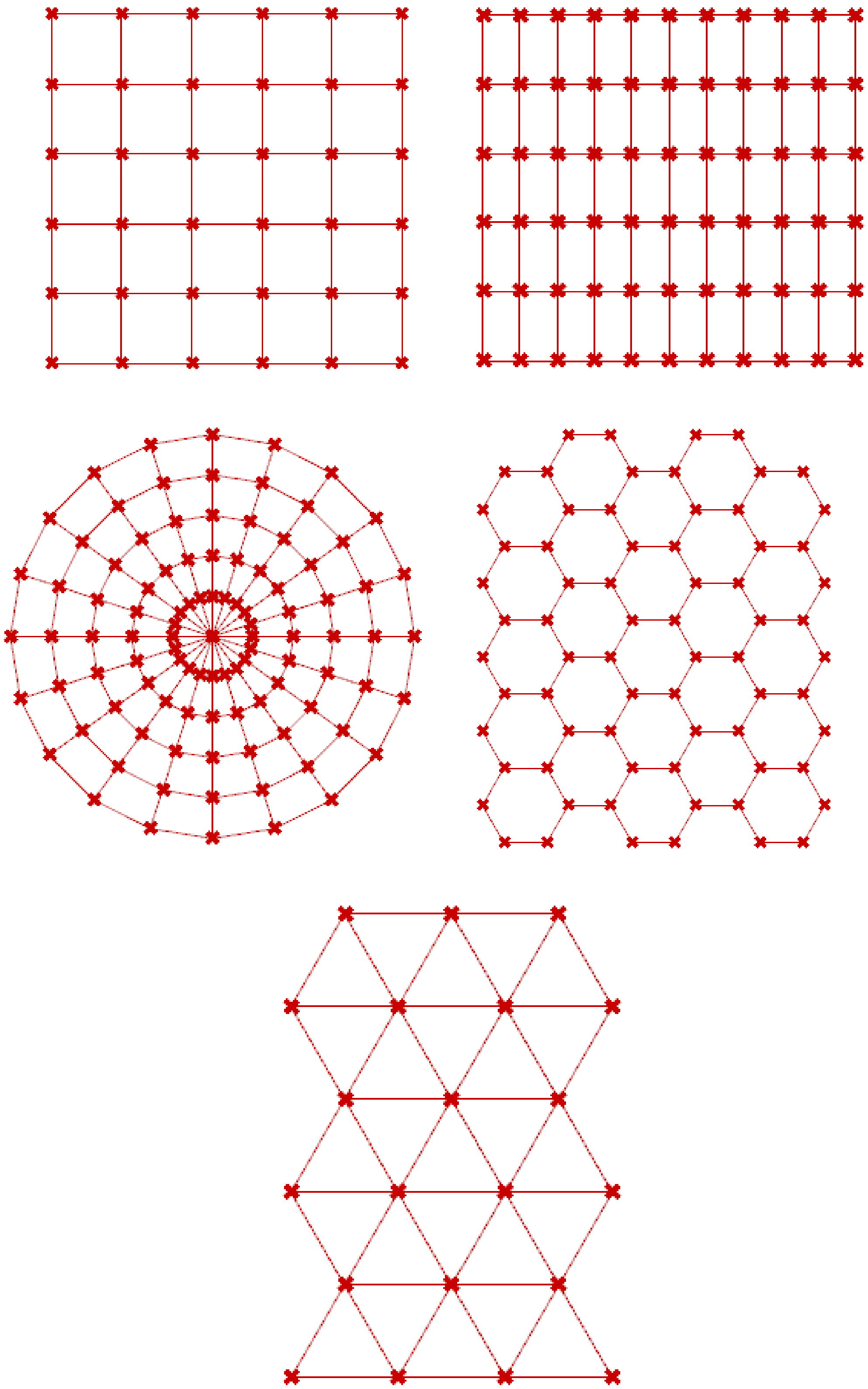


Figure 3-43. *Diverse forms of Grids (Source: Author).*

When two different forms are brought together to create a grid, it results in the creation of numerous combinations, adding an element of complexity and visual richness. These forms have the ability to contain one another, be subtracted from each other, or interlock with one another. This serves to emphasize the contrast and distinctiveness between the forms while also allowing for the expression of functional and symbolic ideas. Through this intricate interplay of forms, an understanding of the design is achieved, enriching the overall visual impact.

3.27.1.6. Grid organization

In the realm of design and architecture, when a collection of forms and empty spaces interact and align with one another, they give rise to what is commonly known as a "grid organization." A grid organization can be visualized in various contexts, such as when perpendicular lines run parallel to each other, intersecting at specific points commonly referred to as intersection points. Its defining features encompass repetitiveness, regularity, and continuity, which contribute to its overall structure and aesthetic appeal. The utilization of a grid organization holds significance in establishing a cohesive and harmonious configuration.

A grid, in its comprehensive nature, encompasses both positive and negative space within its structure. It possesses the potential for various transformations, such as the addition and subtraction of elements, as well as the layering of multiple components, all of which contribute to the emergence of irregularities and variations in size and shape (Ching, 2015).

This provides a range of possibilities for modifying the structure of the grid, allowing it to be flexible and adjustable in terms of its visual appearance, functionality, spatial arrangement, and even its compatibility with the surrounding environment (**Figure 3-44**).

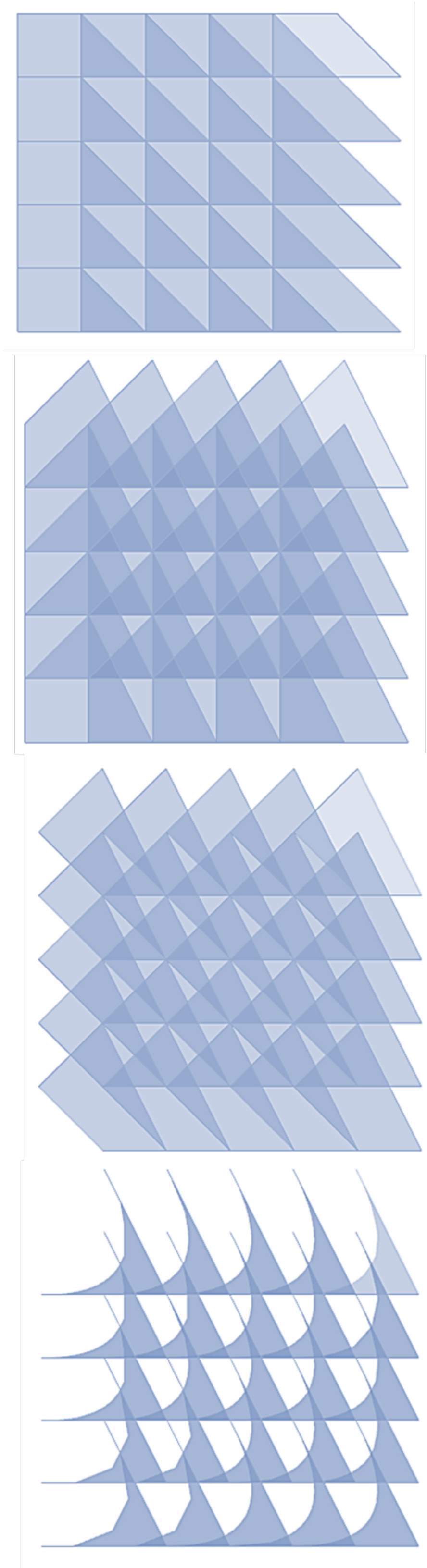


Figure 3-44. *Miscellaneous arrangements of the same grid (Source: Author).*

3.28.The roof

The roof is an essential component of a building, serving both functional and aesthetic purposes. Positioned above the structure, its primary function is to shield and safeguard the interior spaces from various weather conditions. However, it goes beyond its protective role and significantly contributes to the overall visual and spatial qualities of the building. The intricate patterns and designs of the roof add complexity and visual richness to the architectural composition. Moreover, the geometry and proportion of the roof serve not only an aesthetic purpose but also fulfill crucial structural functions (**Figure 3-45**).

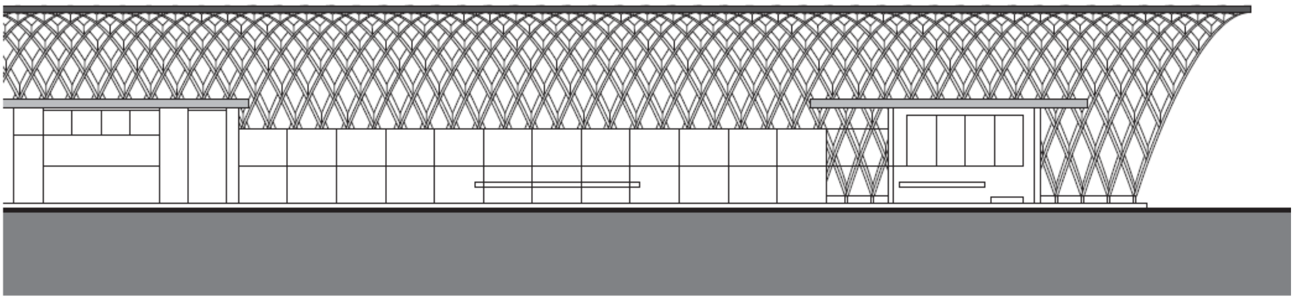


Figure 3-45. *Hale County Animal Shelter, Greensboro, Alabama, 2008, Rural Studio, Auburn University (Ching, 2015)*

3.29.Curved Roof Trusses

Trusses offer a viable solution for implementing structural systems on curved geometries, regardless of whether they are inward or outward. This versatile structural system is specifically designed to accommodate the unique demands posed by curvilinear forms (**Figure 3-46**).

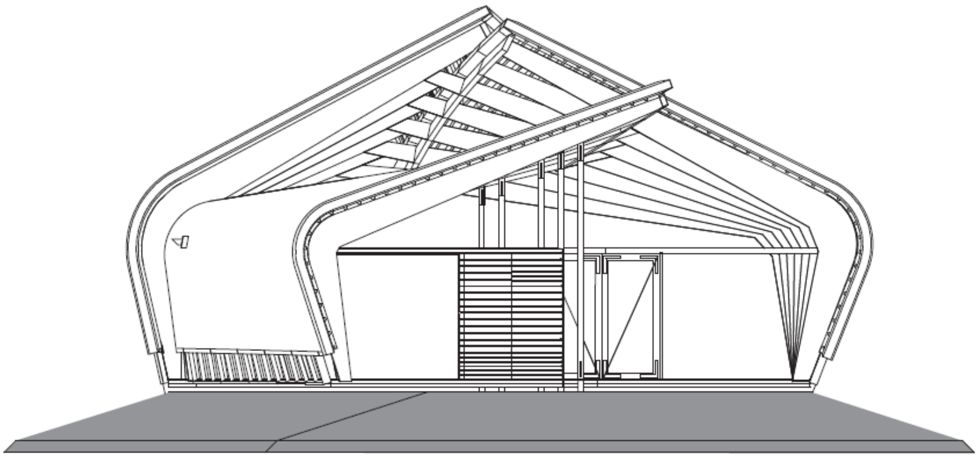


Figure 3-46. *Imagination Art Pavilion, Zeewolde, The Netherlands, 2000, René van Zuuk(Ching, 2015)*

3.30.Architecture and Contours

Le Corbusier (1986) eloquently depicts architecture as a plastic entity, intricately connected to the realm of poetic emotion. It transcends mere functionality and embraces a profound sense of artistry.

Contours, in their unfettered state, serve as the benchmark for an architect, granting them the artistic freedom to deftly manipulate and sculpt volumes, all while meticulously considering the interplay with light. This unrestricted canvas offers architects the opportunity to exhibit their skill, creating different variations.

3.31.Visual Information

Martin Krampen (1979) as cited by Chan (1998), classified the visual information received from the building into four levels:

- The form
- The fenestration (taking notice of the arrangement of windows in an architectural building)
- The sub-fenestration (details beneath or below windows and smaller details)
- The texture

3.32.Visual continuity and spatial continuity

Visual continuity and spatial continuity are closely intertwined and can either be maintained or disrupted based on their arrangement, organization, and intended purpose. In certain instances, both visual and spatial continuity may be preserved, while in others, visual continuity may be upheld while spatial continuity is compromised, or vice versa. The interplay between these two factors plays a crucial role in determining the overall coherence and flow of a design or composition.

3.33.Enclosure and Qualities of Space

Both enclosure and space have their distinctive properties and qualities as shown in **Table 3-4**:

Table 3-4: *Properties of enclosure and qualities of space according to Ching (2015)*

Properties of Enclosure	**Qualities of Space**
Shape	Form
Surface Edges	Color Texture Pattern Sound
Dimensions	Proportion Scale
Configuration	Definition
Openings	Degree of enclosure View or outlook Light

According to Ching (2015), spaces can interact with each other in many forms such as:

- Space within a Space: As indicated, it consists of a larger space that contains a smaller space
- Interlocking Spaces: two spaces that overlap with each other.
- Adjacent Spaces: refers to two spaces that are in contact with each other or share a common border between them.
- Spaces Linked by a Common Space: indicates that a space is connected to another space via a common region.

Julean (2016) noted the need to learn about the space and about how to create it through:

- The observation of the physical features of space.
- The quality of light.
- Perspectives and points of view.
- The path.
- The terrain related climatic and geographical data.
- The sensorial and cultural attributes.

Based on the research conducted by Gimblett et al. (1985), the effectiveness of the physical definition is determined by the strength of the vertical elements present, as these elements significantly contribute to enhancing the perception of enclosure. Conversely, as the distance between the observer and the view expands, the sensation of enclosure diminishes in intensity. This implies that the presence and robustness of vertical elements play a crucial role in creating a stronger sense of enclosure, while increasing distance weakens the feeling of being enclosed.

In **Figure 3-47**, in terms of spatial design, the volume of an area can be visually delineated by the presence of vertical linear elements. In the context of a mosque, for example, the four minarets serve as the vertical linear elements that establish and outline the spatial field in which the dome of the mosque becomes visually prominent (Ching, 2015). This relationship between vertical and horizontal elements is inherent to human perception and our innate ability to define and comprehend space. By incorporating both vertical and horizontal design elements, architects and designers are able to create a sense of depth and dimensionality within architectural spaces (**Figure 3-48**).

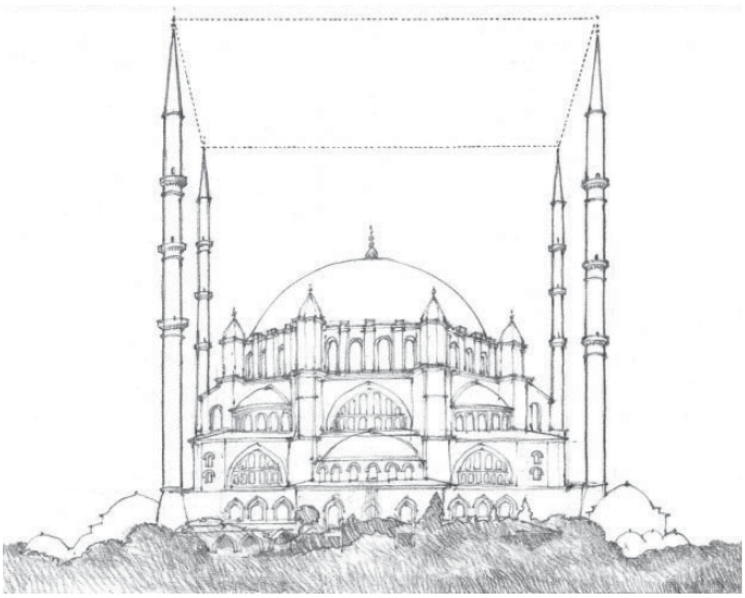


Figure 3-47. *Selim Mosque, Edirne, Turkey, A.D. 1569–1575 (Ching, 2015).*

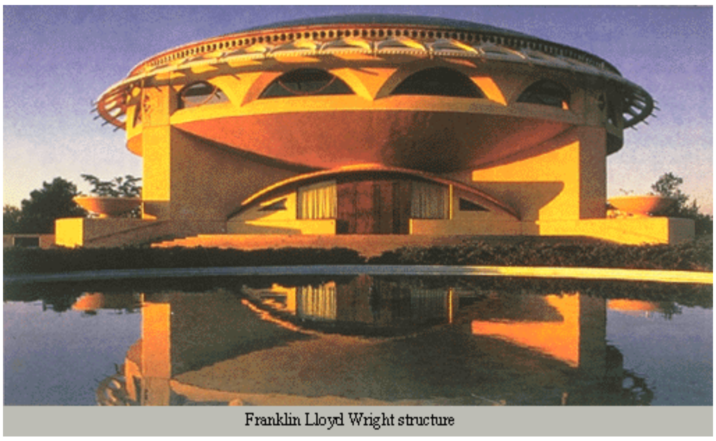


Figure 3-48. *Depth and dimensionality within the architectural space (Source: http://char.txa.cornell.edu/language/ELEMENT/FORM/wright.GIF)*

3.34.Space organization

Julean (2016) categorizes space into three layers:

3.34.1. *The projected space*:

It refers to the virtual space imagined and conceived by the architect depicted by plans and 3D models.

3.34.2. *The produced space*:

Also called the built environment, it refers to physical built space itself.

3.34.3. *The perceived space*:

It is a complex layer, it refers to how the user perceive the space and the perceptions bound to cultural, psychological, and social differences.

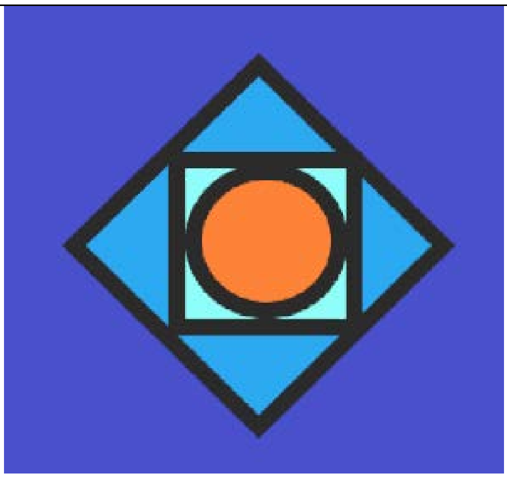
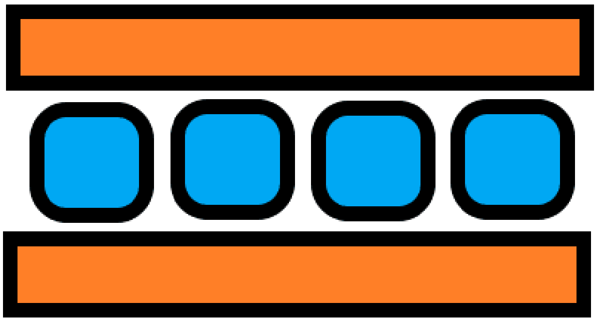
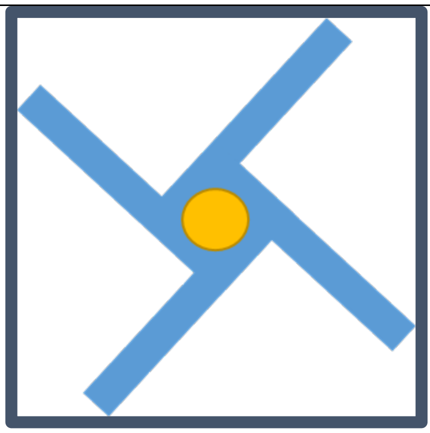
3.35.Space organization requirements

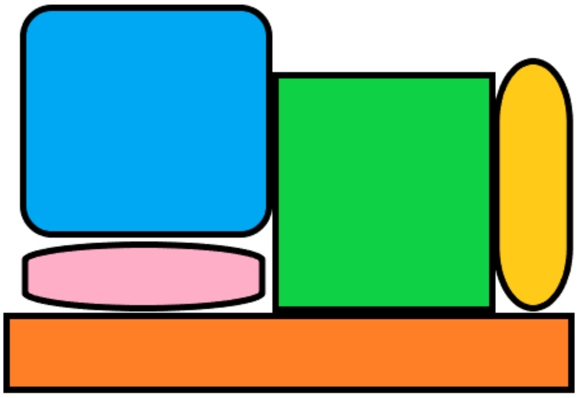
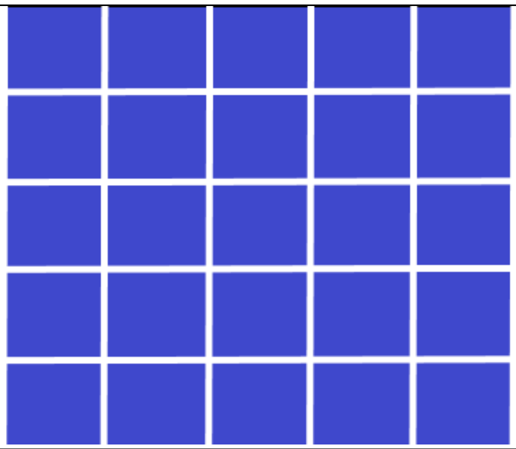
Ching (2015) explains the different requirements for the space organization:

- The space needs to require a specific form and function.
- The space needs to be characterized with flexibility and ease of manipulation.
- Singularity and uniqueness in significance and function must be among the characteristics of space among other space in the building’s organization.
- Grouping spaces of similar function into one functional cluster or a linear sequence.
- The space must have a good lighting, ventilation, and views.
- Segregation between spaces is necessary for privacy.
- The space must have a decent accessibility.

In the same context, he classifies spatial organization into categories as demonstrated in **Table 3-5:**

Table 3-5: *Spatial organizations categories according to Ching (2015) modified by author*

Spatial Organization	**Definition**	**Example**
Centralized Organization	A number of spaces that are grouped within a central space.	
Linear Organization	Repetitive spaces arranged in a linear sequence.	
Radial Organization	A central space around which linear spaces are extended radially.	

Clustered Organization	Spaces are grouped near each other forming a cluster and sharing common traits.	
Grid Organization	The arrangement of spaces is in the form of a structural grid.	

3.36.Proportion, Ratio and scale

3.36.1. Proportion

Proportion as a concept relates to the coherence, order and harmony of relations between forms, shapes and elements or also between a composing element and the whole entity. Moreover, according Ching (2015) there are various theories of proportions such as:

- Golden Section
- Classical Orders
- Renaissance Theories
- Modulor
- Ken
- Anthropometry
- Scale

3.36.2. Scale

The scale signifies the size of an element in comparison to another element. The scale and the expansiveness of space generate comfort. Three factors that affects the scale:

- The shape, patterns, and colors of the surfaces.
- The openings shape and disposition.
- The scale of other elements placed within space.

Ching (2015) says that proportion and scale in architecture are relative and hence can be influenced by factors such as:

- Perspective
- Distance
- Cultural biases

The visual quality of a given object or entity is heavily influenced by the individual's subjective perception of its proportions. While certain proportions may be appealing to some, they may not necessarily resonate with others.

3.36.3. Ratio

Ching (2015) notes that according to Euclid, a ratio concerns to the quantitative comparison of two similar things, while proportion concerns the equality of two ratios or more (**Table 3-6**).

Table 3-6: *Ratio and Proportion (Ching, 2015)*

Ratio	$\frac{a}{b}$
Proportion	$\frac{a}{b} = \frac{b}{c} = \frac{c}{d}$

3.37.Principles of ordering in architecture

According to Le Corbusier (1986), architecture, often considered a noble art, is governed by a set of standards such as:

- Logic
- Analysis
- Precise study

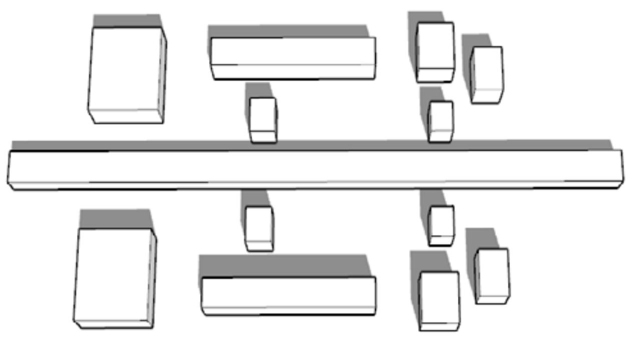
In his opinion, these standards play a crucial role in guiding the design.

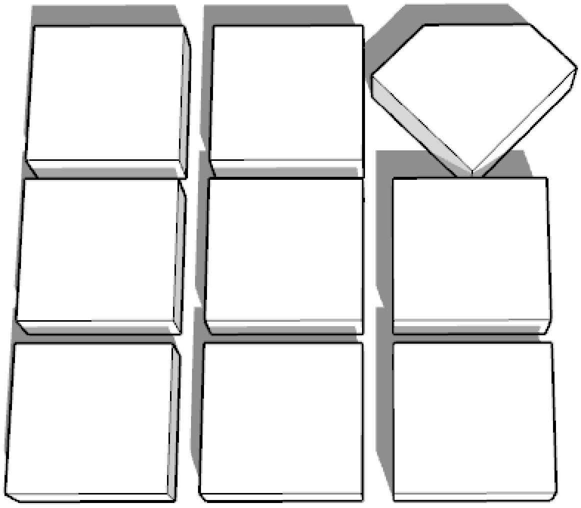
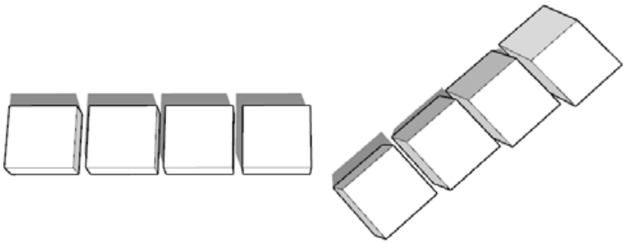
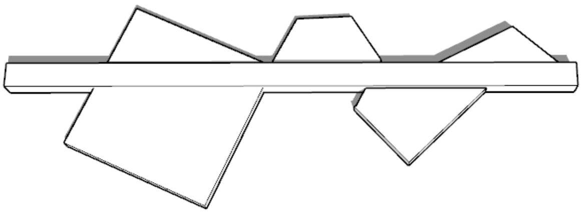
Ching (2015) states that a building's program requirements are complex and diverse and must accommodate to:

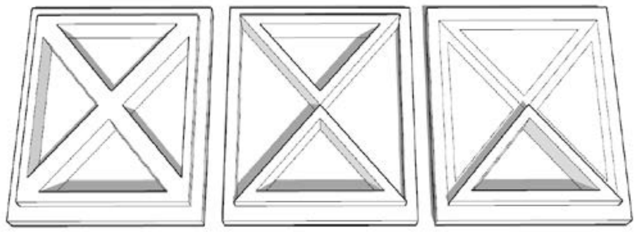
- The intended functions
- The needs of the users
- The purpose and the meaning conveyed

Moreover, he adds that monotony is the result of the absence of diversity in order, and on the other hand, chaos is the absence of order in diversity. Accordingly, he mentions six principles of ordering (**Table 3-7**):

Table 3-7: *Principles of ordering (Ching, 2015, modified by author)*

Ordering principles	**Definition**	**Example**
Axis	An elementary manner of organizing spaces, which consists of two points in space that form a line. In relation to this line, forms and spaces are arranged symmetrically. Architecture is based on Axis as it holds the role of a regulator (Le Corbusier, 1986).	
Symmetry	Forms and spaces are arranged equivalently and oppositely relative to: • an axis • a plane • a center There are two main types of symmetry: • Bilateral symmetry • Radial symmetry	

Hierarchy	The significance attached to a form is based on its proprieties like size, shape and position, in relation to the organization of other forms. There are three main types of hierarchy: • Hierarchy by Size • Hierarchy by Shape • Hierarchy by Placement	
Rhythm	It refers to movement of forms and how they repeat or alternate in a certain pattern. The repetition may concern: • Size • Shape • Detail characteristics	
Datum	Forms and spaces are grouped and organized according to the continuity and regularity of a: • Line • Plane • volume	

Transformation	It refers to the series of transformations and manipulations that a configuration or a structure undergoes to adapt to a certain context or certain conditions, while preserving the initial concept.	

3.38.Compromising and adapting to circumstances

Venturi (1966) states that architecture is not determined by fixed rules and the architect need to compromise, tolerate and improvise and then he adds, "*The architect must decide, and these subtle evaluations are among his principal functions. He must determine what must be made to work and what it is possible to compromise with, what will give in, and where and how. He does not ignore or exclude inconsistencies of program and structure within the order*." (p.41).

3.39.Conclusion

Form in architecture encompasses the shape, structure, and arrangement of a building or object, playing a pivotal role in architectural design. It influences not only the functionality and aesthetic appeal but also the overall environment. The form of a structure is shaped by a multitude of factors, including cultural, historical, social, and technological contexts. It encompasses both the internal and external aspects, such as three-dimensional mass, shape, size, and texture. The relationship between form and function is of utmost importance as they are inseparable and crucial in the design process. Architects skillfully utilize form to craft visually captivating and highly functional buildings that effectively cater to the needs of users and seamlessly blend with the surrounding environment.

Architectural form, at its core, encompasses the intricate interplay between shape, structure, and arrangement that defines a building or object. It serves as a fundamental aspect of the design process and profoundly affects the functionality, aesthetic appeal, and overall environment of the structure. The shape, size, and texture of a building are all elements that contribute to its distinctive form. Form and design in architecture are not merely restricted to the physical appearance of a structure; they go beyond that to include the cultural, historical, social, and technological contexts.

It is emphasized that it is crucial to instruct students on the intricacies of the perceptual process. This entails guiding them in understanding the fundamental principles of Gestalt laws and how they contribute to the comprehension of sensory information and the understanding of how the mental representations are structured.

CHAPTER IV: PARAMETRIC PROCESS AS A DESIGN METHOD

4.1. Introduction

In the realm of architectural design, a cutting-edge and progressive technique known as the dynamic parametric approach has emerged. By harnessing the power the principles of parametric design, this method not only enables the creation of intelligent buildings but also facilitates the seamless testing, analysis, and modification of architectural elements. This comprehensive and sophisticated approach ensures that the resulting structures not only meet aesthetic and functional requirements but also possess the capability to adapt and evolve over time. By classifying complex propositions into multiple layers that can be easily modified, this approach offers durable and sustainable solutions for different situations.

Computer aided parametric design plays a crucial role in the realm of modeling and design processes by providing a wide range of solutions. In this study, there is a focus on exploring the potential collaboration between parametric design and simulation-based tools to create a parametric model that exhibits both a perceived quality and optimized performance. One of the major objectives of this research is to shed light on the significance of perceived quality as a fundamental factor to consider when developing sustainable models. Additionally, the study aims to establish the relationships between this notion, the existing parametric design approaches, and the simulation-based environment. By embracing a responsive process, the proposed model will effectively integrate these concepts, allowing for the testing and application of various parameter variations to overcome design-related challenges. This comprehensive investigation delves deep into the topic, providing an understanding of how the synergy between parametric design, simulation-based tools, and perceived quality can contribute to the creation of innovative and sustainable designs.

Parametric design enables the automatic generation of a wide range of outcomes, forms, and shapes through the use of algorithms and configurable parametric systems that are guided by inputted data. This model can be easily modified by adjusting a list of parameters and executing specific commands, resulting in a more efficient workflow. The approach of parametric design offers a flexible platform for exploring various design possibilities while providing easy access to modeling and simulation data. It opens up multiple avenues to enhance the quality of constructions and analyze the impact of the design process on architectural structures, particularly in arid regions where intelligent environmental solutions are crucial. This inclusive perspective greatly enriches the potential of parametric design in architecture and construction.

On a broader level, the implementation of a parametric system enables the creation of intricate and sophisticated structures by leveraging algorithms and scripting techniques. This approach facilitates the seamless integration of cutting-edge technologies into the construction industry, encompassing automated mechanical design, computationally generated robotic structures, and modern curtain walls (Murray, 2009). Thus, the parametric system's ability to manipulate and adapt design parameters can definitely empower architects.

4.2. Background on Parametric Design

Parametric design, a field that extensively utilizes Computer-Aided Design (CAD), enables the visualization and creation of digital models in various domains, particularly in architecture. This design approach empowers designers with a wide array of options and the capacity to generate numerous solutions through the utilization of algorithms and scripting, often referred to as algorithmic design. When combined with simulation applications, parametric design facilitates a deeper understanding of the nature of a design and offers opportunities for improvement in several aspects, including visual and perceived quality, performance, and comfort. Through this collaborative platform, designers can analyze and evaluate the performance of digitally created models, ultimately adapting solutions that are more suitable for the given context. This comprehensive and intricate approach enriches the design process, fostering an enhanced understanding and the creation of more effective solutions.

Mathematical studies of parametric equations, in particular, are the foundation of parametric design. In the 1960s, when architects and engineers first started using computers to assist in the design process, parametric equations were first used in design. Parametric design did not, however, start to be used extensively in the world of architecture until the 1990s.

Parametric modeling has been recognized for its capacity to improve productivity, respond quickly to introduce changes, and give exact geometric data for both digital manufacturing and performance analysis (Menges, 2006).

Designers can greatly benefit from the emerging CAD technology, particularly during the pre-design phase. This advanced technology offers precise form manipulation, a versatile process, and flexible commands that foster creativity and innovation. Notable software examples of parametric design, such as Generative Components, Grasshopper, and Digital Project, provide designers with enhanced freedom and enable them to focus on the innovative aspects of design production. In order to achieve sustainable designs that positively affect the environment while incorporating new technologies, it is essential to comprehend the correlation between parametric design, simulation tools, and related practices. This understanding facilitates design exploration, quality enhancement, and comfort optimization, paving the way for the creation of environmentally conscious designs.

Parametric design is a powerful approach to three-dimensional designing that involves the utilization of various tools to generate a multitude of forms and shapes through the manipulation of parameters, algorithms, and scripting. Kolarevic (2003) provides a comprehensive description of parametric design, highlighting that it is not the shape of a particular design that is emphasized, but rather the declaration of its parameters. By assigning different values to these parameters, it becomes possible to create different objects or configurations. This is achieved by employing equations to establish relationships between objects, resulting in what is known as associative geometry - a network of interconnected constituent geometries. Through such interdependencies, the way objects behave can be defined through transformations. This concept is further accentuated by Burry (1999), who emphasizes the value of being able to define, determine, and rearrange geometrical relationships in parametric design.

A parametric system can be understood as a complex system consisting of multiple interconnected components. Within this system, the generation of geometries is regulated by a set of rules and parameters that are interlinked. If there is a modification in the properties of a specific element in the geometry, all other associated parts automatically adjust accordingly. This feature ensures the seamless updating of the entire system when changes are made to any part of it (Woodbury, 2010).

A parametric system is comprised of interlinked parameters, where each parameter has a specific value that governs the geometric transformation, behavior, and various design elements of an object (Jabi, 2013). This system enables the precise control and customization of a model by manipulating these interconnected parameters. The values assigned to these parameters dictate how the object behaves.

4.3. Parametric Architecture

Based on the research conducted by Tedeschi et al. (2014), the concept of Parametric Architecture was initially defined by the renowned Italian architect Luigi Moretti. He was recognized for his groundbreaking designs, particularly in the realm of sports facilities such as soccer stadiums and tennis courts. Moretti employed a novel approach by utilizing pseudo isocurves calculations to generate intricate shapes and maximize the visual perspectives within these structures (**Figure 4-1**).

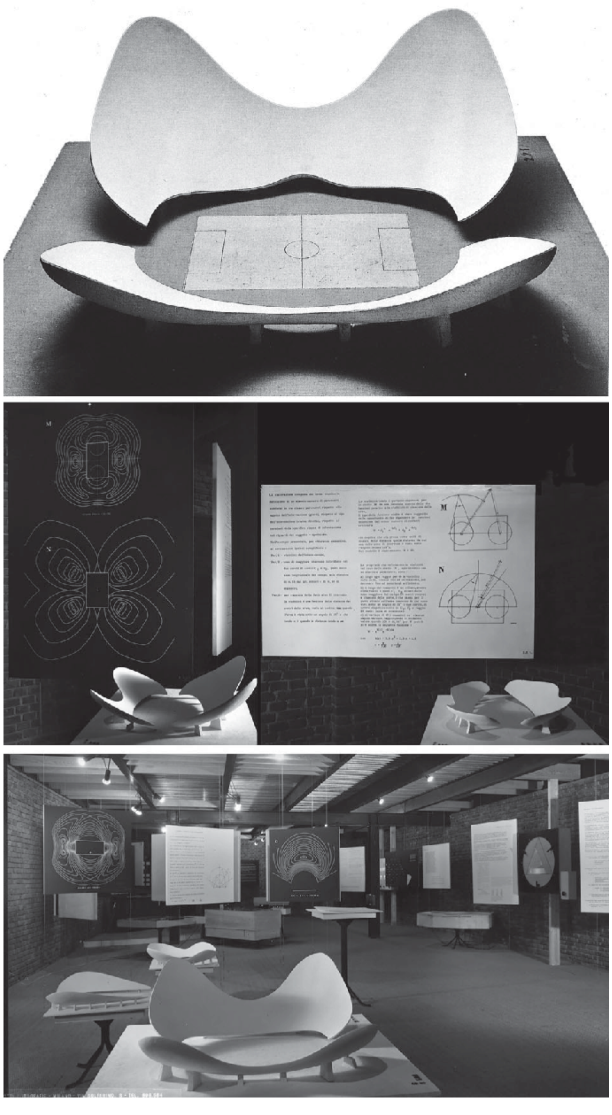


Figure 4-1. *Luigi Moretti's contributions to the field of architecture were exemplified in his models and exposition on parametric architecture, which took place during the renowned Triennale di Milano in 1960. (Bianconi et al., 2019)*

Parametric modeling is a highly beneficial technique that is known for simplifying complex processes. At first glance, it seems accurate to say that parametric models actually reduce complexity, especially when considering Kolmogorov's definition of descriptive complexity. However, upon deeper analysis, it becomes evident that the creation of intricate algorithms necessitates a significant amount of brain activity and energy expenditure. Therefore, while parametric modeling may initially appear to simplify things, it still requires substantial intellectual effort and cognitive stimulation to develop sophisticated algorithms. (Scheurer, 2010)

4.4. Algorithmic modeling

Algorithms are used in the process of parametric design to create and modify intricate geometric shapes. Using this methodology, designers may make intricate forms and structures that would be challenging or impossible to make using more conventional design techniques. The popularity of parametric design, a relatively young area, has increased recently as a result of developments in hardware and software. The history of parametric design, its fundamental ideas and methods, and its influence on modern architectural practice will all be covered in this article.

As per the findings of Tedeschi et al (2014), algorithms serve the purpose of discovering solutions and executing specific tasks by following a predefined set of instructions. In essence, they imitate the cognitive ability of humans to break down a complex problem into a series of simple steps and then efficiently perform computations. Moreover, algorithms facilitate the establishment of associations among different variables, such as fundamental geometries, numerical values, and data. This enables the generation of intricate structures utilizing straightforward and explicit sequences that delineate the interconnections between various components. By employing algorithms, one can foster the creation of sophisticated forms by leveraging the inherent simplicity and clarity of these step-by-step instructions. They are, therefore similar to a recipe that contains various ingredients, and to cook the meal, certain instructions are followed:

- Mix ingredients
- Spread them
- Bake the mix
- Remove from oven
- Cool

In the last decades, the field of architectural design has become increasingly complex, resulting in the need for a meticulous and multifaceted approach to form finding. This process requires a careful consideration of various factors, such as the determination of forms, shapes, and structures.

4.5. Digital tools

The application of digital tools in the modeling and design process originated in the 1970s within the automobile and aerospace industries. Over time, its usage expanded into the field of architecture during the 1980s and 1990s. Presently, digital design plays a significant role in both the architectural and engineering sectors, serving as a fundamental tool for both the design process and the actual realization of projects. Its widespread adoption has revolutionized the way professionals approach design, enabling them to achieve greater precision, efficiency, and innovation in their work.

According to Silvestri (2009), Parametric architecture emerges from the process of digital morphogenesis, where intricate parameters collaborate harmoniously to produce the most optimal form, considering the inherent parameters. This architectural approach demonstrates an intricate interplay between various complex factors, resulting in the creation of a refined and sophisticated design.

Silvestri further discussed an alternative definition of parametric architecture, which can be described as performative architecture. This concept encompasses the generation of form by coupling different parameters. These parameters play a crucial role in controlling and guiding the development of the architectural form to meet a range of criteria (**Table 4-1**). This approach allows for a highly sophisticated and adaptable design process that ensures the architectural solution is optimized and responsive to various needs and requirements. By integrating specific parameters, architects can respond adequately for presented challenges.

Table 4-1: *Examples parameters control and guide the form elaboration according to Silvestri (2009)*

Parameter	Example
Mechanical	The design should minimize bending forces
Functional	The design should contain the maximum possible volume in a certain area.
Thermal	The design should minimize heat dispersion.

4.6. Parametric vs. traditional

Parametric design, with its ability to generate and manipulate design variations based on predefined parameters and algorithms, offers a faster and more alternatives to reduce design work compared to traditional design methods.

Parametric design sets itself apart from conventional design approaches through a multitude of distinctive characteristics. By leveraging input parameters and employing algorithmic procedures, it bestows unrivaled flexibility, adaptability, and efficiency upon the entire design process. Additionally, it empowers designers to optimize their creations according to precise criteria, thereby ensuring the attainment of the most desirable outcomes. Moreover, this unique methodology guarantees the utmost consistency across diverse design elements, solidifying its position as an innovative and indispensable practice in the field of design.

Through the implementation of parametric design, designers and engineers are empowered to modify their projects in real-time, resulting in automatic updates to the model. This enables designers to extensively explore numerous possibilities and alternatives, enabling them to carefully evaluate different options before settling on the ultimate design solution. With the ability to make instantaneous adjustments and view the corresponding changes within the model, designers can efficiently iterate their designs, ensuring a wide range of options.

4.7. Important Ideas and Techniques

Algorithms are used to create and modify intricate geometric forms in parametric design. These algorithms are built on a collection of guidelines or parameters that specify the form's appearance and behavior. These factors may then be changed by the designer to produce a broad variety of unique forms and structures. The capacity to build complicated shapes and structures that would be challenging or impossible to produce using conventional design approaches is one of the main benefits of parametric design. This is so that designers may construct shapes based on mathematical concepts as opposed to trial-and-error methods.

Parametric design is a highly advanced form of modeling configuration that enables designers to effectively manipulate various aspects of their models with exceptional efficiency and minimal effort, as portrayed in Figure 4-2. This is achieved through the remarkable versatility of parametric CAD, which surpasses the capabilities of traditional CAD systems (Forbes & Ahmed, 2011). With its comprehensive range of features, parametric CAD offers designers a robust platform to effortlessly modify and adapt their models, ultimately streamlining the design process and maximizing productivity.

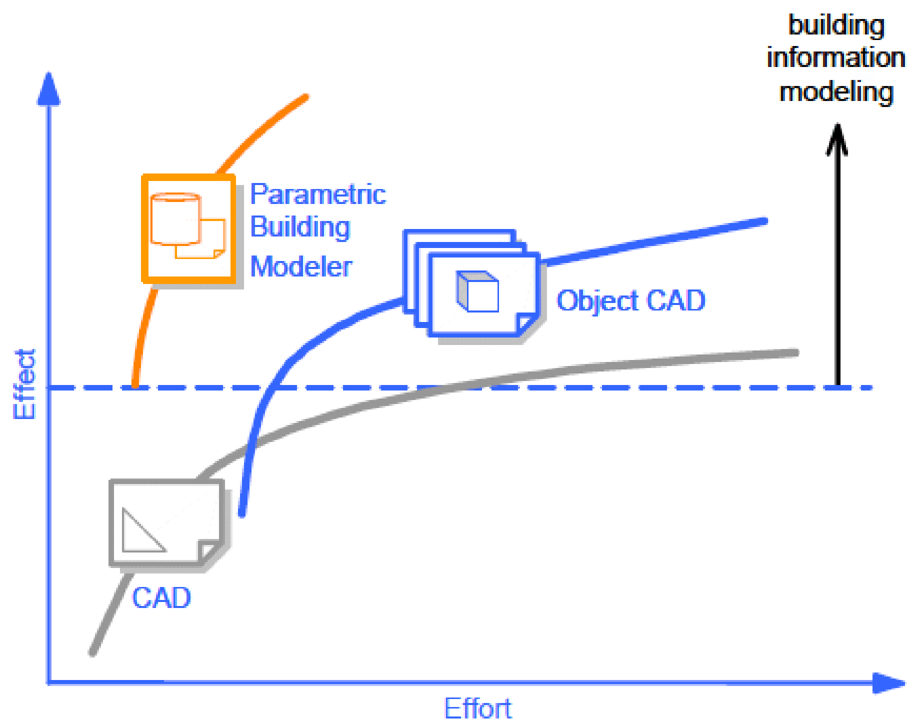


Figure 4-2. *The effect/effort ratio of parametric modeler (Autodesk, 2003)*

4.8. Influence on Modern Architecture

Modern architectural practice has been significantly influenced by parametric design. It has made it possible for architects to design buildings and structures that are more effective, environmentally friendly, and aesthetically pleasing than before. Buildings that can change their shape and orientation depending on the location of the sun are just one example of how parametric design has made it possible for architects to construct structures that are more sensitive to their surroundings.

To sum up, parametric design is an efficient tool that has transformed the discipline of architecture. Complex forms and structures that would be challenging or impossible to develop using conventional design approaches have now been made attainable by it. The profession of modern architecture has been significantly impacted by parametric design, allowing architects to construct structures that are more effective, sustainable, and eye-catching than before. It is anticipated that parametric design will continue to play an increasingly significant role in the discipline of architecture as technology develops.

Using complicated shapes and structures that would be difficult or impossible to produce using conventional design techniques, architects may now create them using parametric design. Examples of parametric design in architecture include the following:

London City Hall, designed by Norman Foster, and The Heydar Aliyev Center and Galaxy SOHO, created by Zaha Hadid (**Figure 4-3**), serve as exemplary showcases of contemporary architecture that demonstrate the innovative use of parametrization through algorithmic design. In addition to merely designing 3D models, parametric CAD tools have evolved to encompass a broader objective, focused on enhancing design quality and optimizing various related aspects. This is achieved through collaboration with integrated or external simulation tools, effectively combining aesthetics with functionality in ways that go beyond mere visual appeal.

Zaha Hadid, an acclaimed architect renowned for her pioneering work in architectural design, is credited with introducing the term "parametricism" and has leveraged this design philosophy to push the boundaries of conventional architectural norms.

Through her out of the box way of thinking, Hadid has consistently challenged traditional norms and explored new frontiers.

Parametric design has proven to be a highly effective method in various architectural and engineering projects, demonstrating its potential in pushing the boundaries of construction innovation. One remarkable example of its application can be seen in the groundbreaking MX3D project in Amsterdam,

By employing parametric CAD tools, architects like Foster[1] and Hadid[2] are able to harness the power of algorithmic design, enabling them to create architectural masterpieces that not only captivate the eye but also fulfill practical requirements. The utilization of parametrization facilitates a dynamic approach to architectural design, allowing for flexibility, adaptability, and efficiency in creating complex structures.

[1] Pritzker Prize winner in 1999, born in June 1, 1935, Manchester, England. Education: Dip.Arch., Manchester University, Manchester, 1961; Cert.TP, Manchester University, 1961; M.Arch., Yale University, New Haven, Connecticut, 1962

[2] Pritzker Prize winner in 2004, born in October 31, 1950, Baghdad, Iraq; Died: March 31, 2016. Education: Diploma Prize, Architectural Association, School of Architecture, London, 1977

Figure 4-3. *Galaxy SOHO by Zaha Hadid Architects (Source: Deutscher, R. (2013). flickr. photograph. Retrieved June 6, 2023, from https://www.flickr.com/photos/bobarc/11448525635/in/photostream/.)*

4.9. Parametric variety

Parametric design offers numerous advantages, making it a highly beneficial approach. One of its key benefits lies in its ability to facilitate the exploration of a wide range of variations with ease.

By modifying the input parameters, designers have the ability to generate an extensive range of design variations, numbering in the hundreds or even thousands. This allows them to thoroughly evaluate and select from a wide array of options, ensuring that the final design is optimal (**Figure 4-4**)

Expanding upon the previous statements, it becomes beneficial to have a comprehensive understanding of various design options, as this enables the architect to explore a wider range of possibilities and optimize the design according to specific criteria.

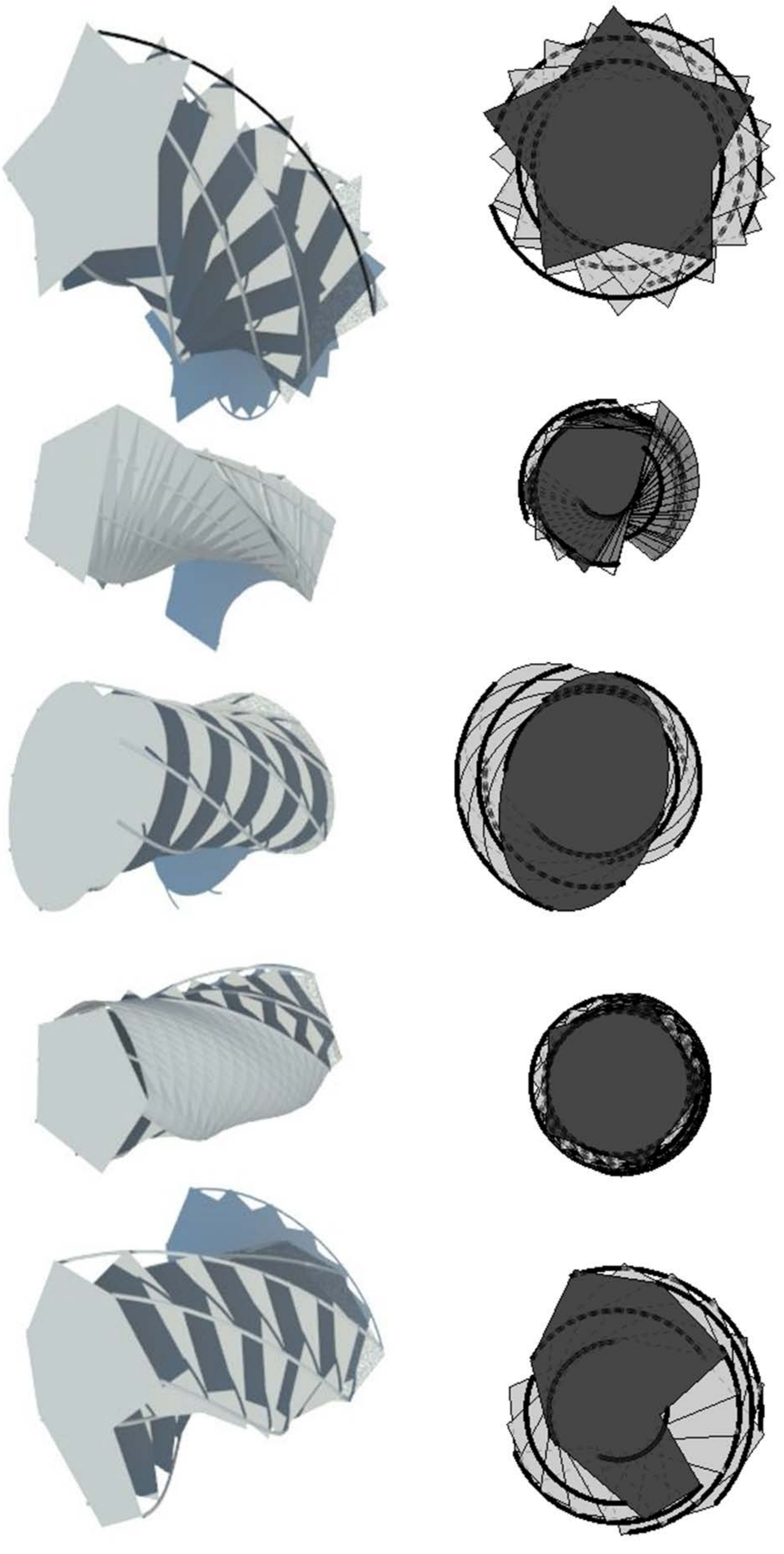


Figure 4-4. *Range of design variations (Source : Author).*

4.10.Parameterization and Multidisciplinarity

According to Silvestri (2009), in the realm of nonstandard designs, the realization of successful projects heavily relies on the collaborative and collective efforts of specialists from various disciplines. This entails the symbiotic relationship between architects and engineers, where their expertise and insights converge to accommodate and address the intricate morphological complexities that arise in relation to two specific aspects:

4.10.1. *Structural solutions*:

To accomplish groundbreaking designs, it becomes imperative to employ inventive and resourceful approaches in conceptualizing structural solutions. This entails going beyond traditional methods.

4.10.2. *Analysis methods and mechanical verification*:

Free forms go beyond conventional systems that are reliant on columns and beams. In order to achieve a harmonious balance between *artistic* and *aesthetic* elements and the scientific and technological aspects, precise and robust calculations are imperative. This entails meticulous consideration of form and function, taking into account both the visual appeal and the structural integrity of the design.

According to Silvestri (2009), gaining a deeper understanding of how our perceptual mechanisms work in interpreting two-dimensional digital images can have significant implications for improving the way we represent information. This, in turn, can ensure smoother and more effective communication among various actors, which is considered a crucial aspect of the multidisciplinary and collaborative design process, particularly in the context of non-standard architecture. By delving into the intricacies of perceptual mechanisms and their role in spatial interpretation, we can explore new avenues for more efficient representation modes and facilitate fluid interaction between different actors involved in the design process.

4.11.Morphology and tectonics

Architecture can be likened to arts and crafts in many ways, as it encompasses various functional aspects that are intertwined with different domains such as symbolism, economics, and even politics. The practice of architecture not only involves creating aesthetically pleasing structures but also requires careful consideration of their context and the related aspects.

According to Silvestri (2009), morphologic and tectonic experimentations of the non-standard architecture manifest themselves through:

- Metaphors
- Suggestions and influences
- Significant ideas and theories from different fields such as: science, art, and technology

Architectural objects play a crucial role in scenography, going beyond their mere presence as components. They are dynamic entities that actively engage with the user, fostering an interactive experience. Therefore, architecture is perceived not just as a physical structure, but rather as an event that emerges from the intricate interplay between individuals and their surroundings. This interaction between humans and their built environment gives rise to a unique and transformative architectural experience (Silvestri, 2009).

4.12.Conception and design

Design in architecture is built upon a foundation of ideas and experiences derived from our perception of the physical world. It is driven by the functionality of a concept, whether it is tangible or conceptual. This motivation plays a crucial role in shaping the design process, but it should not disregard the knowledge and skills that the individual has acquired beforehand. In other words, when creating architectural designs, it is essential to consider both the inspiration derived from the environment and the expertise and understanding that the designer possesses. This methodology to design ensures that the final outcome is not only aesthetically pleasing but also functional and practical (Silvestri, 2009).

According to Silvestri (2009), design is a guided process that encompasses creating something new and innovative, while also making modifications to an existing state. It involves intellectual originality and novelty, as well as the fulfillment of specific needs and requirements. Designing a physical object requires a thoughtful approach that addresses and responds to these needs. The act of design is a creative endeavor that brings about transformation and results in the creation of something that did not previously exist. It is a comprehensive and formal process that involves careful consideration and planning to ensure the desired outcome is achieved. In this light conception has certain characteristics attached to it (**Table 4-2**):

Table 4-2: *Conception characteristics according to Silvestri (2009)*

Characteristic	Definition
Materiality	The primary purpose of architectural design is to bring material entities into existence through the application of specific technologies. It represents the tangible manifestation of the architectural idea.
Needs and constraints	The process of architectural design exists to respond to necessities and satisfy the needs whether they were aesthetic, functional for example, and in this quest, several related constraints may appear, every creative process is prone to face difficulties resulting from the passage from imagination to realization.
Formal and spatial qualities	The process of architectural design concerns the formal qualities, it is about realizing a form responding to the presented necessities, it can be, by extension be described by terms such as morphology and spatial configuration (how the elements are arranged in space) which is the center focus of architectural design hence the space that the provide is equally important to the form itself.

4.13.Spatial design and parameterization

Silvestri (2009) explained in **Figure 4-5** that Spatial design is a complex and dynamic process that involves the iterative exploration and reinterpretation of both mental and physical images. In the realm of spatial design, the interpretation of mental images relies heavily on visual perception. This iterative nature of spatial design implies that it is not a linear progression, but rather a constant reevaluation and refinement of ideas and concepts.

Moreover, he states that there are two modes (**Figure 4-6**), in the process of spatial design:

4.13.1. *Perception*:

That rules the relations between the mental representation and the real object.

4.13.2. *Representation tools*:

That manages the relations between the mental representation and the 2D representation (or parametric and 3D virtual representation).

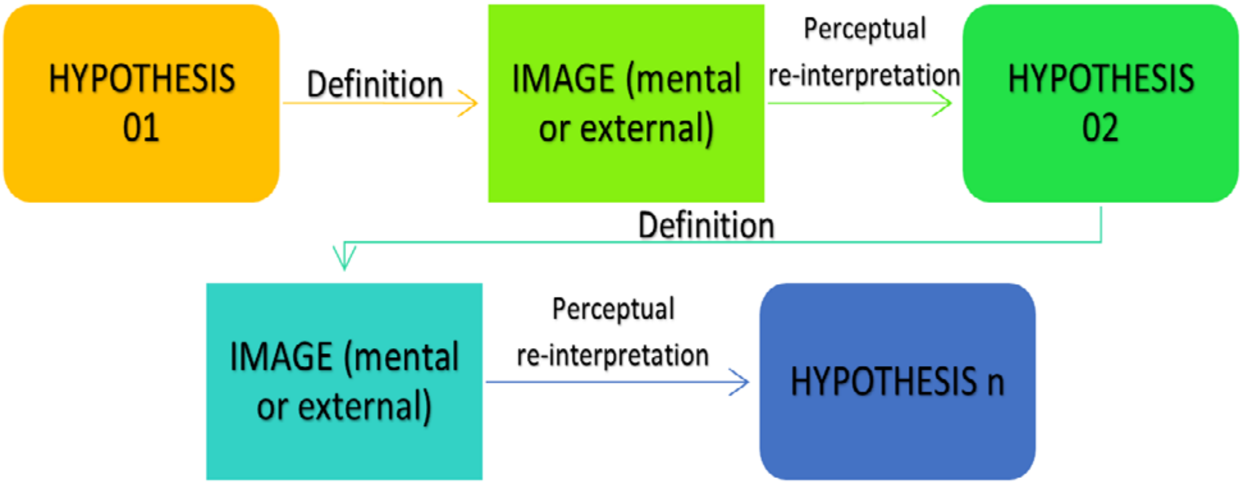


Figure 4-5. *Spatial design as an iterative process. (Silvestri, 2009, modified by author)*

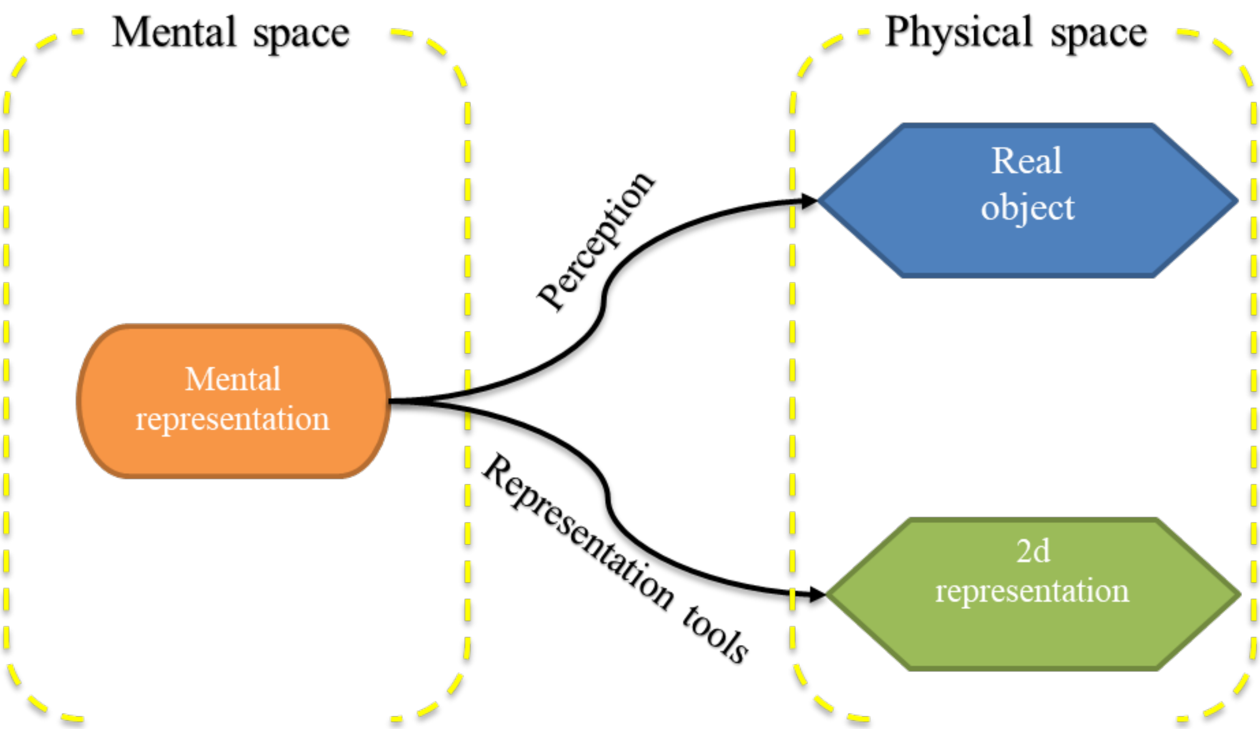


Figure 4-6. *The two modes in the process of spatial design. (Silvestri, 2009 modified by author)*

4.14.Problem resolution processes in spatial design

According to Silvestri (2009) there four processes to solve problems pertinent to the spatial design:

- Heuristic Optimization
- Trial and error and case-based reasoning
- Sequential and iterative process
- Dialectical process

4.14.1. Heuristic Optimization

Heuristic Optimization is the solution searched for by the designer, among an infinite number of solutions and accordingly the designer chose the best solution possible in relation to the confronted obstacles, this solution doesn't necessarily need to be the best, but the most possibly satisfying one to the needs of the user and surely the choices of the designer have major role in the subjective process.

4.14.2. Trial and error and case-based reasoning

Trial and error and case-based reasoning, as the name indicates, it is a process that depends on trial and error, where a number of solutions are tested to choose the most suitable ones and cull the one considered as inadequate and unsatisfying while case-based reasoning refers to the process that consists of solving encountered problems based on the solutions extracted from experience stuck in memory of the designer of similar previous situations, it is a process of analogical reasoning that has a fundamental role in the architectural design as cognitive mechanism used for problem solving.

4.14.3. Sequential and iterative process

The process of spatial design is sequential for it is composed of several fundamental steps:

- Initial ideas
- Definition
- Details

It is a process characterized as being iterative and recursive and consisting of successive repeated analysis and evaluation, with each repetition, the solution is being refined.

4.14.4. Dialectical process

In **Table 4-3,** Dialectical process refers to the continuous interaction occurring between the designer and the object during the process of design.

Table 4-3: *Evolution in design process according to Silvestri (2009)*

Design Process		
Unstructured		Structured
Ambiguous		Unambiguous
Abstract		Realistic
Vague		Detailed

4.15.Parameterization, modeling and representation tools

Table 4-4 summarizes modeling and 3D geometric representation and morphological generation tools.

Table 4-4: *Modeling and representation tools according to Silvestri (2009)*

Modeling Tool	Description
Modeling and 3d geometric representation	Three-dimensional modeling tools (AutoCAD, Archicad) allow for drawing 3d objects in any given form starting from primary elements like lines, circles, surfaces, cubes, etc. they are tools of pure representation and the most used in the construction field.
3d modeling, representation and animation	3d modeling and animation tools (C4D, 3DS max, Maya, and Rhinoceros, etc.) are developed to execute intuitive operations and design complex geometric configurations such as curved and free forms and sequenced objects. These type of tools is widely used in the field of non-standard architecture to generate forms of high complexity.
Mechanical or physical modeling	Physical modeling tools allow for simulating and visualizing physical properties and phenomenon like curved surfaces, thermal flux, Finite elements, and daylight simulation. (Ansys, Ecotect, etc). They are largely employed in fields like construction, engineering, vehicles manufacturing, aeronautics and their use has been extended in non-standard architecture to analyze complex morphologies.
Coupled tools	Also called Computer-Aided Design, Computer Aided Manufacturing, and Computer-Aided Engineering. Coupled tools (CATIA) allow the designer to create unitary models that contain different types of information; geometrical, mechanical and other requirements. Some of these tools were developed for the sake Aerospatiale industries, however, they are also used now in

	architecture to non-standard to find mechanical solutions of complex structures.
Morphological generation tools (associative or parametric tools)	Morphological generation tools (Generative Components) provides the possibility of generating forms based on a system of rules (whether the rules are geometric, organizational or mechanical), In order to create forms and modify them through parameters' coupling. They are also used in the field of non-standard architecture.

4.16.Grasshopper

Rhino Grasshopper, an add-on for the popular commercial 3D computer graphics and design software Rhinoceros 3D, functions as a visual scripting language. Developed by Robert McNeel & Associates, Rhinoceros 3D offers extensive capabilities for creating stunning 3D models in various fields.

Grasshopper is a sophisticated software program specifically designed for parametric design. It offers an array of powerful tools that enable creative designers to effortlessly construct their modeling logic and exert precise control over variations using only a limited number of parameters. This intuitive visual scripting platform serves as a gateway for artists and architects alike, empowering them to explore their inventive ideas with ease and efficiency.

The utilization of this technique enables the development of parametric models, which possess the capability to swiftly generate alterations and variations, thereby automating repetitive modeling tasks.

Grasshopper is an integral part of the Rhino v8 software and comes equipped with a wide array of plugins that enhance its functionality and versatility.

.Grasshopper, a highly adaptable and powerful visual scripting language, has garnered widespread popularity across various industries for its ability to generate a diverse range of designs. Its application extends far and wide, as it has been employed to create captivating designs in numerous fields.

Architects have greatly benefited from the utilization of Grasshopper in their architectural endeavors. This powerful tool enables them to create parametric designs for buildings, facades, and interior spaces. Its versatility lies in its ability to effortlessly adjust panel sizes and generate diverse variations, making it an indispensable asset in architectural project design.

Product design plays a crucial role in today's manufacturing industry. One innovative tool that facilitates mass production of customizable products is Grasshopper. By incorporating powerful plugins like Squid and Pterodactyl, designers are able to take advantage of its extensive capabilities. Additionally, Grasshopper allow for seamless integration and automation.

Generative design has gained popularity in the field of architecture and product design. Grasshopper, a widely used software, has proven to be instrumental in this innovative process. By employing algorithms and optimization techniques, generative design allows for the creation of unique and dynamic designs.

An excellent illustration of this can be found in the work of Arturo Tedeschi, who utilized Grasshopper3D and its plugins to enhance creativity.

Software prototyping can be greatly facilitated by utilizing the extensive capabilities of Grasshopper's API and embedded features. This versatile tool not only enables architects and software developers to create custom applications and visualizations but also serves as a potent prototyping solution. With Grasshopper, professionals can explore and test different software ideas, ensuring that they meet the desired goals.

These illustrative instances exemplify the extensive spectrum of utilization of Grasshopper across diverse design domains. The exceptional adaptability and parametric characteristics of this tool render it highly appealing to designers seeking to forge ground-breaking and streamlined designs.

With its capacity for flexibility and parametric functionality, Grasshopper has emerged as a preferred choice for designers who aspire to produce creative ideas.

Using Grasshopper provides the designer with many opportunities such as:

- Interacting with a vast community of designers, that form a network of users sharing their works and expertise and open the door to fruitful discussions regarding confronted problems.
- Grasshopper undergoes continues updates and improvement, and frequently adds fixes and new features
- Thanks to the variety of plugins and extensions it supports, Grasshopper offers an ecosystem for the designer to achieve his true potential and to operate on many levels of design and analysis (physics analysis, simulations, etc.).
- Grasshopper is flexible enough to make interactions with different software, its compatibility allows for exchanging data in real time with various programs like Archicad, Ecotect, Excel, etc.

- In addition to its compatibility with software, Grasshopper can also interact with hardware to produce intricate and complex physical configurations (Kinect, Arduino)

4.17.Extensions

Rhino and Grasshopper are renowned software tools that have gained a reputation for their extraordinary adaptability and exceptional dexterity. These tools possess an extensive repertoire of features and exhibit a remarkable ability to effortlessly incorporate a diverse array of plugins, thereby amplifying their already impressive capabilities to new heights (**Figure 4-7**). With their unparalleled versatility and seamless integration of various plugins, Rhino and Grasshopper empower designer to explore new ideas, ranging from architectural design to engineering analysis such as:

- Ladybug (solar access, shadows, etc.),
- Honeybee (daylight (Radiance), comfort and energy (EnergyPlus),
- Karamba (Finite Element Calculation, etc.),
- Millipede (structural analysis and optimization).
- Kangaroo (physics engine for interactive simulation, optimization and search formulas).

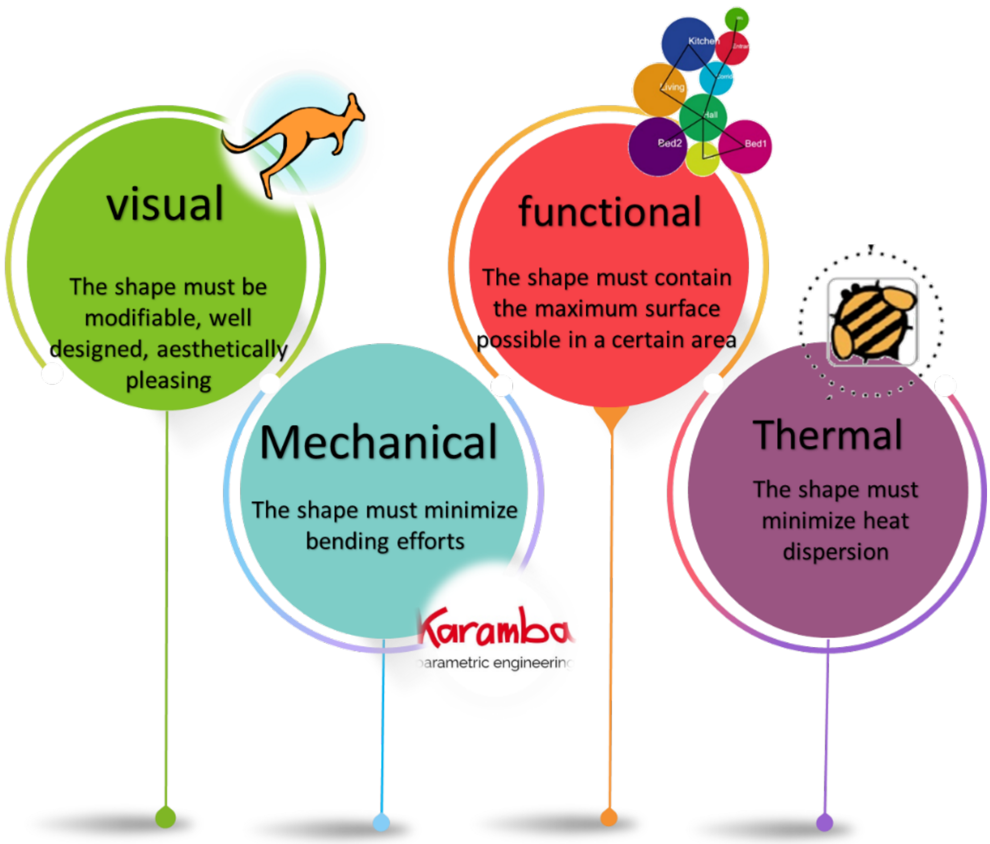


Figure 4-7. *The parameters mentioned above are instrumental in ensuring a formal elaboration (Source: Author).*

The parameters that govern the formal elaboration represent indicators that determine the perceived quality of a structure. They possess unique qualities and characteristics that distinguish them. These parameters act as benchmarks for assessing the overall excellence and quality of the building. Mazouz and Zerouala (2001) underlined the importance of incorporating environmental factors and variables in architectural design.

4.18. Control parameters

Parametric design is a comprehensive design approach that employs algorithmic procedures to mold various aspects, including building elements and engineering components, instead of relying solely on manual manipulation. This advanced method allows for the creation of intricate and elaborate designs by utilizing mathematical algorithms and parametric modeling techniques (**Figure 4-8**). Mathematical modeling can be integrated in architecture and town planning research as highlighted by Derradji and Aiche (2014), in their work.

In this comprehensive approach, the connection between design intent and design response is established through the utilization of parameters and rules. The term "parametric" pertains to the input parameters that are incorporated into the algorithms.

This perspective emphasizes the significance of parameters in guiding the outcome of design decisions.

These processes involve the optimization of specific design goals in relation to a defined set of design limitations. This enables the discovery of the ultimate configuration of the designed entity, which is determined by these constraints. Such optimization techniques ensure that the final form and structure of the object are achieved by effectively balancing the design objectives.

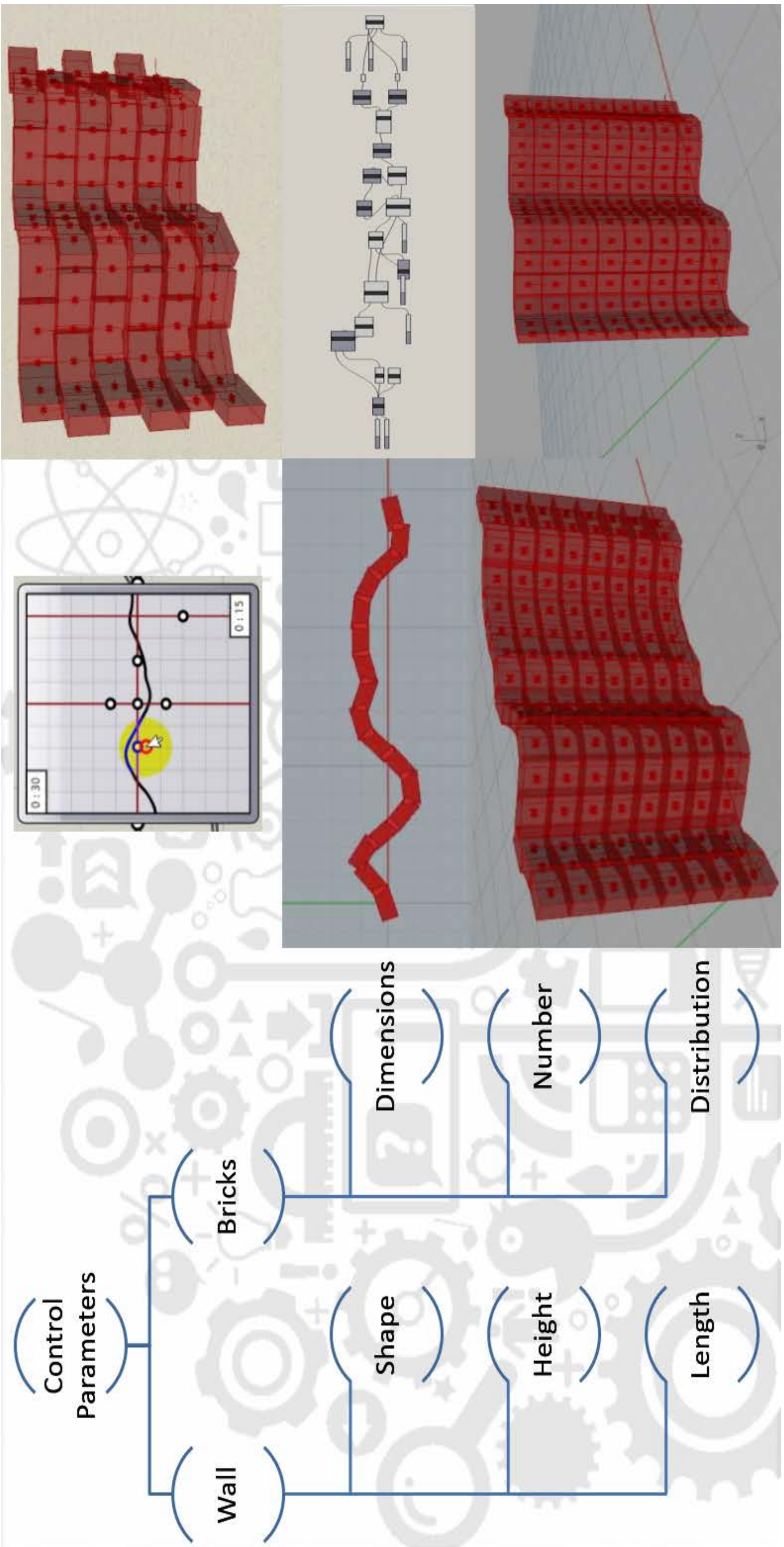


Figure 4-8. *Design control parameters (Source : Author).*

4.19.Components

Grasshopper encompasses an extensive array of components that fulfill various functions, encompassing geometry-related operations, as well as an assortment of other commands. These components are organized into distinct tabs based on their properties and intended purpose (**Figure 4-9**). For instance, surface components are grouped together, as are grid components, facilitating ease of access and streamlined workflow. This organizational structure not only enhances user experience but also promotes efficient utilization of the Grasshopper platform.

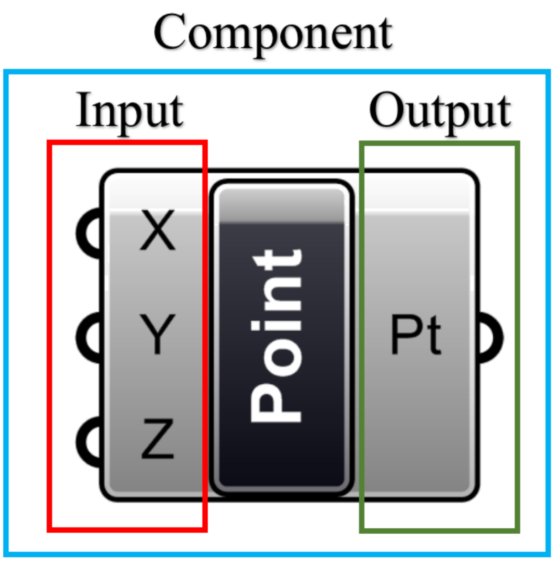


Figure 4-9. *Point component (Source: Author).*

4.20.Curvature

The term "curvature" refers to the characteristic of a segment or shape that allows it to smoothly change direction without forming any sharp angles. In other words, a curved line contrasts with a straight line by its ability to flow gracefully. Curvature entails a gradual transition and a continuous change in direction, imparting a sense of fluidity and elegance to a form or trajectory, in addition to the ability to control it parametrically. It is related to *curvedness* vs. *linearity* (Silvestri, 2009).

4.21.NURBS / splines

According to Tedeschi et al (2014), the term NURBS, which stands for "Non-Uniform Rational B-Splines," refers to 2D lines or curves that have the capability to generate intricate 3D geometries and complex freeform surfaces using mathematical calculations. These NURBS play a significant role in computer graphics, design, and modeling. They characterized by:

- Degree: it represents a positive and integer number:
  - NURBS-lines and equally NURBS-polylines represents degree 1
  - NURBS-circles represents degree 2
  - Free-form curves represents degree 3 or 5.
- Control-points: NURBS curves are manipulated using control points (weight)
- Knots: the smoothness of the curve is controlled by a list of numbers, which are knots.
- Evaluation rule: it consists of:
  - Inputs: degree, control points and knots
  - Outputs: location of a point.

Splines and NURBS (non-uniform rational B-spline surfaces) originated in the 1950s within Renault and Citroen laboratories, where they were developed as mathematical representations for curves and curved surfaces. These innovative concepts quickly gained popularity among architects who sought to incorporate them into their design processes. Since their inception, splines and NURBS have become integral components within the program menus of architects, enabling them to create more intricate and visually appealing designs (Scheurer, 2010).

According Silvestri (2009) NURBS (Non-Uniform Rational B-Splines) and splines play a significant role in design applications, thanks to their close resemblance to the spontaneous perceptual geometry. These mathematical tools are highly efficient in spatial design. By utilizing parametric curves, designers can effectively rationalize the variables that govern curved forms. This is made possible through the use of control points, which allow for easy manipulation and offer a high level of precision.

The NURBS and splines techniques have proven to be invaluable in the field of design, particularly due to their ability to be manipulated to generate free forms.

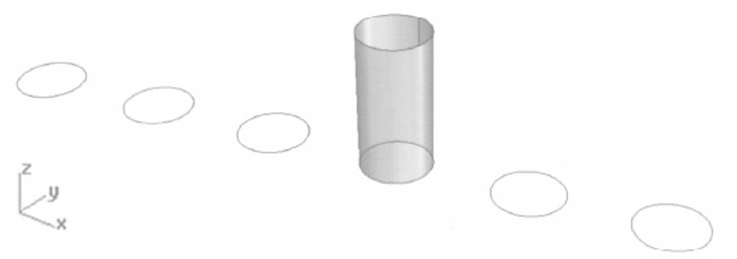
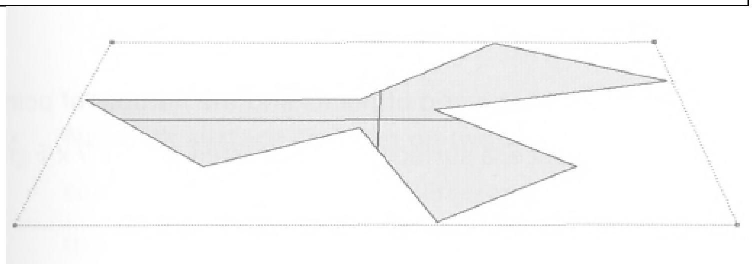
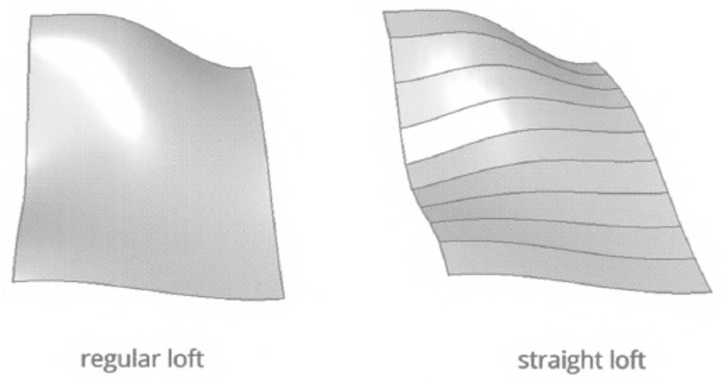
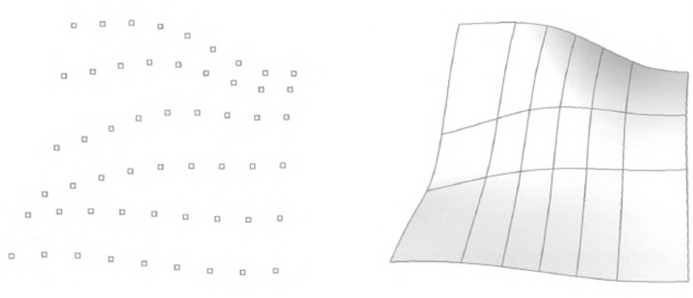
4.22.p-forms

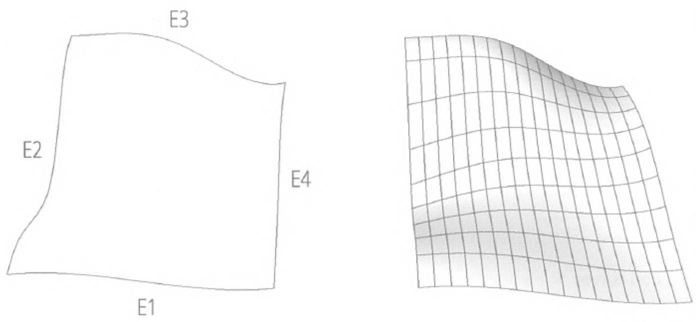
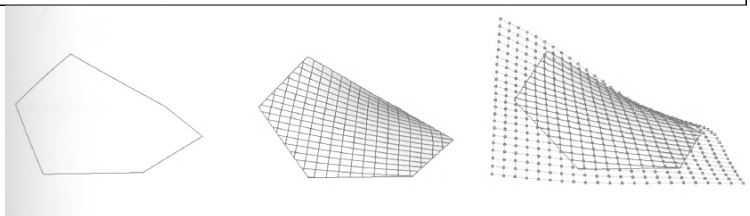
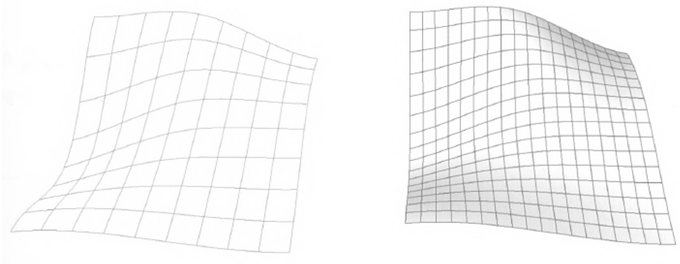
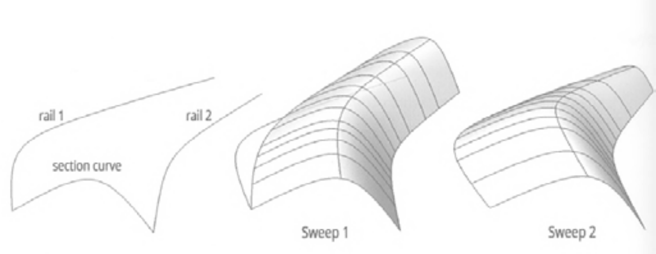
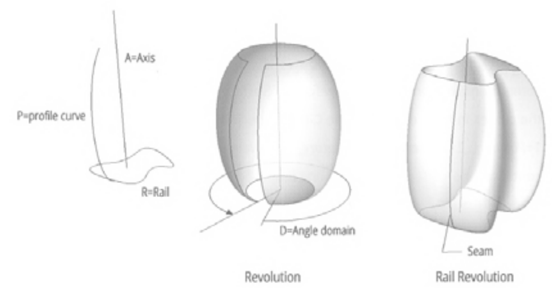
According Silvestri (2009), p-forms are parametric curves that can be used to represent curved forms through successive approximation steps starting from a simple geometric concept which is the ratios between the midpoints of two segments or the position of three points.

4.23.Surface

Grasshopper offers a variety of components that enable the creation of surfaces. These components are conveniently located in the free-form panel of the Surface tab (**Table 4-5**).

Table 4-5: *Surface parametric creation (Tedeschi et al., 2014)*

Surface	Definition	Example
Extrude	Through the component extrude, a surface either can be created from an open or closed curve following a determined victor.	
Boundary surface	It is a planar surface generated from a group of boundary edge curves.	
Loft	The creation of the surface is done through a group of orderly successive profile curves. When adjusting the profile curves, the surface changes accordingly.	
Surface from points	A grid of points is used to generate the surface; the points can be manipulated through mathematical function to produce different types of surfaces.	

Edge surface	The component edge surface uses 2, 3 or 4 edges to generate a surface.	
Patch	A set of perpendicular curves are generated by the component patch to create a fitted surface.	
Network surface	Allows for creating surface from curves in the u direction and v direction (forming a network of curves)	
Sweep 1 and Sweep 2	The surface is generated by following two rails using a section curve	
Revolution and Rail Revolution	By revolving a profile curve around a certain axis the surface is created. The profile curve needs to follow a determined a rail.	

Frank Gehry's[3] approach involves utilizing flexible sheet materials to construct models, allowing him to analyze the intricacies of their geometries and subsequently design buildings that align with those findings. By adopting this methodology, Gehry seeks to gain a comprehensive understanding of the inherent characteristics and potentials of these materials (Tedeschi et al., 2014) (**Figure 4-10**).

Figure 4-10. *MARTa Herford Museum by Frank Gehry (Source: Herford MART. (n.d.). wikimedia. Retrieved May 29, 2023, from https://commons.wikimedia.org/wiki/File:Herford_MARTa_88.jpg.)*

[3] Pritzker Prize winner in 1989, born in February 28, 1929, Toronto, Canada. Education: B.Arch., University of Southern California, Los Angeles, 1954

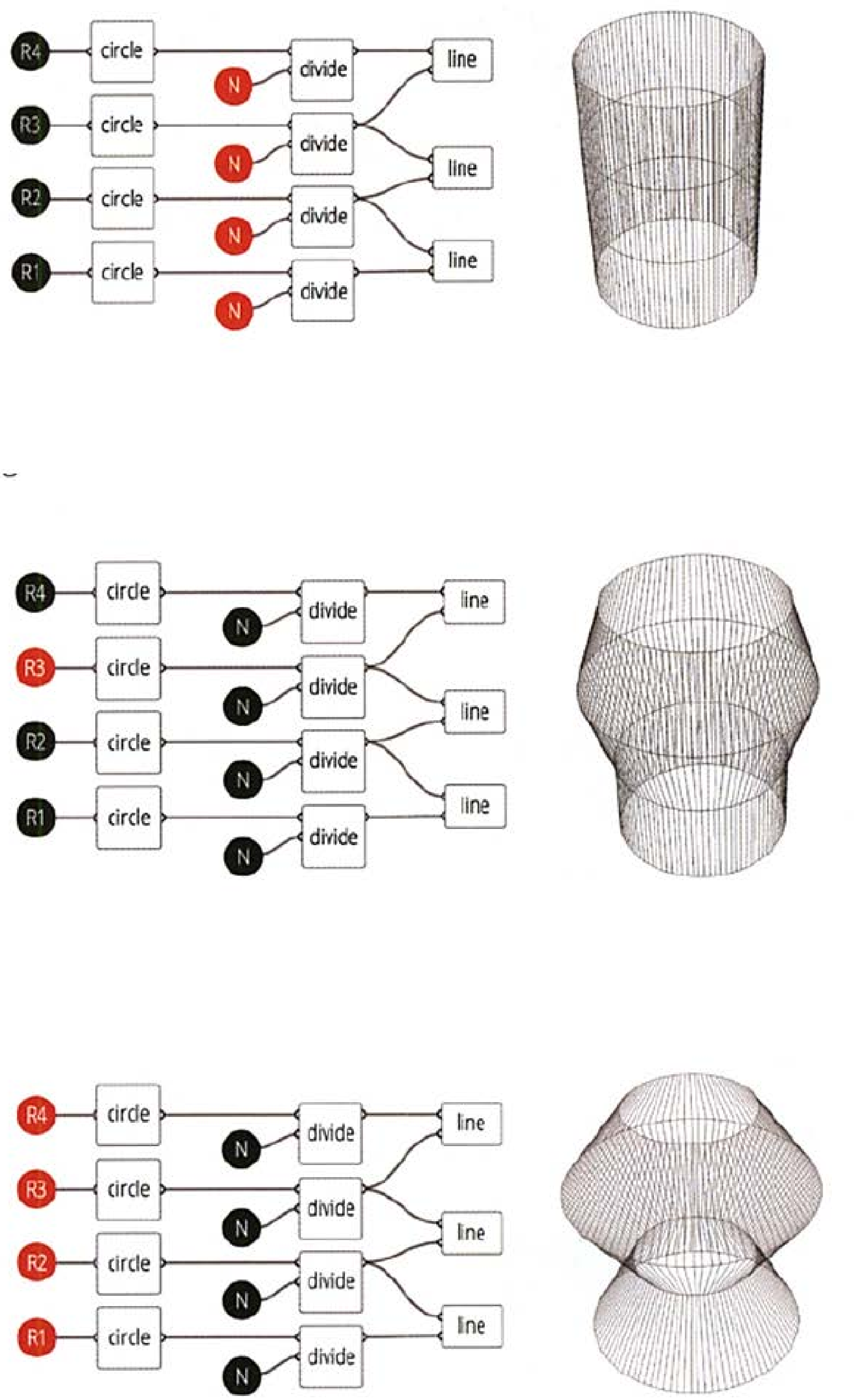


Figure 4-11. *Geometry manipulation through parameters through R component. (Tedeschi et al., 2014)*

The geometry can undergo another modification through the manipulation of the R components (R1, R2, R3, R4) (**Figure 4-11**).

Ruled surfaces, which are formed by a series of straight lines, offer significant manufacturing benefits that should be taken into account (**Figure 4-12**). These advantages can be observed when considering the production of ruled panels using glass-fiber-reinforced concrete, which can be more efficiently manufactured compared to the conventional approach of producing double-curved panels (Pottmann, 2010).

Figure 4-12: *Ruled surfaces consisting of curves (Pottmann, 2010)*

4.24.Weaving

Weaving is a highly intricate and meticulous technique employed to create a visually captivating surface that consists of a complex arrangement of interlaced and threaded patterns in both the U and V directions, achieved through the strategic manipulation of the vertical (warp) and horizontal (weft) threads. This art form derives its beauty from the interplay between two threads that gracefully transition between positive and negative points on the grid-like surface, resulting in captivating and interwoven configurations (**Figure 4-13**).

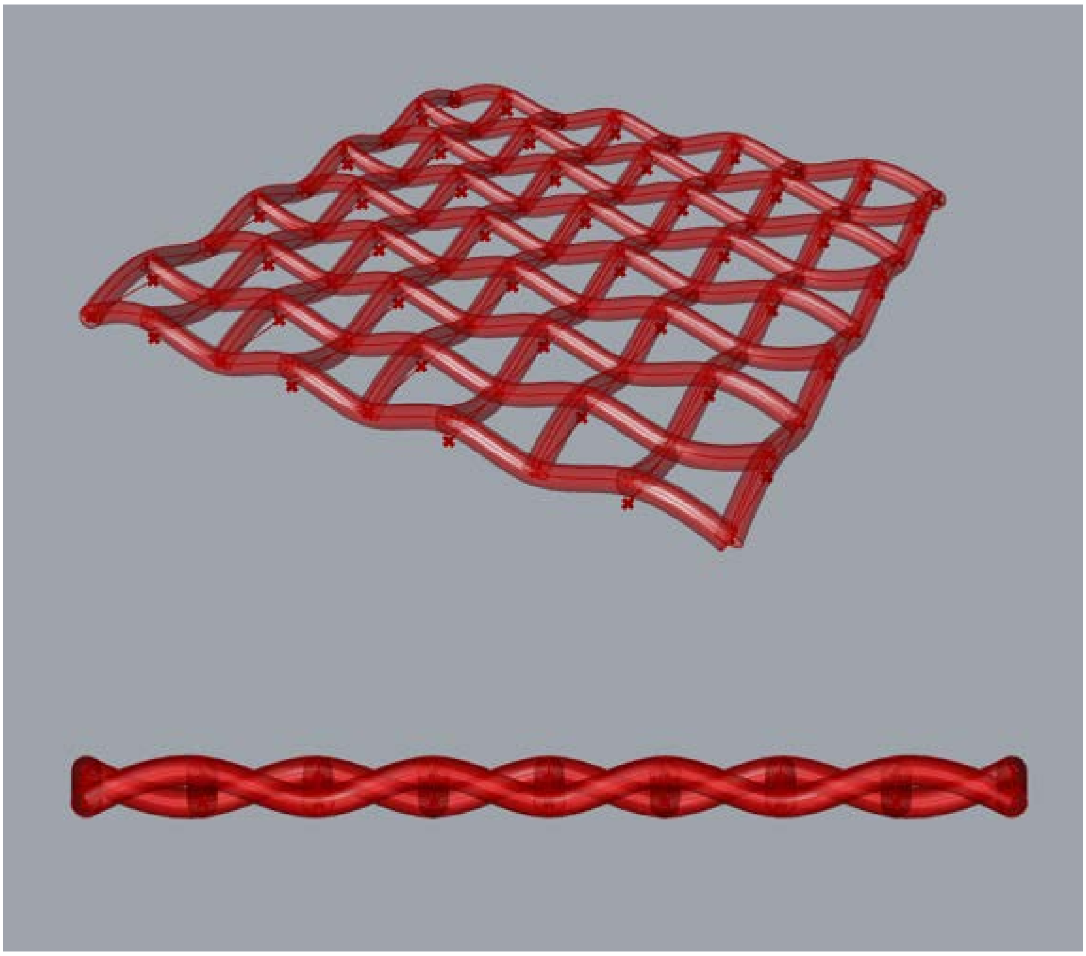


Figure 4-13. *Weaving is a technique composed of interlaced and threaded patterns in both directions (U and V) (Source: Author).*

4.25.GECO and Ecotect/ Grasshopper connection

GECO consists of a group of components within Grasshopper allowing real time data exchange between Ecotect and Grasshopper. The flexibility and intuitiveness of the working process between the two tools and the interactive environment (real-time feedback for complex model geometries) give the designer the possibility to control multiple parameters related to:

- Thermal performance
- Solar radiation analysis
- Daylighting analysis
- Shadows analysis
- Acoustical analysis.
- Environmental optimization

Simulations can be conducted to determine the appropriate inclination of louvres in relation to the sun position and produce different configuration for shape optimization according to solar radiation and weather data (**Figure 4-14**).

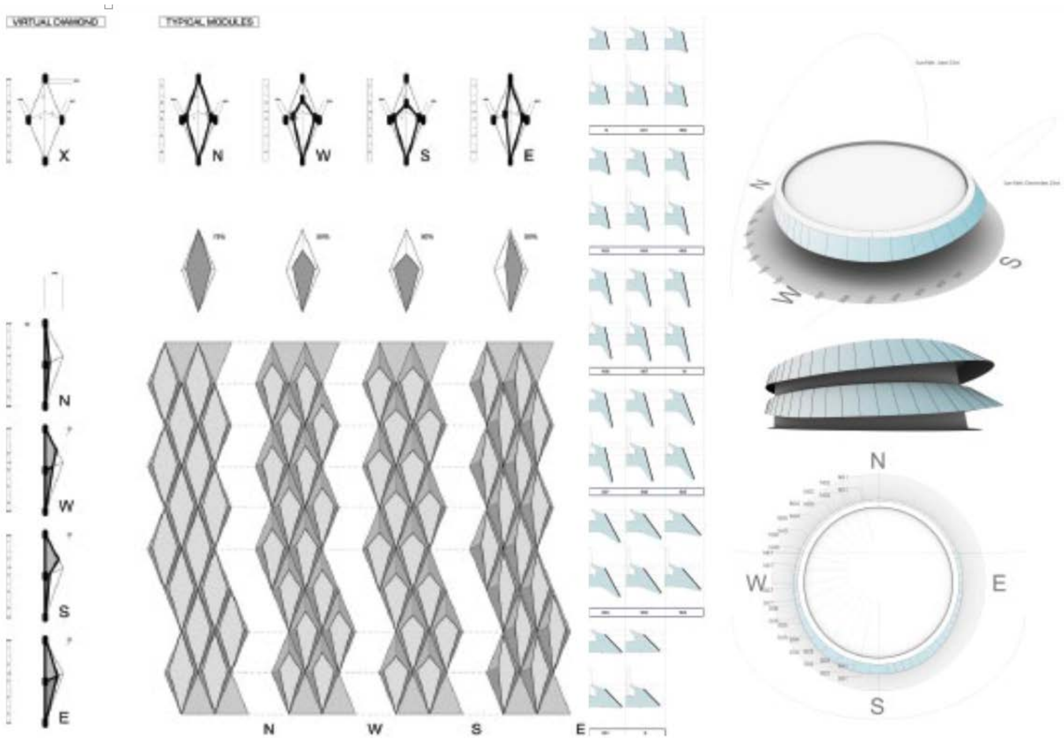


Figure 4-14. *Simulation and form optimization (Tsigkari et al, 2011)*

4.26.Archicad/ Grasshopper connection

The Archicad extension comprises a collection of components integrated within Grasshopper, enabling the seamless exchange of data in real time between Archicad and Grasshopper. This powerful integration facilitates a flexible and intuitive workflow between the two tools, creating an interactive environment that provides real-time feedback for intricate model geometries. With this advanced functionality, designers are empowered with the ability to manipulate multiple parameters, granting them ultimate control over their designs (**Figure 4-15**).

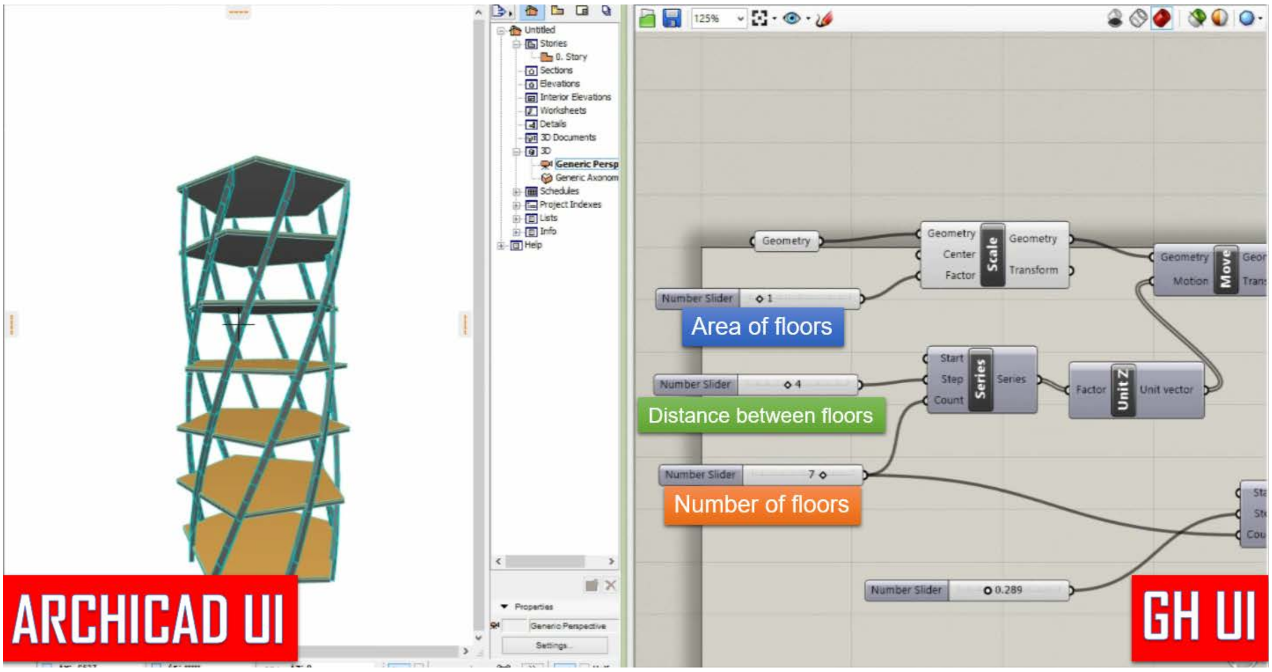


Figure 4-15. *Archicad/ Grasshopper connection (Source: Author).*

4.27.Python Introduction

In 1991, the renowned software engineer Guido van Rossum took the initiative to conceive and publish Python, a highly popular high-level programming language that is widely utilized in various domains for general-purpose programming. Python, with its dynamic type system and automated memory management, has garnered immense recognition and usage over the years. Additionally, Python offers an extensive and comprehensive standard library. It additionally supports an array of programming paradigms such as:

- Object-oriented programming
- Imperative programming
- Functional programming
- Procedural approaches

The Python programming language offers a wide range of data structures and functions that play a crucial role in data science programming. This chapter extensively explores these essential components and their diverse applications in architectural design. By thoroughly comprehending these elements, designers can efficiently establish a foundation for handling data and creating algorithms that enable them to generate a multitude of designs over time. This comprehensive understanding not only facilitates the initial development of programs but also empowers designers to advance their skills in data science programming and achieve their long-term goals in the field of architecture.

To effectively utilize Python and develop innovative solutions that cater to specific needs, it is crucial to have a deep understanding of manipulating data structures and procedures. These techniques enable the creation of novel approaches to combining data structures to fulfill the outlined requirements. While each data structure serves a distinct purpose, certain situations may necessitate the utilization of multiple data structures in conjunction with one another. This amalgamation of diverse data structures allows for a more comprehensive and sophisticated solution to complex problems (Subramanian, 2015). By harnessing the power of data manipulation and the versatility of Python, professionals can achieve enriched outcomes and unlock new perspectives.

4.28.Scripting with python

Due to the limitations imposed by macros, scripting languages have gradually emerged as a solution. These scripts can be seen as a hybrid of macros, actual applications, and plugins, resulting in a versatile and powerful toolset for developers. Unlike macros, they can conduct:

- Mathematical operations
- Assess variable conditions
- Adjust to their surroundings
- Engage with the user

In stark contrast to programs, scripts have the advantage of not requiring prior compilation in order to be executed. Rhinoceros, a software platform, offers an implementation of the Python programming language, allowing users to harness its power and versatility.

When it comes to computer programming, scripts serve as text files that are executed line by line. In contrast to macros, scripts have the ability to dictate the order in which each line is executed. This level of control grants scripts the capability to skip or repeat specific commands, a feature facilitated through a practice known as "conditional evaluation." This approach grants programmers increased flexibility in designing programs that can adapt to varying conditions and requirements. Through conditional evaluation, scripts are empowered to take autonomous decisions based on set criteria.

Python is a programming language that boasts a straightforward yet potent syntax, robust methodologies for programming, object-oriented characteristics, and an extensive community of developers who have contributed to building a substantial user-built library community.

4.29.Structuring

In accordance with Oxman and Oxman (2010), structuring refers to the process by which a logical connection between different architectural elements is established, forming a coherent whole (The procedure through which the logic of a distinct parts-to-whole relation arises between architectural elements). This process is informed by architectural theory, which provides a cultural framework for understanding tectonics and its transformative role in creating configurative patterns. The concept of digital tectonics allows for the parametric representation of this transformative creation, further enhancing the understanding and application of structural design principles in architecture. It provides:

- The mathematical/geometric logic
- The syntactic and formal logic:
    - Branching
    - 3-D packing
    - Voronoi patterns
    - Fractals

4.30.Form generation synthesis

Hyperboloid of revolution

$$\frac{x^2}{a^2} + \frac{y^2}{a^2} - \frac{z^2}{c^2} = 1,$$

Hyperbolic paraboloid

$$z = \frac{y^2}{b^2} - \frac{x^2}{a^2}$$

Figure 4-16. *Hyperboloids of revolution and hyperbolic paraboloids and their mathematical formula (Burry, 2011)*

Buildings can be considered as intricate assemblages of various components that work together to create a functional and aesthetically pleasing structure. When modifications or changes are made to the design of a building, it becomes imperative for these sets of components to adjust accordingly. This entails a thorough examination and adaptation of the information contained within the collections, with each individual component needing to accommodate the specific alterations made (**Figure 4-16**).

Parametric design tools bring forth a completely new range of concepts and ideas that professional designers might not be acquainted with. These tools not only introduce unique functionalities but also require a different approach to design compared to traditional ones. According to Menges (2006), these notions are derived from:

- Design theory
- Computational theory
- Object-oriented software engineering

A parametric modeling system that involves a subdivided host surface. This surface is defined by two perimeter curves, and the curves are essentially determined by sets of three points. These points have coordinates that are continuously updated through an iterative process. The update is controlled by a function that is influenced by a coefficient, which in turn generates pseudo-random values (Menges, 2006) (**Figure 4-16 and 4-17**).

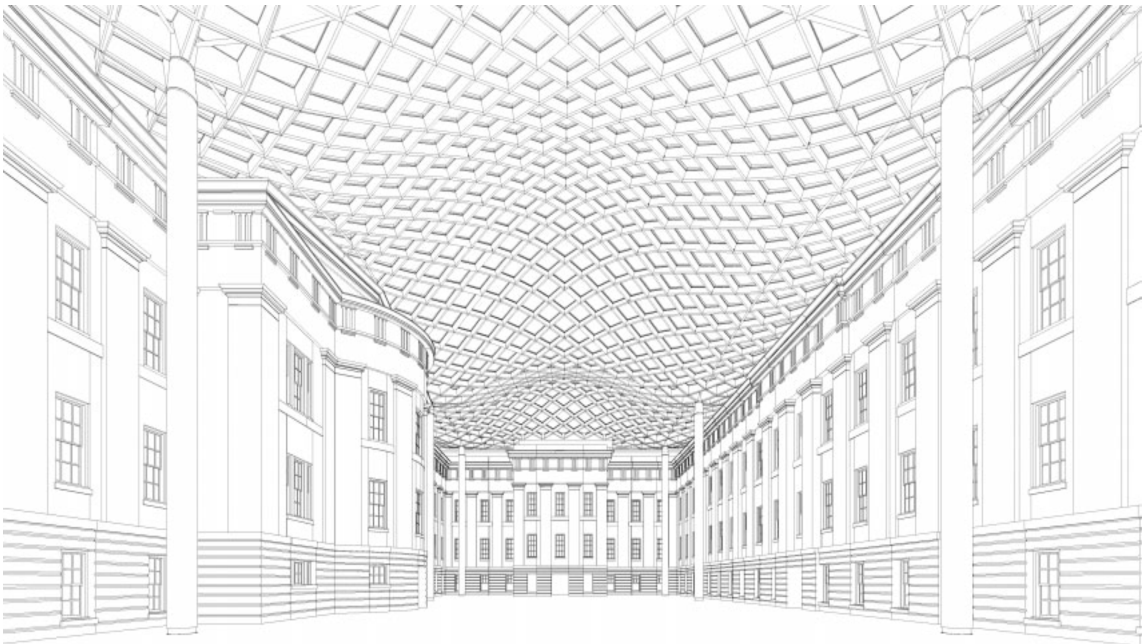


Figure 4-17. *Study of a courtyard enclosure interior. (Menges, 2006)*

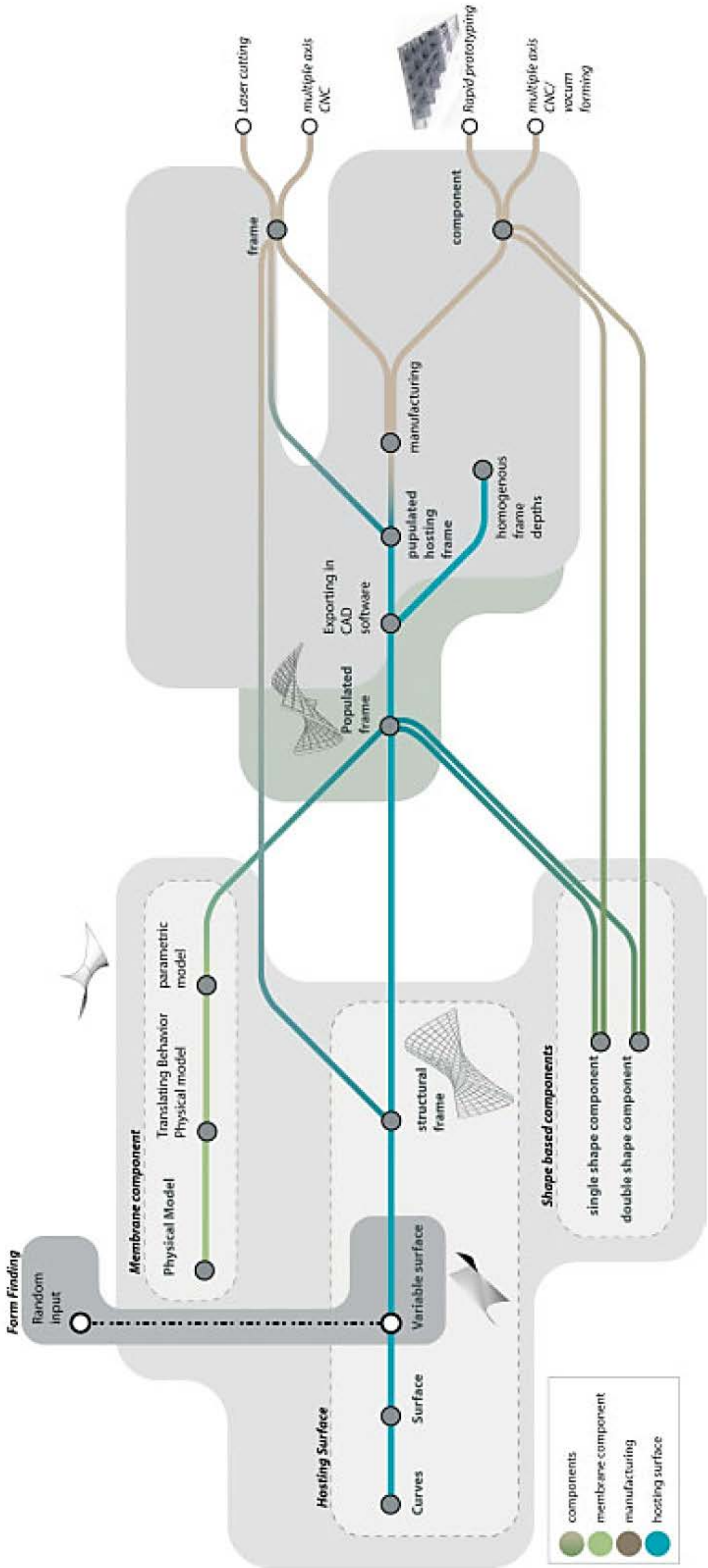


Figure 4-18. *Flow graphic illustrating form generation synthesis, Giannis Douridas and Mattia Gambardella (Hensel & Menges, 2006)*

4.31.Categories for generating geometrically intricate forms

Mangelsdorf (2010), in **Table 4-6,** cited four categories for generating geometrically intricate forms (example in **Figure 4-19**):

Table 4-6: *Categories for generating geometrically intricate forms (Mangelsdorf, 2010)*

Category	Definition
Form-Finding	Form-finding concerns the creation of engineered minimum surfaces based on physical restrictions, such as doubly curved tension or compression structures.
Simple Mathematical Geometry	This classification includes complicated geometries founded on elementary mathematical geometries such as the sphere, cylinder, torus, line, circle, and ellipse.
Free Form	The notion of free form explains the development of the shape independent of physical restrictions or the limits of basic mathematical geometries. As a result, there is nothing to direct the structural engineering design.
Hybrid Approaches	The inherent constraints of comprehensive free form requires combining the characteristics of all three approaches outlined previously. It provides for a considerable degree of freedom in the generation of the form while incorporating physics-based notions.

Figure 4-19. *The Smithsonian's grid shell is built on a quadrangle system. (Mangelsdorf, 2010).*

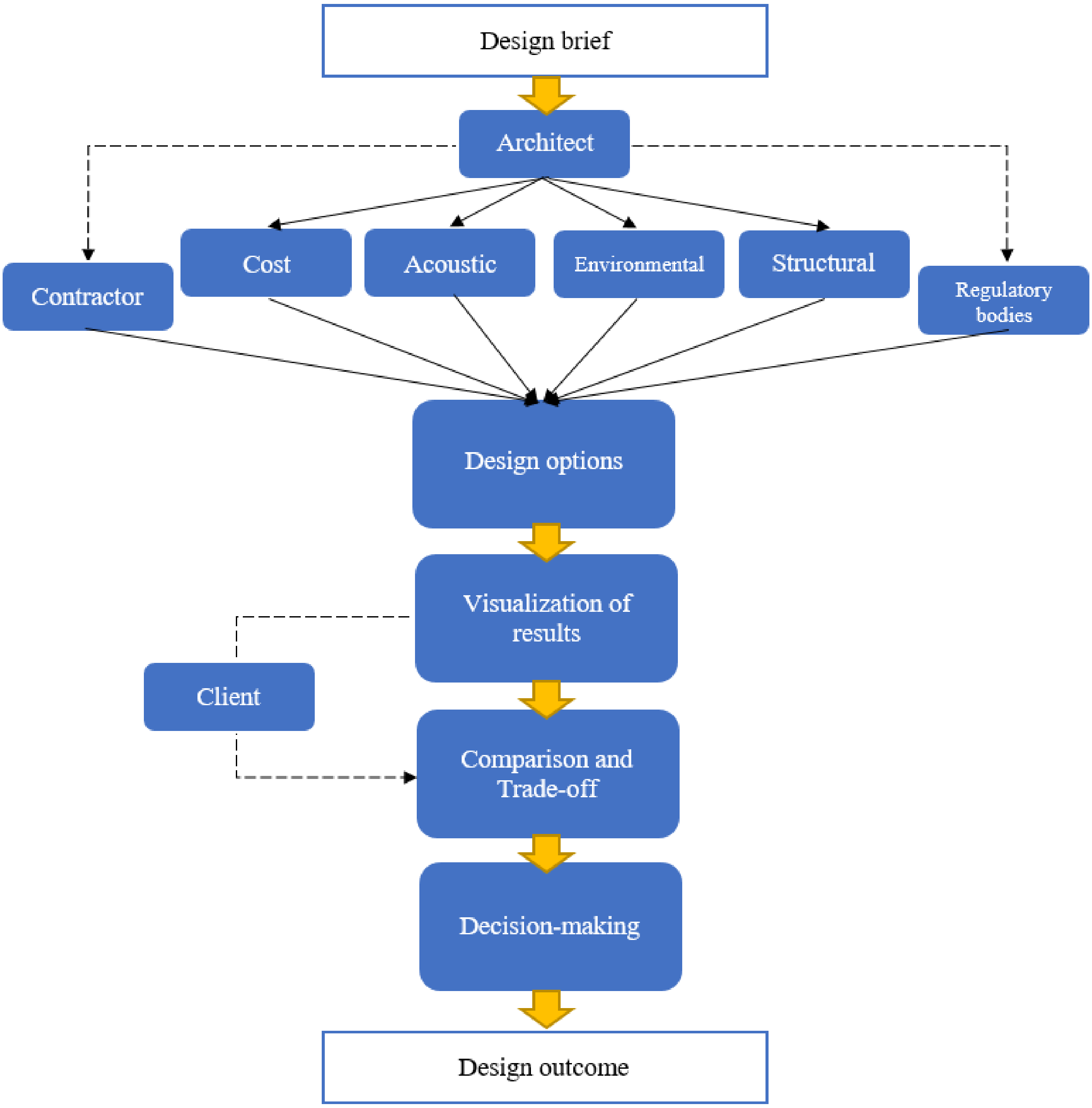


Figure 4-20. *Semi-automated design (Holzer & Downing, 2010)*

During the design process, there are numerous factors that come into play and demand the architect's careful integration within their design options. It is crucial for the architect to consider and incorporate these factors into their creative decisions. Subsequently, the architect proceeds to develop a visualization that harmoniously combines these various elements (**Figure 4-20**). This visualization is then presented to the client, who eagerly awaits the opportunity to provide feedback. This feedback serves as the basis for any necessary modifications and ultimately shapes the final design outcome (**Figure 4-21**).

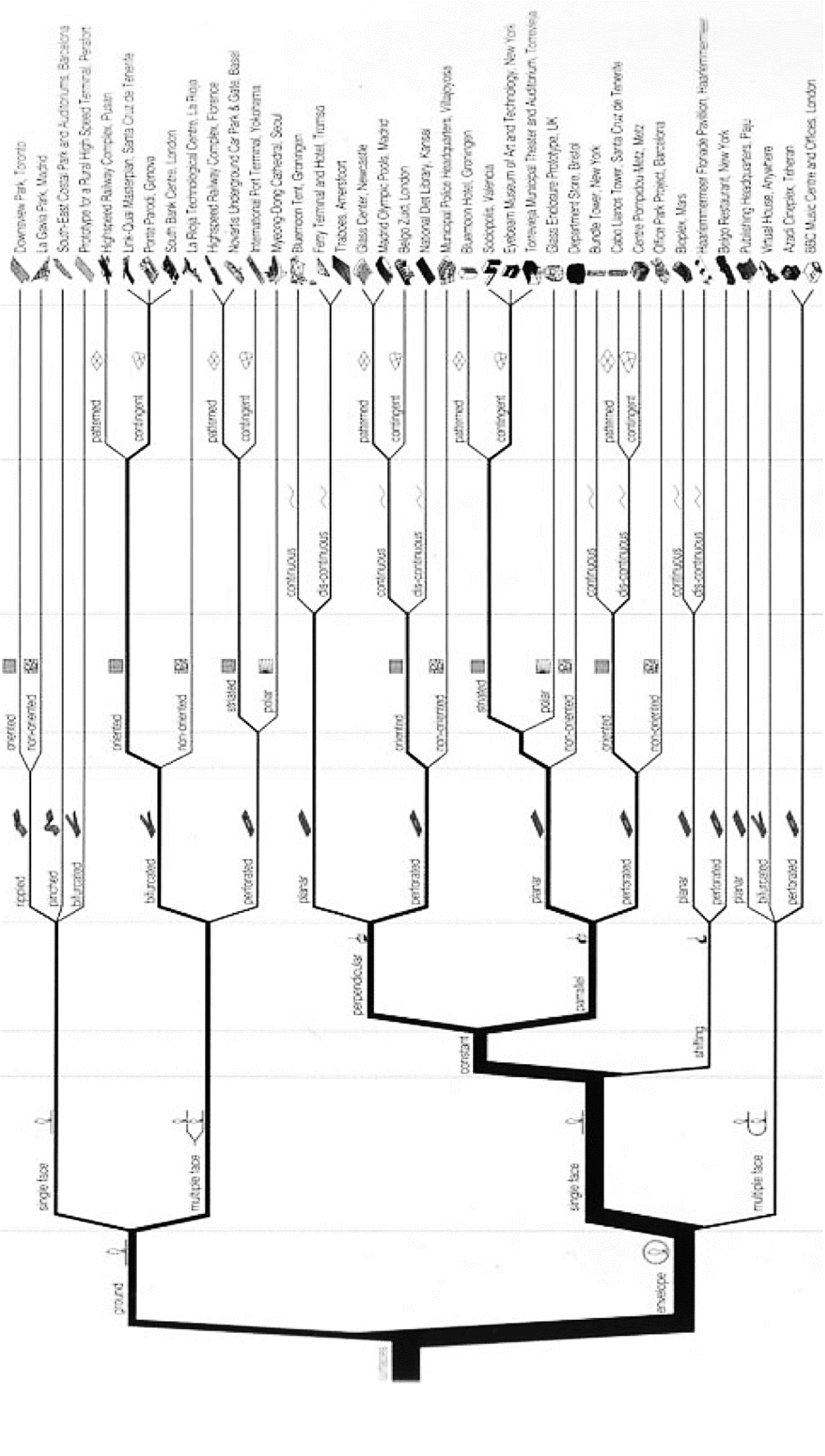


Figure 4-21. *Foreign Office Architects' Phylogenetic tree for projects surface generation (Moussavi & Polo, 2004)*

4.32.Timber fabric

According to Weinand & Hudert (2010), Timber is gaining popularity as a modern building material. The inherent characteristics of timber such as:

- Sustainability
- Pliability
- Flexibility
- The ability to retain a certain form
- Strength
- Versatility
- Adaptability

These attributes render it highly appealing to designers who seek to engage in creative exploration and experimentation.

The utilization of a recurring structure is indispensable in the fabrication of structural wood textiles. This entails the incorporation of the Textile Module, which consists of two planar wood panels ingeniously interlaced through a braiding technique (**Figure 4-22**). By implementing a specific assembly process and selecting materials that possess suitable characteristics, an exceptionally sturdy and durable construction is achieved (**Figure 4-23**). This approach proves to be structurally efficient, ensuring optimum performance and longevity (Weinand & Hudert, 2010).

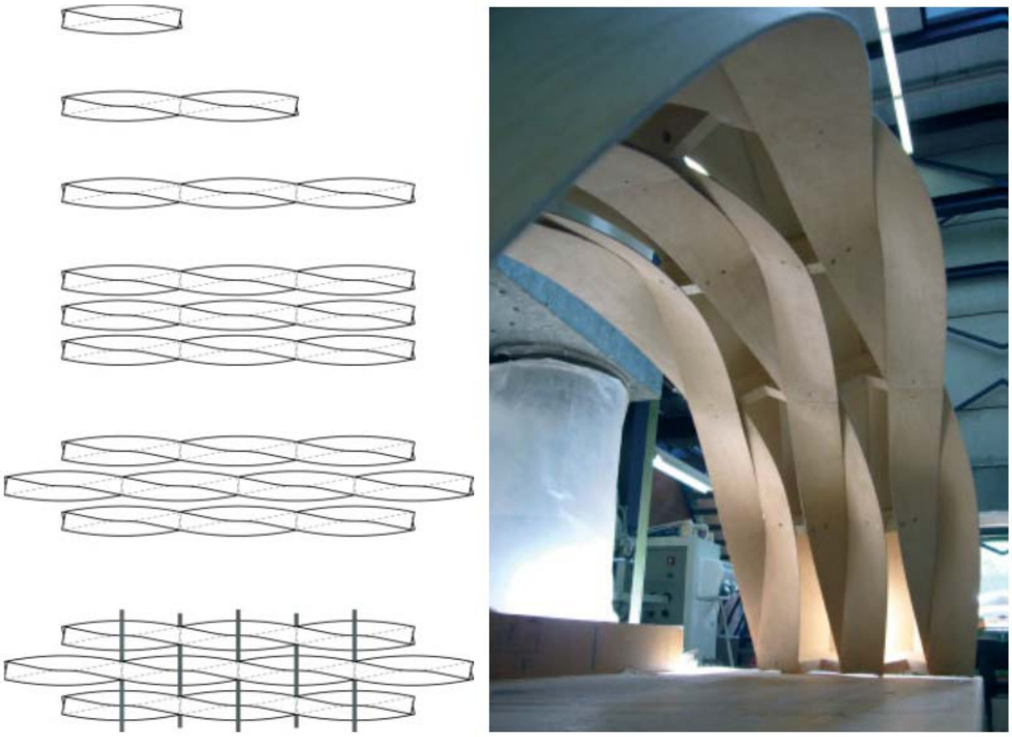


Figure 4-22. *Different configurations of Timberfabric (Weinand & Hudert, 2010)*

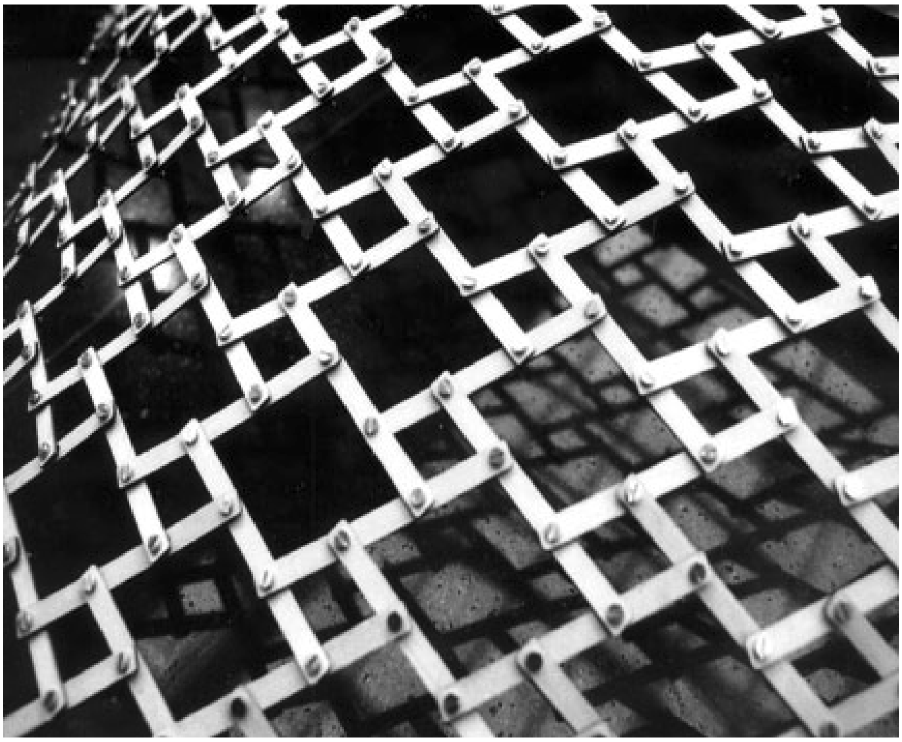


Figure 4-23. *The pavilion's physical model is comprised of wooden plates and basic pin linkages. Forest Park Pavilion, St Louis, Missouri, 2002 by Shigeru Ban and Arup AGU, (Bosia, 2011)*

Throughout history, discussions and visual methodologies pertaining to architectural design have predominantly prioritized form over materiality. In these discourses, the material aspects of architecture have often been disregarded, merely considered for their aesthetic properties or technical functionality, while remaining subordinate to the importance of form (Kotnik & Weinstock, 2012).

4.33.London City Hall by Norman Foster

The London City Hall is a building situated in London, United Kingdom, created for the local government of London (**Figure 4-24**). Its distinctive shape, which was developed between 1998 and 2003, reduces the façade's overall exposure to solar radiation. The movement inside the structure is implemented by a spiral ramp, offering the public the chance to travel "around their representatives," which is a metaphor for democracy in the building's architecture. The structure is intended to utilize only 25% of the yearly energy consumption of a conventional air-conditioned office building. This is accomplished by using a geometry that resembles the famous sphere and reduces the building's perimeter, which is where heat gains and losses occur. A modern architectural example of parametric form discovery is the London City Hall. The building's design is an illustration of the idea that seeks to address the single most combined problem confronting street management by reducing clutter and improving accessibility. The London City Hall serves as an illustration of how a building's design may be modified to make it more user-friendly and energy-efficient.

Figure 4-24. *London City Hall by Norman Foster (Source: Author, 2019)*

4.34.Conclusion

Digital tools have become indispensable in the realm of non-standard architecture, serving a far greater purpose than mere visualization. Their significance extends beyond the surface level, as they contribute significantly to facilitate and optimize the whole process; According to Silvestri (2009) it surpasses that to:

- Spatial modeling
- Mechanical modeling
- Organizational management
- 3D modeling and animation

Parametric tools provide designers with the opportunity to manipulate forms in a visual and intuitive manner, even without a full comprehension of the intricate geometric aspects involved. These tools also offer the capability to automatically generate forms through the use of algorithms, thereby presenting an immense potential for architectural design. They facilitate the creation of visual representations for complex spatial configurations, which would otherwise be challenging, if not impossible, to achieve manually. Moreover, these tools play a crucial role in modeling and simulating various mechanical and thermal phenomena that are characterized by their inherent complexity and the abundance of parameters and variables involved. Their utilization not only helps architects visualize intricate designs but also aids in the accurate modeling and simulation of mechanical and thermal processes, wherein the interplay of multiple factors must be considered. The comprehensive nature of these contemporary tools empowers designers to overcome the limitations of traditional approaches and expand their creative horizons.

In regards to professionals, the utilization of digital representation, such as virtual models or 2D imagery, proves to be highly effective in conveying clearer indications of legibility. This serves the purpose of facilitating the pairing process between the expert's perception and the physical object, in contrast to the utilization of an actual 3D model. The comprehensive nature of digital representation, in terms of providing enhanced signs of clarity, contributes significantly to the efficient execution of this pairing process.

CHAPTER V: EVALUATION OF PERCEIVED ARCHITECTURAL QUALITY OF THE CULTURE HOUSE OF THE CITY OF KHENCHELA

5.1. Introduction

The chapter addresses the perceived architectural quality as a concept of multiple dimensions and its indications in architecture and how it deals in a profound way with perception and the means in which it stimulates the user and drives him to judge if the quality of an architectural phenomenon fulfills the designated requirements and answers its occupants' needs. In this light, it was essential to assess the perceived architectural quality of the culture house ALI-SOUAIHI located in the city of Khenchela in the north east of Algeria and to analyze the different attitudes and tendencies of each strata to form a general conception of the perceived quality of the building. The study encompasses a five-point Likert scale questionnaire and uses a quantitative research method to assess the perceived architectural quality of the culture house, the questionnaire was administrated to 200 randomly selected individuals. The results show that respondents had moderate mean scores for the building evaluation in regard to its perceived architectural quality and that three of the four socio-demographic variables studied, affected the perceived quality assessment. It can be concluded that respondents' opinions and attitudes need to be considered and investigated prudently to improve the perceived architectural quality of the culture house

5.1.1. Problem statement

Perceived architectural quality is intricately related to how individuals perceive and interpret information coupled with its connotations and meanings. This process, which involves both cognition and perception, encompasses gathering information about a building through perception and attributing it with intricate meanings and significance, drawing upon various cognitive abilities such as memory, attention, learning, thinking, intelligence, communication, and language. The perception of users regarding the perceived qualities of a structure encompasses multiple dimensions. Consequently, it became imperative to redefine perceived quality as a novel architectural concept in order to effectively evaluate it, considering that perceived architectural quality is a measurable entity with multidimensional attributes. This is particularly significant given the intricate relationship between the user's perception and the architectural structure itself. Through the exploration of these factors, an enriched understanding of perceived architectural quality in the field of architecture can be achieved, allowing for broad evaluation and analysis.

Aaker (1991) has extensively discussed the concept of perceived quality in conjunction with other researchers such as Aaker and Jacobson (1994), Hellofs and Jacobson (1999), Rao et al. (1999), and Wolfinbarger and Gilly (2003). However, there has been a lack of empirical studies that thoroughly investigate this concept and its implications in the multidisciplinary field of architecture. This field aims to cater to the diverse needs of users, encompassing functional, psychological, cognitive, ergonomic, climatic, and economic aspects (Akin, 2001).

Consequently, it is essential to adopt a multidisciplinary approach when examining perceived architectural quality, considering insights from the psychological literature on perception and the marketing perspective on perceived quality in relation to architectural structures. Furthermore, it is imperative to integrate these concepts into the realm of architecture and tailor them to the specific characteristics of the field. This integration will facilitate the development of a conceptual model for understanding and evaluating perceived architectural quality in a comprehensive and enriching manner.

Following the aforementioned literature insights, this chapter aims to:

- Propose a model for perceived architectural quality inspired by previous work that can be used in architectural quality research.
- Evaluate the respondents' perceptions to the building's various architectural quality aspects based on the new established model.
- Examine how socio-demographic factors affect the perceived architectural quality.
- Explore the relationship between the dimensions composing the perceived architectural quality.

5.2. Methodology

5.2.1. A new paradigm for understanding the perceived quality in architecture.

The author's framework for evaluating architectural quality is influenced by several researchers, adopting a multidisciplinary approach and considering its alignment with the field of architecture. In this wide-ranging exploration, the framework seeks to enrich the assessment process by incorporating various perspectives and disciplines to ensure a comprehensive understanding of architectural quality (**Table 5-1**).

Additionally, the study utilizes Ladwein's model (2001) and the AHP Based Model by Saaty (1990) for evaluating the quality of architectural design, as presented by Harputlugil et al (2009), in order to break down the assessment of perceived architectural quality into a more streamlined hierarchical structure.

Through the thorough evaluation of the perceived quality, it becomes possible to provide a comprehensive assessment of the architectural quality. It is important to acknowledge that the perception of architectural concepts is heavily reliant on the subjective judgment made by users regarding the information they perceive from an object or a product. This assessment encompasses a deep understanding of the various elements and features that contribute to the perceived architectural quality.

Table 5-1: *Perceived quality dimension and their corresponding references.*

Dimension	Reference
Perceived visual quality	Garvin (1984) Aaker (1991) Stone-romero (1997) Giordano (2006) Stylidis (2015)
Perceived comfort	Blondel (1777) Alberti (1991) Aaker (1991) Giordano (2006)
Perceived build quality	Box (1983) Aaker (1991) Giordano (2006)
Perceived spatial quality	Lynch (1960) Giordano (2006)
Perceived reliability	Aaker (1991) Kim (2008) Garvin (1984) Marakanon (2017) Rao (1999) Parasuraman, Zeithaml & Berry (988) Giordano (2006)

This model holds the potential to adapt seamlessly into architectural contexts and serves as an initial milestone in the progression of formulating a sensory analysis or satisfaction survey for the evaluation of perceived architectural quality. In light of this, the author establishes distinct categories for the model that align with the physical attributes of the structure and the architectural prerequisites.

Consequently, the assessment of perceived architectural quality hinges on the observer's subjective understanding and interpretation of the sensory attributes inherent in a building's design. By incorporating this comprehensive approach, the aim is to enrich the understanding and evaluation of architectural quality, offering a more nuanced perspective on the subject matter.

When it comes to attributes, whether they are objective or subjective, they have the ability to convey signals, messages, and connotations. These signals may not be apparent at first glance and require some level of processing in order to be understood. It is the perceiver who interprets these signals and decodes them based on their cultural background, personal experiences, and memories.

As a result, a conceptual model is suggested as a means to capture the perceived architectural quality, which takes into account various dimensions that embody the qualities of a building, all of which are influenced by the user's perception. This model can be effectively integrated into architectural design, ensuring that the user's perception is prioritized and considered throughout the process (**Figure 5-1**).

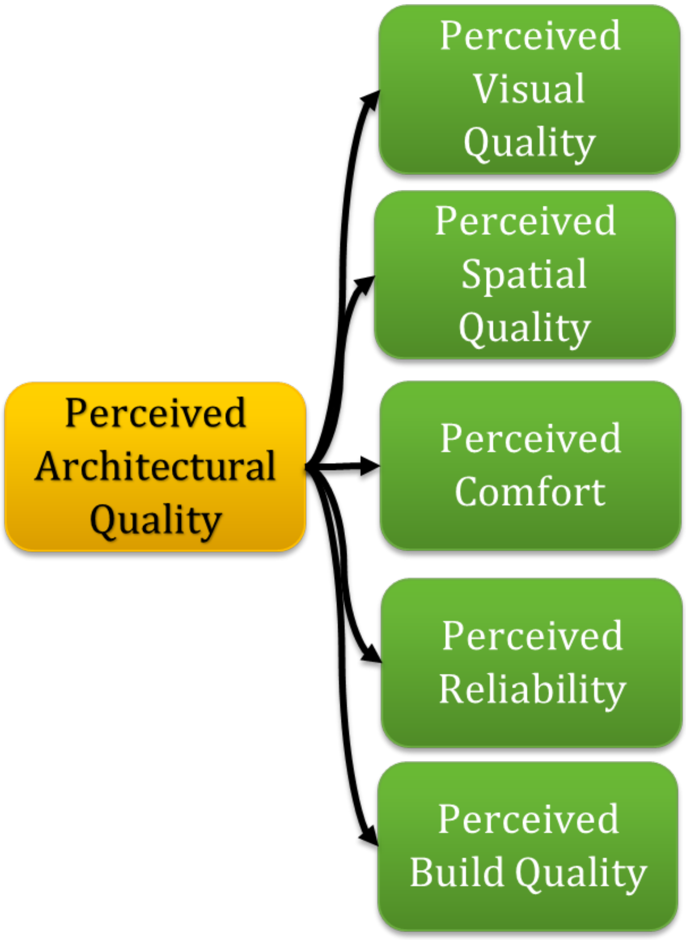


Figure 5-1. *A conceptual model of perceived architectural quality (Source: Author).*

5.2.1.1. Perceived visual quality

In regards to architectural aesthetics, the focus lies on the innate characteristics that buildings possess, which aim to captivate the observer's visual perceptions. These features encompass a wide range of factors, including the structure's shape, dimensions, symmetry, proportions, color scheme, complexity and intricacy (Higuera-Trujillo et al., 2021).

The aesthetic experience of individuals using a building is greatly influenced by their subjective interpretation of its physical attributes. This interpretation is shaped by an individual's knowledge, personal preferences, and cultural background (Chatterjee and Vartanian, 2014).

5.2.1.2. Perceived spatial quality

The concept of "Perceived spatial quality" encompasses several key factors that contribute to the overall effectiveness and perception of a building. These factors include the accessibility of the building, the legibility and clarity of its spaces, the navigability and ease of movement within the building, the readability and comprehension of its architectural design, the ergonomic considerations that enhance user comfort and functionality, the spatial arrangement and its ability to delineate the various functions and activities within the building, the visual representation and depiction of the building, its location and identification within its surroundings, and the level of integration with the surrounding environment.

Function, as one of the pillars of the architectural quality triad, plays a crucial role in determining the success and effectiveness of a building. (Pollio and Morgan, 1960; Blondel, 1777).

5.2.1.3. Perceived comfort

Perceived comfort, in the context of building performance, refers to the subjective interpretation and understanding of the effectiveness of thermal and acoustic aspects. Unlike experts who employ diverse techniques and a unique approach to analyze building performance, ordinary users lack the necessary knowledge and experience to conduct such evaluations.

However, they are able to pick up on comfort cues within buildings that can serve as indicators of performance. These cues, which are perceptually translated by users, play a vital role in assessing the overall comfort levels and can provide valuable insights into the effectiveness and efficiency of a building's thermal and acoustic performance.

The evaluation of a building's performance differs significantly from that of a marketing product or a machine. This disparity arises due to the diverse characteristics inherent in the nature of buildings.

Therefore, assessing the performance of an object is comparatively simpler, as opposed to the challenges posed when evaluating an architectural structure, which is fraught with complexities arising from its scales and intricacies. The scales and complexities of architectural buildings make their evaluation a daunting task.

5.2.1.4. Perceived reliability

The concept of "overall impression of security" relates to the holistic assessment of a building's safety and resilience. It encompasses not only the construction's overall energetic performance but also its technological sophistication. When evaluating the overall impression of security, factors such as the robustness of the structural system and the level of technological advancements incorporated within the building are taken into account. This helps to ensure that the building not only provides a sense of security but also is technologically well equipped.

5.2.1.5. Perceived build quality

When considering the selection of suitable materials and textures, as well as the precise fit and finish of a product, attention to detail and adherence to standards and regulations, as perceived by the end-user, are crucial factors. This highlights the meticulousness and craftsmanship involved in delivering a polished and refined end result that exudes exceptional quality. It denotes a level of sophistication achieved through the superior craftsmanship and superior quality of the utilized materials. (Giordano, 2006).

5.2.2. Participants

Power analysis using G*Power 3.1.9.4 (Faul et al., 2007) was conducted to determine the appropriate sample size to execute each test. G*Power indicated a sample size of 199 is needed to run a one-sample t-test with effect size = 0.2, power = 0.8 and $\alpha = 0.05$; a sample size of 154 is needed to run two-sided two-sample t-test with effect size = 0.5, power = 0.8 and $\alpha = 0.05$; a sample size of 200 is needed to run two-sided Analysis of variance (ANOVA test) for five groups with effect size = 0.25, power = 0.8 and $\alpha = 0.05$. G*Power indicated a sample size of 35-94 is needed to run a one-sample Wilcoxon signed-rank test with effect size = 0.3-0.5, power = 0.8 and $\alpha = 0.05$; a sample size of 134-178 is needed to run a two-sided Mann-Whitney U test with effect size = 0.5, power = 0.8, $\alpha = 0.05$ and ratio = 1-3; a sample size of 80-200 is needed to run a two-sided Kruskal-Wallis test for five groups with effect size = 0.25-0.4, power = 0.8 and $\alpha = 0.05$; and a sample size of 84 is needed to run two-tailed correlations with effect size = 0.3, power = 0.8 and $\alpha = 0.05$.

In order to thoroughly examine and evaluate the perceived architectural quality of the cultural facility known as ALI-SOUAIHI in Khenchela, Algeria, a comprehensive stratified questionnaire was employed. The questionnaire was distributed to a diverse range of 200 participants, encompassing different age groups, residency areas, and education levels as detailed in **Table 5-2**. This systematic and random selection of participants aimed to capture a wide range of perspectives and tendencies within each stratum. Situated in the heart of the city, ALI-SOUAIHI holds immense cultural and functional significance, making it the sole structure with a pronounced cultural identity in the region. By undertaking this analysis, we can enrich our understanding of various viewpoints and preferences regarding this architectural building.

Table 5-2: *Respondent's socio-demographic overview.*

Gender		Age		Residency		Education	
Male	141	< 20	9	Near the building	91	< High School Degree	80
Female	59	20-30	72	Far from the building	78	High School Degree	18
		30-40	66	Outside the city	31	Bachelor's Degree	28
		40-50	36			Master's Degree	56
		> 50	17			PhD Degree	18

5.2.3. Case Study

The investigation focuses on examining the perceived architectural excellence of the ALI-SOUAIHI culture house in the city of Khenchela, located in the northeastern region of Algeria (**Figure 5-2**).

Situated in the bustling heart of the city facade (**Figure 5-3**), this building holds immense cultural and functional significance, making it a cherished landmark among the local populace.

Since its inauguration on February 17, 2003, the culture house has continuously undergone renovation efforts aimed at enhancing its overall appearance and appeal.

Notably, the construction of an enclosing wall has effectively separated the structure from its surroundings, while extensive repainting has revitalized its external facade (**Figure 5-4**).

This comprehensive analysis delves into the numerous facets of this distinguished cultural entity, examining its architectural attributes and exploring its significance within the city's cultural landscape.

Culture houses typically serve as a reflection of a city's cultural and social values, as evident in their architectural designs and their ability to align with their intended purposes. This particular aspect, which plays a crucial role, requires a meticulous examination to ensure its credibility in the given scenario. A profound analysis is necessary to thoroughly understand and appreciate how these cultural establishments contribute to the overall identity of the city.

As mentioned in the official website (https://m-c-khenchela.webnode.fr/about-us/), the culture house:

- Occupies an area of 8400 square meters.
- It has 17 workshops and a club.
- It has a 512-seat lecture hall equipped with the latest gear.
- It has an exhibition hall: The total number of participants is 8,323.

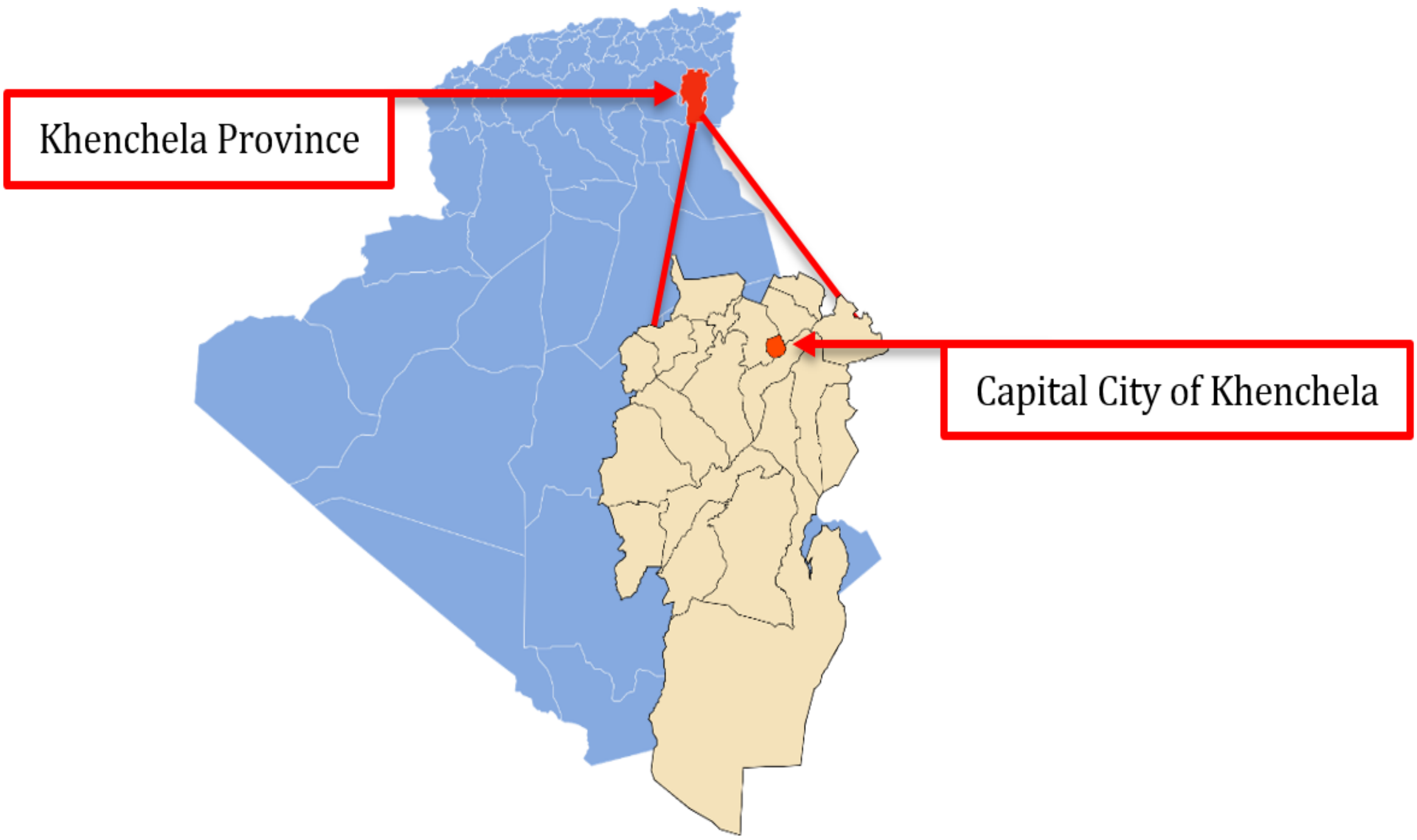


Figure 5-2. *The geographical location of the city of Khenchela. (Source: Kerbush, 2012 and Mouh2jijel, 2020; treated by author as cited by Hamdaoui et al. 2022).*

Figure 5-3. *The geographic location of the city of Khenchela's culture house (Source: Google Earth, 2022).*

Figure 5-4. *Views of the city of Khenchela's culture house (Source: Author, 2022).*

5.2.4. Procedure

The questionnaire utilized in this study was carefully crafted to align with the theoretical concepts that were discussed and analyzed in the literature review. To gauge participants' satisfaction levels, a five-point Likert scale ranging from 1 (indicating total dissatisfaction) to 5 (indicating complete satisfaction) was employed. Prior to its implementation, a pilot test was conducted, involving the distribution of the questionnaire to a group of 10 individuals who then provided their responses to the pre-test questions. This process aimed to ensure the questionnaire's validity and reliability before its widespread usage.

After receiving feedback, we took the necessary steps to improve the formulation of each question in the questionnaire, ensuring that any ambiguous or unclear aspects were addressed and made more understandable.

Subsequently, the enhanced questionnaire was distributed to a sample of 200 individuals. These participants were requested to provide their personal information and were then prompted to rate the different perceived architectural attributes they perceived in the building. By gathering these ratings, we aimed to obtain a comprehensive and detailed understanding of how these individuals perceived and evaluated the various aspects of the building's design and structure.

5.2.5. Data analysis

The data regarding perceived architectural quality follows a normal distribution, whereas the data for the composing dimensions deviate from normal distribution. This deviation has been confirmed through the results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests as shown in **Table 5-3** and **Table 5-4**.

Consequently, it is recommended to utilize parametric tests for analyzing perceived architectural quality, while non-parametric tests are more suitable for analyzing its dimensions. The normal distribution of the former and the deviation of the latter call for different analytical approaches in order to accurately assess the different aspects of architectural quality.

In order to thoroughly assess the differentiation in the sample scores, an ample analysis was conducted using a one-sample Wilcoxon signed-rank test for the five dimensions. The purpose of this analysis was to compare the scores to the neutral value.

In order to determine whether there is a noteworthy distinction between the scores of male and female respondents, a Mann-Whitney U test was conducted. Furthermore, to investigate if age, residency, and education groups exhibit significant differences among themselves, a Kruskal-Wallis test was employed. This comprehensive statistical analysis delves into the core objective of exploring potential disparities across various demographic factors.

To minimize type I error, Dunn's post-hoc analysis with Bonferroni correction was employed. . In assessing the effect size, the Cohen's d was calculated using the expression $d = t/\sqrt{N}$ as proposed by Rosenthal (1991). Eta^2 in the ANOVA test was calculated by squaring the value of Eta dependent on the perceived architectural quality's general mean.

In regards to the effect size of the one-sample Wilcoxon signed-rank test, the r value was calculated using the expression $r = Z/\sqrt{N}$ as proposed by Rosenthal (1991) for the one-sample Wilcoxon signed-rank test and the Mann-Whitney U test.

For the Kruskal-Wallis H test with three or more groups (k), the effect size was determined by transforming chi^2 into an F value with (k-1) numerator degrees of freedom (dfn) and (N-k) denominator degrees of freedom (dfd). This was done using the equation $F (dfn, dfd) = chi^2/(k-1)$, which was modified from Murphy and Myors' work (2014).

The aforementioned statistical methods, their respective effect size calculations, and the rationale behind the transformations were utilized to ensure a comprehensive analysis.

Then, the measure known as partial eta squared, denoted as ηp^2, was computed using the following equation: $(F \times dfn) / (F \times dfn + dfd)$, as explained by Lakens (2013). This calculation involved utilizing the previously obtained F value (with degrees of freedom dfn and dfd).

The data analysis and application of relevant statistical tests were conducted using IBM SPSS version 28.0[1].

[1] IBM SPSS software, initially developed in 1968 by SPSS Inc. before IBM's acquisition in 2009, is renowned for its advanced capabilities and intuitive interface. Boasting an extensive repository of machine learning algorithms, text analysis tools, and open-source adaptability, IBM SPSS Statistics caters to a wide range of analytical needs. This powerful software suite accommodates both hypothesis testing and hypothesis generation methodologies. Notably, IBM SPSS Modeler facilitates hypothesis generation through a comprehensive, bottom-up analytical approach, while IBM SPSS Statistics enables top-down hypothesis testing analysis. The union of these tools empowers users to execute intricate analyses and derive meaningful insights from their data, making it a pivotal asset in the realm of advanced analytics.

Table 5-3: *Normality tests for perceived architectural quality.*

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Perceived Architectural Quality	0,046	200	0,200	0,992	200	0,386

Table 5-4: *Normality tests for perceived quality dimensions.*

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Perceived visual quality	0,081	200	0,003	0,965	200	0.000
Perceived spatial quality	0,085	200	0,001	0,982	200	0,01
Perceived comfort	0,113	200	0.000	0,968	200	0.000
Perceived reliability	0,155	200	0.000	0,967	200	0.000
Perceived build quality	0,092	200	0.000	0,975	200	0,001

The ratings provided by the respondents for each item that make up a specific dimension, also known as Respondent's Dimensional Items (RDI), were averaged to calculate the User's Dimension Mean (RDM) using the formula mentioned below:

$$R_1C_1M = (R_1C_1I_1 + R_1C_1I_2 + \ldots + R_1C_1I_1)/\text{number of construct items.}$$

In order to enrich the content and provide a comprehensive analysis, the Respondent's perceived architectural quality Mean (RPQM) was determined. This measure was obtained by calculating the average of the Respondent's Dimension Means (RDM) based the formula for calculating R1CRM involves summing up the values of R1D1as designated in the following formula:

$$R_1PQM = (R_1C_1M + R_1C_2M + \ldots + R_1C_nM)/\text{number of constructs}$$

During the analysis process, each individual component within every dimension was thoroughly examined utilizing the Cronbach's alpha internal consistency test. This comprehensive examination yielded highly reliable results, as indicated by the substantial alpha values falling within the range of 0.733 to 0.849. (**Table 5-5**).

Table 5-5: *Reliability test for perceived quality dimensions.*

Construct	Dimension	Item	Item description	Cronbach's Alpha
	Perceived visual quality	PVQ1	On the overall impression of the exterior appearance of this building.	0.840
		PVQ2	If the building design is authentic.	
		PVQ3	On the colors used in the building.	
		PVQ4	If the building's exterior design incorporates advanced techniques.	
		PVQ5	If the architectural style of the building seems modern.	
		PVQ6	If the building design meets the aesthetic preferences of the respondents.	
	Perceived spatial quality	PSQ1	Do you find it easy to walk around inside the building (don't feel lost)?	0.792
		PSQ2	Can you easily enter the building without obstructions?	
		PSQ3	On the legibility of the cultural facility.	
		PSQ4	Do you think the main entrance to the building is clear?	
		PSQ5	On the overall assessment of the workspace ergonomics.	
		PSQ 6	If the interior spaces of the building correspond to its intended functions.	
		PSQ 7	Does the building have a distinctive feature in its exterior design?	
		PSQ 8	Can you create a clear mental image of the shape of the building?	
		PSQ 9	Can you easily locate the building from anywhere in the city?	
		PSQ 10	If the building is considered a landmark.	
		PSQ 11	Do you find the building to be homogeneous and harmonious with the surrounding buildings?	
	Perceived comfort	PC1	What do you think of the quality of natural lighting?	0.849
		PC2	What do you think of the quality of artificial lighting?	
		PC3	What do you think of the night lighting quality of the building outside?	
		PC4	Are you satisfied with the thermal comfort inside the building in winter?	

	PC5	Are you satisfied with the thermal comfort inside the building in summer?	
	PC6	How do you find the sound insulation of the building?	
Perceived reliability	PR1	What do you think of the performance of the secondary bodies (electricity and gas supply, water, heating, etc.)?	0.733
	PR2	Is the building technologically well equipped (monitoring system-hardware…)?	
	PR3	Do you think the structure of the building inspires confidence in you?	
Perceived build quality	BD1	Do you think the building is up to execution standards?	0.762
	BD2	What do you think of building fit and finish level?	
	BD3	Does the building give the impression that it needed a large budget to construct it?	
	BD4	What do you think of the construction materials used	

5.3. Results

5.3.1. General evaluation of perceived architectural quality

According to **Table 5-6**, the perceived architectural quality was evaluated and yielded a mean score of 2.784 with a standard deviation of 0.716. To determine the deviation of the sample scores for perceived architectural quality from the hypothesized value of H0 = 3 (which represents the neutral value on a Likert scale), a one-sample T-Test was conducted.

This test aimed to ascertain whether the observed values were below or above the neutral value, thereby examining the differentiation in the sample scores (**Figure 5-5**).

The results of the test indicated that there was a significant difference in the perceived architectural quality median compared to the null hypothesis (H0 = 3). This difference was supported by a negative standardized test statistic ($t = -4{,}261$, $p<0.001$).

Table 5-6: *Perceived architectural quality one-sample T-Test (N=200). Test Value = 3*

	Mean	Std. Deviation	t	df	Sig. (2-tailed)	Mean Difference	95% CI	Cohen's D
Perceived Architectural Quality	2,784	0,716	-4,261	199	0.000***	-0,216	[-0,315, -0,116]	-0,301

**p<0.05; **p<0.01; ***p<0.001*

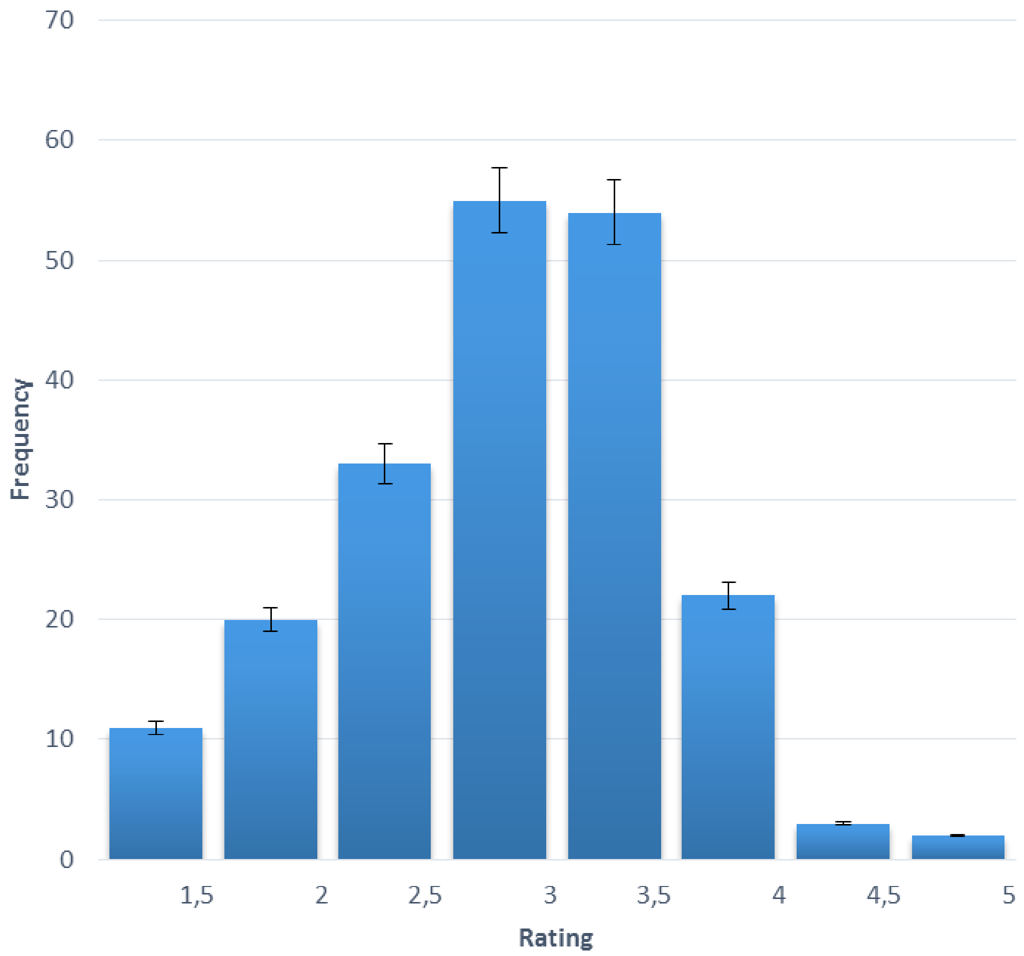


Figure 5-5. *Distribution of respondents' ratings [a] for perceived architectural quality on a 5-point Likert scale; 1 = totally unsatisfied to 5 = totally satisfied. [a]5% error bars shown. (Source: Author).*

5.3.2. Socio-demographic influence on respondents' evaluations of perceived architectural quality

5.3.2.1. Gender

The results of the Independent 2-tailed t-test, as depicted in **Table 5-7**, demonstrate a statistically significant distinction between males and females (t = -3.071, p = 0.003). It is important to note that the majority of respondents were males, accounting for 70.5% of the total sample size. Their mean score was calculated to be 2.687, with a standard deviation (S.D) of 0.708. On the other hand, females constituted 29.5% of the respondents, with a mean score of 3.016 and S.D of 0.715. This indicates that females exhibited a more positive attitude towards the building than their male counterparts. The obtained results shed light on the gender-based differences in attitudes towards the building (**Figure 5-6**).

Table 5-7: *Perceived architectural quality Independent 2-tailed t-test for equality of means for Male vs. Female*

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI	Cohen's D
Perceived Architectural Quality	-3.071	112.406	0.003**	-0.329	0.107	[-0.541. -0.117]	-0,217

**p<0.05; **p<0.01; ***p<0.001*

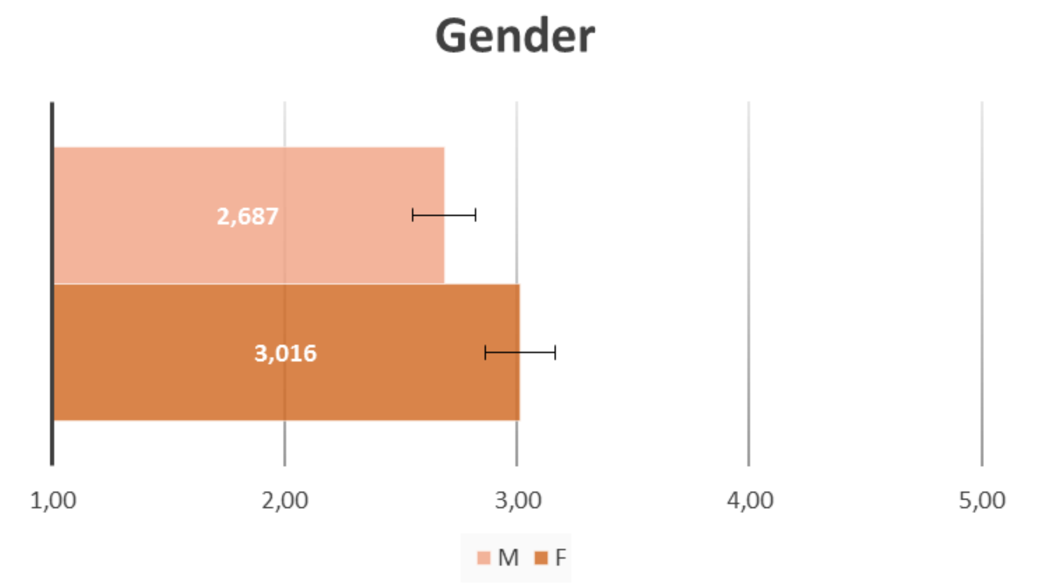


Figure 5-6. *Perceived architectural quality scores [a] for Gender groups. [a]5% error bars shown. Note. M=Male; F= Female (Source: Author).*

5.3.2.2. Age

The ANOVA test (**Table 5-8**) was carried out to comprehensively analyze and evaluate the impact of respondents' age on the mean score of perceived architectural quality.

This analysis aims to enrich our understanding of how age as variable affects obtained scores (**Figure 5-7**).

The test findings indicated that there was a notable and meaningful distinction among a minimum of two groups ($F(4, 195) = 4.272$, $p = 0.003$). The respondents' age distribution can be categorized as follows: the majority of respondents fell within the age range of 20 to 30 years, constituting 36% of the total sample, followed by the age group of 30 to 40 years (33%), the age group of 40 to 50 years (18%), respondents who were above the age of 50 (8.5%), and those who were below the age of 20 (4.5%). These statistical findings highlight the demographic composition of the respondents into various age.

The average values and proximity were comparatively lower and closer in the younger age groups, specifically those below 20 years old, individuals aged between 20-30 years old, and those within the 30-40 years old category. On the other hand the means relatively higher among older respondents (40-50 and >50).

Table 5-8: *A one-way ANOVA test for Age groups.*

		Sum of Squares	df	Mean Square	F	Sig.	Eta²
Perceived Architectural Quality	*Between Groups*	8.211	4	2.053	4.272	0.002**	0,081
	Within Groups	93.689	195	0.480			
	Total	101.9	199				

**p<0.05; **p<0.01; ***p<0.001. Note: BG = Between Groups, WG = Within Groups*

The Tukey-Kramer test (**Table 5-9**), which is conducted for the purpose of multiple comparisons, provides a comprehensive analysis of the differences in the average perceived architectural quality among various age groups. Specifically, Table 6 presents the findings that indicate a significant distinction between respondents aged 30-40 and those aged 40-50 (p = 0.009), as well as respondents above the age of 50 (p = 0.013). These results highlight the enriched understanding of how age influences the perception of architectural quality, as evidenced by the in previous findings in literature review.

Table 5-9: *Tukey-Kramer post-hoc test for Age groups.*

	Variable	Pairwise comparison	Mean Difference	Std. Error	Sig.	95% CI.
Perceived Architectural Quality	Age	(30-40)-(40-50)	-0.479	0.144	0.009**	[-0.874. -0.083]
		(30-40)-(> 50)	-0.606	0.189	0.013*	[-1.125. -0.087]

**p<0.05; **p<0.01; ***p<0.001*

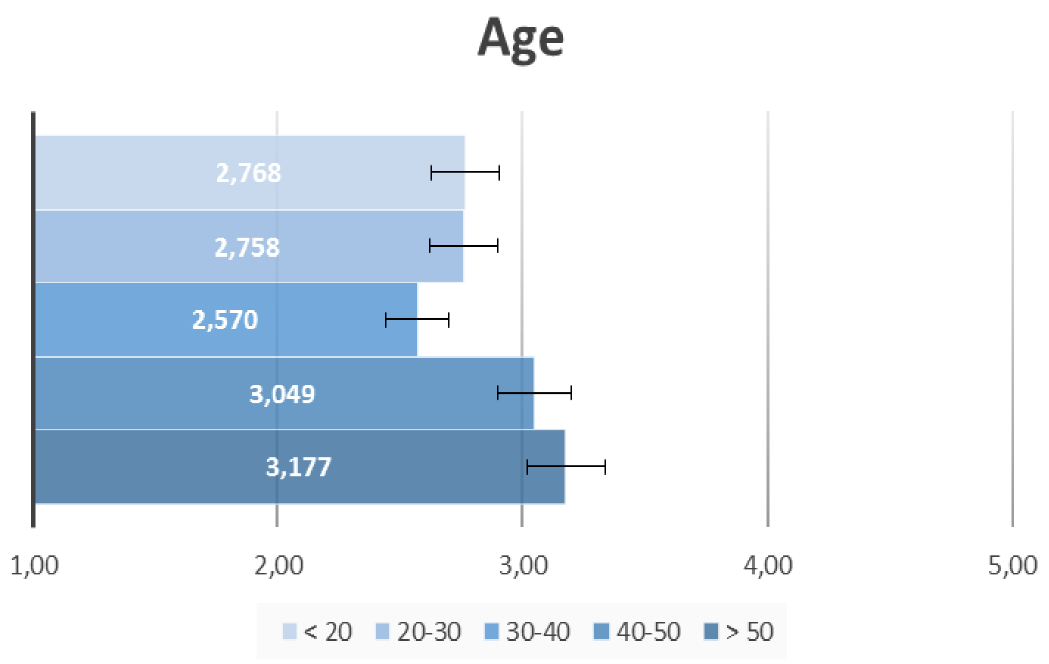


Figure 5-7. *Perceived architectural quality scores [a] for Age groups. [a]5% error bars shown. (Source: Author).*

5.3.2.3. Residency

According to the comprehensive analysis conducted using a one-way Anova test (**Table 5-10**), it was determined that there exists a significant difference between at least two groups (F (2, 197) = 3.541, p = 0.031).

This statistical analysis examines the residency profile of the respondents, providing valuable insights into their living situations (**Figure 5-8**). Specifically, the data reveals that approximately 45.5% of the respondents reside in close proximity to the building, while 39% live at a considerable distance from it.

Additionally, the data reveals that among the respondents residing near the building, the average score obtained was 2.650, with a standard deviation of 0.646. On the contrary, respondents living far from the building had an average score of 2.853, with a slightly higher standard deviation of 0.757.

Furthermore, it is interesting to note that individuals residing outside the city recorded a significantly higher average score of 3.007, accompanied by a standard deviation of 0.747.

Table 5-10: *A one-way ANOVA test for Residency groups.*

		Sum of Squares	df	Mean Square	F	Sig.	Eta²
Perceived Architectural Quality	*Between Groups*	3.536	2	1.768	3.541	0.031*	0,035
	Within Groups	98.364	197	0.499			
	Total	101.9	199				

**p<0.05; **p<0.01; ***p<0.001. Note: BG = Between Groups, WG = Within Groups*

Upon conducting a detailed analysis using the multiple comparisons test (**Table 5-11**), it is evident that there is a significant variation in the perceived architectural quality mean value between individuals living in close proximity to the building and those residing outside the city (p = 0.042).

This statistical finding indicates that the perception of architectural quality differs significantly based on the residential location of the respondents.

The data analysis revealed that there was no substantial variation in the average perception of architectural quality among two groups of respondents, namely those residing in close proximity to the building and those residing farther away (p = 0.163).

Similarly, no significant distinction in perceived architectural quality was observed between respondents living outside the city and those living far from the building (p = 0.520).

Table 5-11: *Tukey-Kramer post-hoc test for Residency groups.*

	Variable	Pairwise comparison	Mean Difference	Std. Error	Sig.	95% CI.
Perceived Architectural Quality	Residency	NB - OC	-0.357	0.147	0.042*	[-0.704. -0.010]

**p<0.05; **p<0.01; ***p<0.001 NB = near the building, OC = outside the city.*

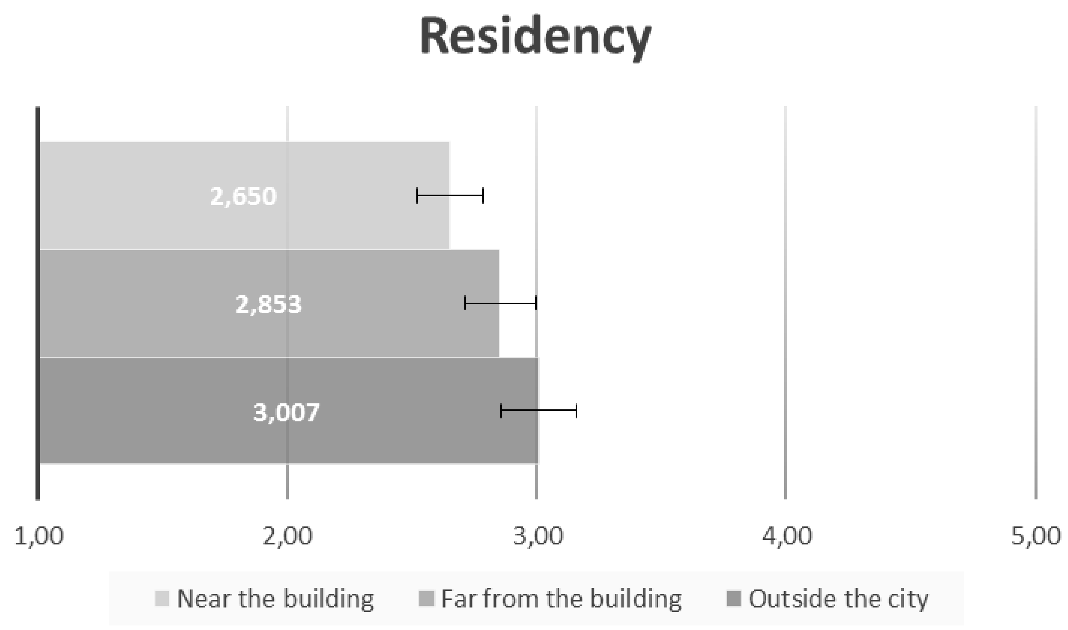


Figure 5-8. *Perceived architectural quality scores [a] for Residency groups. [a]5% error bars shown (Source: Author).*

5.3.2.4. Level of education

The participants in this study came from a diverse range of educational backgrounds, spanning from individuals with less than a high school degree to those with a PhD. When it comes to the perceived architectural quality, there was no significant difference among respondents with different levels of education (**Figure 5-9**).

This finding was confirmed by statistical analysis, which revealed that the mean values were relatively similar and there was no statistically significant variation (F (4, 195) = 0.230, p = 0.942) (**Table 5-12**).

Based on data analysis, it has been determined that the educational background of the participants did not yield a significant impact in shaping their perspective on the construction of the culture house.

Table 5-12: *A one-way ANOVA test for Education groups*

		Sum of Squares	df	Mean Square	F	Sig.	Eta^2
Perceived Architectural Quality	*Between Groups*	0.478	4	0.119	0.23	0.922	0,005
	Within Groups	101.422	195	0.52			
	Total	101.9	199				

**p<0.05; **p<0.01; ***p<0.001. Note: BG = Between Groups, WG = Within Groups*

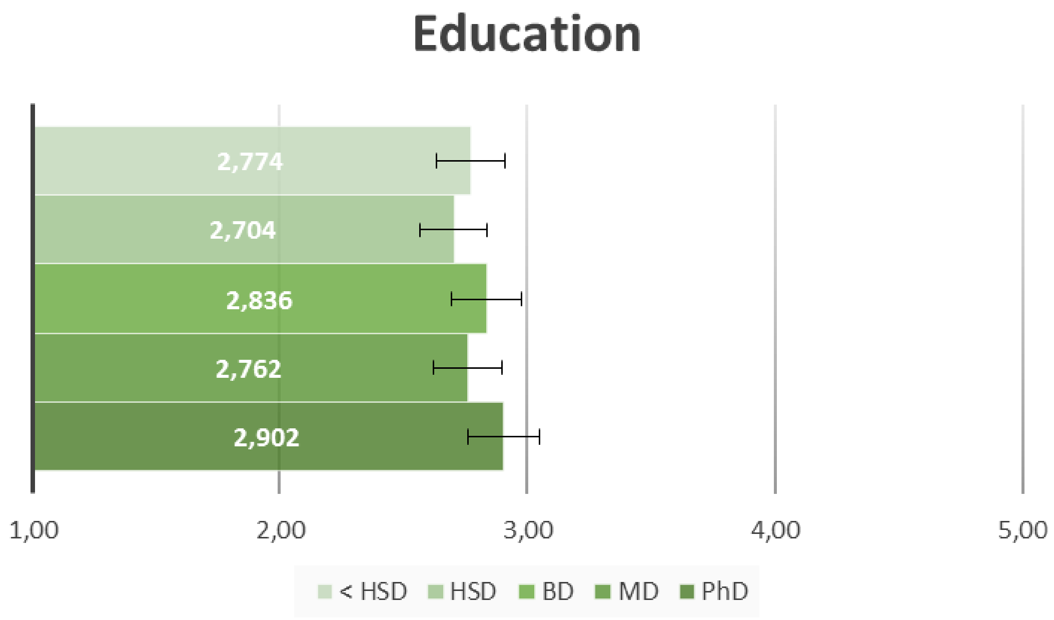


Figure 5-9. *Perceived architectural quality scores[a] for Education groups. [a]5% error bars shown. Note. < HSD=less than High School Degree; HSD= High School Degree; BD= Bachelor's Degree; MD= Master's Degree. (Source: Author).*

5.3.2.5. Profession

The results of the Anova test, as presented in **Table 5-13**, indicated a significant difference among multiple groups (F (9, 190) = 4.057, p = .000). This finding highlights the noteworthy impact of respondents' professions on their attitude towards the building of the culture house. Notably, when examining the mean scores of the respondents' attitudes based on their professions, it was observed that the scores varied significantly. Specifically, social work had the lowest mean score of 1.91, while art and culture profession had the highest mean score of 3.440. The mean scores for architecture, engineering, commerce, education, and administration were 2.862, 2.393, 2.650, 2.915, and 2.997, respectively (**Figure 5-10**). This analysis reveals the influential role of professions on individuals' attitudes towards the culture house.

Table 5-13: *A one-way ANOVA test for Profession groups*

		Sum of Squares	df	Mean Square	F	Sig.	Eta^2
Perceived Architectural Quality	*Between Groups*	16.427	9	1.825	4.057	0.000***	0,162
	Within Groups	85.473	190	0.45			
	Total	101.9	199				

**p<0.05; **p<0.01; ***p<0.001. Note: BG = Between Groups, WG = Within Groups*

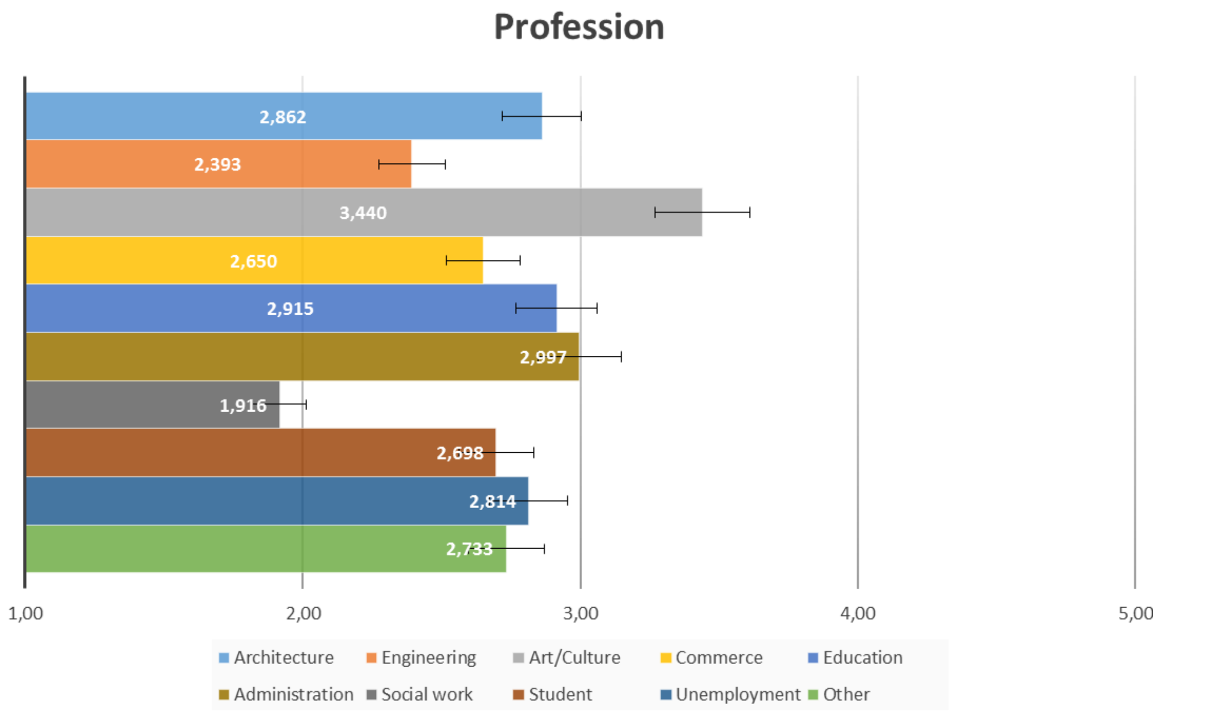


Figure 5-10. *Perceived architectural quality scores [a] for Profession groups. [a]5% error bars shown. (Source: Author).*

The analysis conducted on **Table 5-14**, known as the multiple comparisons test, reveals significant variations in perceived architectural quality scores among respondents from different professional backgrounds. Specifically, respondents working in Social work profession were found to have significantly different scores compared to those in Architecture (p = 0.014), Art/Culture (p = 0.000), Education (p = 0.008), Administration (p = 0.001), and Unemployment (p = 0.007). Moreover, a significant difference was observed between respondents in the Art/Culture domain and those in Engineering (p = 0.022) and Commerce (p = 0.039). These findings highlight the noteworthy discrepancies in perceived architectural quality across various professional domains, shedding light on the diverse perspectives of respondents from different professional backgrounds.

Table 5-14: *Tukey-Kramer post-hoc test for profession groups.*

Variable		Pairwise comparison	Mean Difference	Std. Error	Sig.	95% CI.
Perceived Architectural Quality	Profession	Architecture-Social work	0,946	0,246	0,006**	[0,159, 1,733]
		Engineering-Art/Culture	-1,047	0,318	0,039*	[-2,065, -0,028]
		Art/Culture-Commerce	0,790	0,244	0,045*	[0,009, 1,571]
		Art/Culture- Social work	1,523	0,293	0,000***	[0,585, 2,462]
		Education - Social work	0,999	0,248	0,003**	[0,206, 1,792]
		Administration - Social work	1,081	0,236	0,000***	[0,324, 1,838]
		Social work - Unemployment	-0,898	0,229	0,005**	[-1,631, -0,165]

**p*<0.05; ***p*<0.01; ****p*<0.001. *Note: Only significance* <0.05 *is mentioned in the table*

5.3.3. General assessment of perceived architectural quality dimensions

Table 5-15: *Results of the one-sample Wilcoxon signed-rank test.*

	N	Median	χ2	Z	Sig.	r
Perceived visual quality	200	2.333	2453.5	-8.441	0.000***	-0.597
Perceived spatial quality	200	3.181	11234,5	2,271	0,023*	-0.153
Perceived comfort	200	3.000	7158	-1,056	0,291	-0.565
Perceived reliability	200	3.000	5377,5	-2,062	0,039*	-0.501
Perceived build quality	200	2.750	4723,5	-4,453	0.000***	-0.501

**p*<0.05; ***p*<0.01; ****p*<0.001. *Note: Test value = 3.*

In order to assess the distinction in the scores of the five dimensions of perceived architectural quality (perceived visual quality, perceived spatial quality, perceived comfort, perceived reliability, and building quality), a one-sample Wilcoxon signed-rank test was employed. This test, as illustrated in **Table 5-15**, aimed to compare the sample scores with a hypothesized value of H0 = 3, which indicates the neutral value on a Likert scale. The objective was to determine whether the observed values are below or above this neutral value, thus establishing the degree of differentiation in the perceived architectural quality. This formal analysis delves into the statistical method used and elaborates on the specific dimensions being evaluated. Its purpose is to enrich the understanding and provide a detailed examination of the findings regarding each dimension. The results of the test revealed significant differences in the perceived visual quality, building quality, and perceived reliability scores compared to a reference value H0 = 3. Specifically, the perceived visual quality showed a significantly lower median with a negative standardized test statistic (Z = -8.441, p<0.001). Similarly, the building quality and perceived reliability scores also exhibited substantial differences from the reference value with negative standardized test statistics (Z = -4,453, p = 0.000) and (Z = -2,062, p = 0,039), respectively. However, these deviations were relatively smaller compared to the perceived visual quality. Conversely, the perceived spatial quality displayed a significantly higher median with a positive standardized test statistic (Z = 2,271, p = 0,023), indicating that the observed values were above the reference value.

In contrast, no significant difference was found between the perceived comfort observed value and the test value (Z = -1,056, p = 0,291). These findings suggest that the perceived visual quality, perceived build quality, and perceived reliability were considerably different from the reference value, while the perceived spatial quality showed a positive difference, and perceived comfort demonstrated no significant deviation.

Despite the observed value of perceived reliability being equal to the hypothesized value, the statistical test demonstrated a noteworthy discrepancy. This discrepancy can be attributed to the fact that the scores are not distributed symmetrically around the hypothesized value. The statistical analysis indicates a substantial deviation from the expected results, even though the initial assumption of perceived reliability was met.

Considering these findings, it is important to acknowledge that a significant number of participants expressed moderate to above-moderate dissatisfaction with the spatial quality and comfort, while the ratings were below average for Building quality, Perceived reliability, and particularly the perceived visual quality of the cultural facility.

This is further supported by the descriptive statistics provided for each element (**Figure 5-11 to 5-16**). The findings indicate that the majority of respondents perceived moderate levels of quality with regards to spatial aspects and comfort, whereas the overall assessment of the perceived build quality, reliability, and visual appeal of the cultural facility was found to be below average.

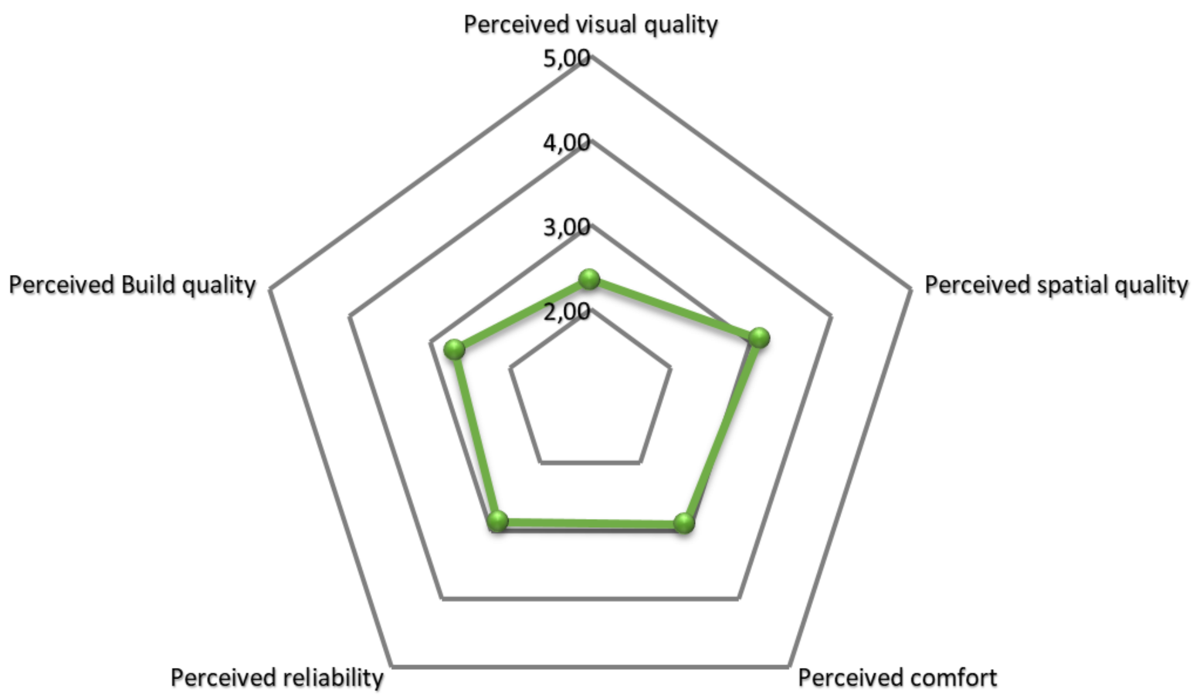


Figure 5-11. *Radar chart for the dimensions composing perceived architectural quality. (Source : Author).*

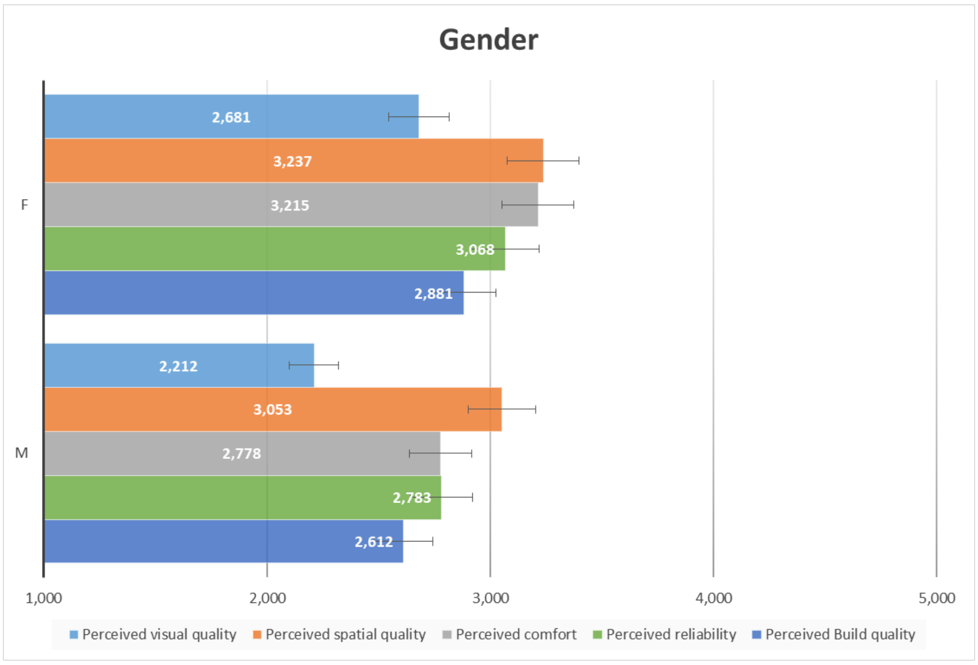


Figure 5-12. *Perceived architectural quality dimensions scores [a] for Gender groups. [a]5% error bars shown. Note. M=Male; F= Female (Source: Author).*

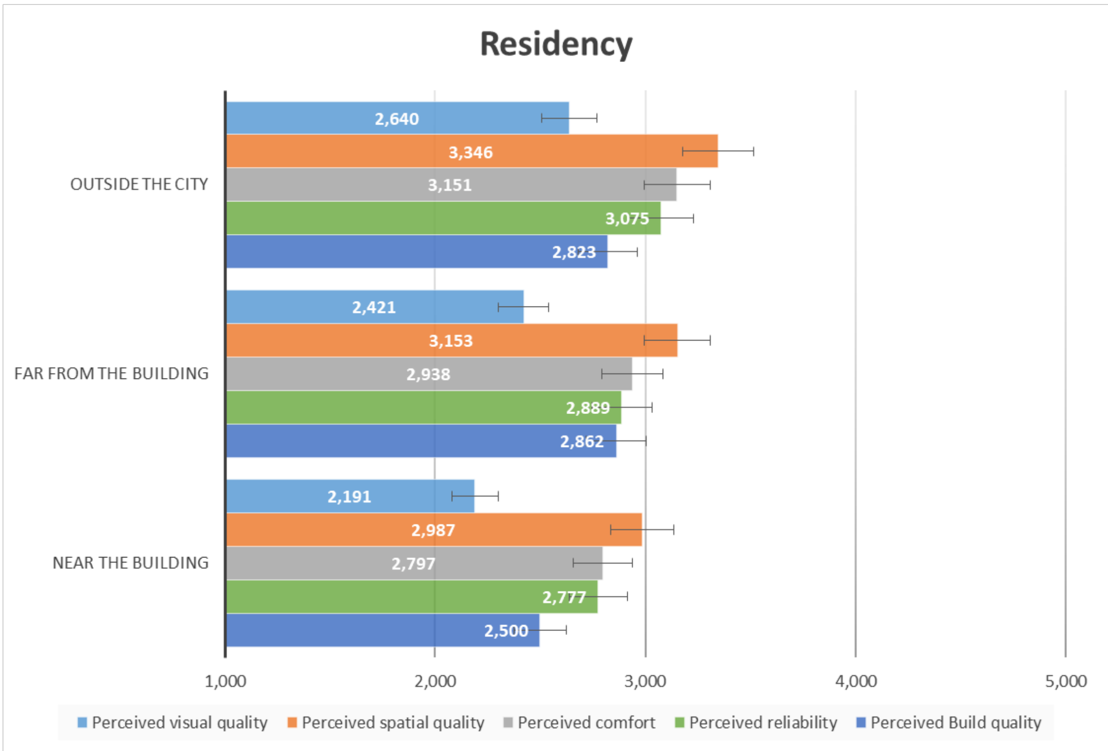


Figure 5-13. *Perceived architectural quality dimensions scores [a] for Residency groups. [a]5% error bars shown. (Source: Author).*

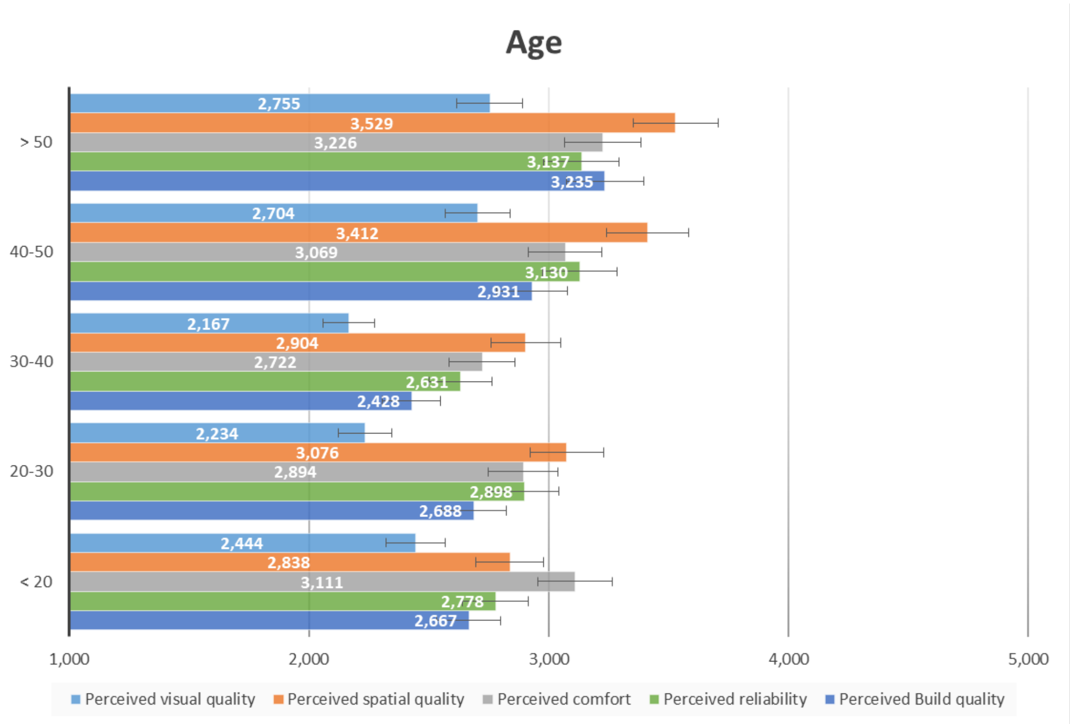


Figure 5-14. *Perceived architectural quality dimensions scores [a] for Age groups. [a]5% error bars shown. (Source: Author).*

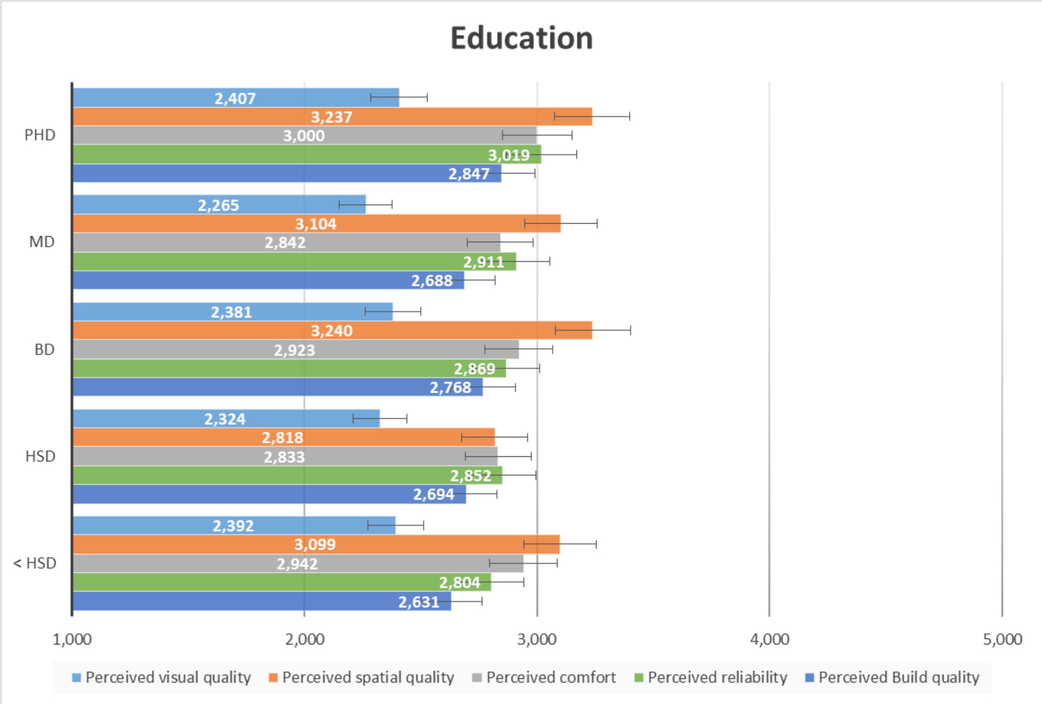


Figure 5-15. *Perceived architectural quality dimensions scores* [a] *for Education groups.* [a]*5% error bars shown. Note. < HSD=less than High School Degree; HSD= High School Degree; BD= Bachelor's Degree; MD= Master's Degree (Source: Author).*

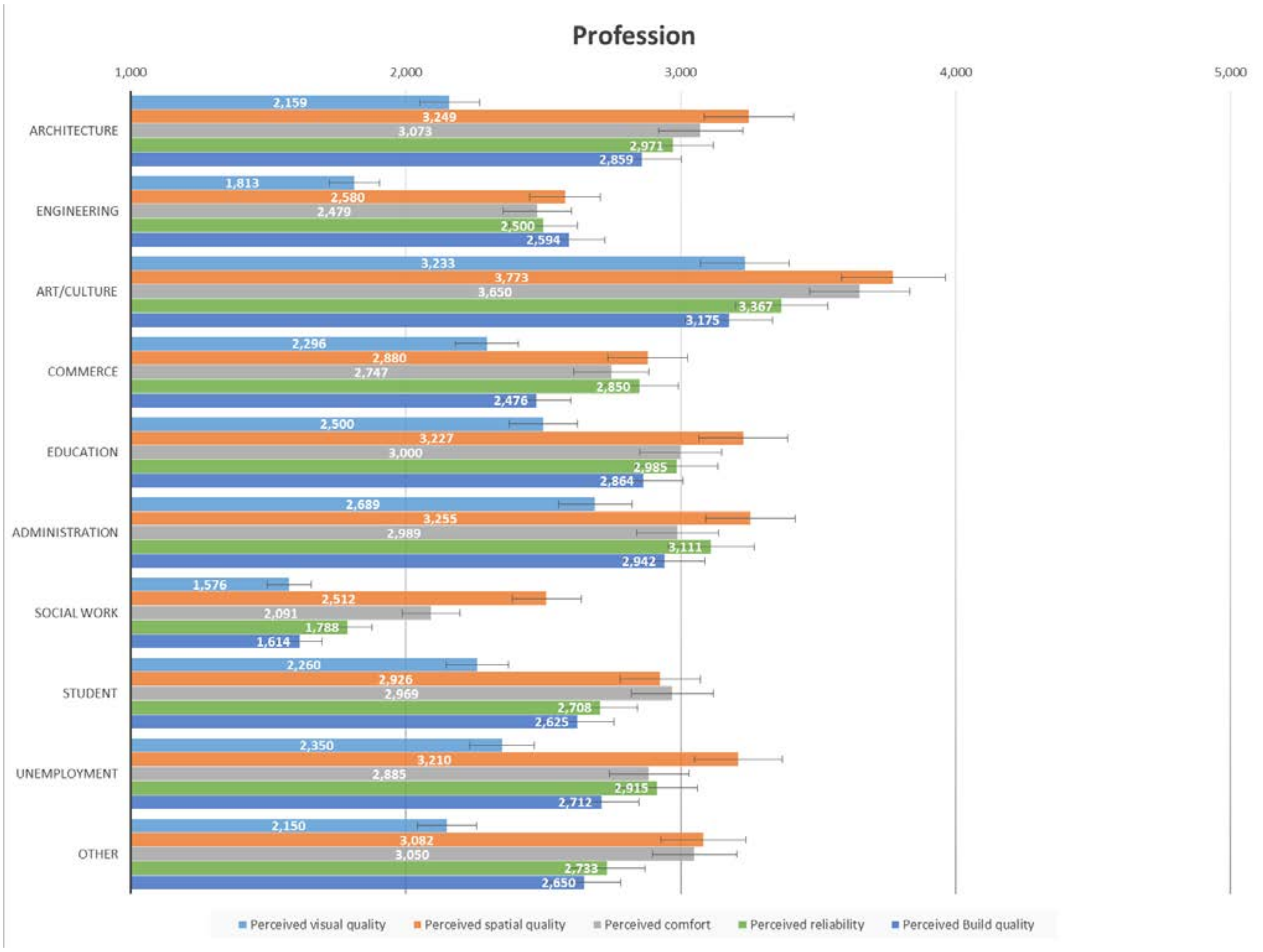


Figure 5-16. *Perceived architectural quality dimensions scores [a] for Profession groups. [a]5% error bars shown. (Source: Author).*

Table 5-16: *Distribution of respondents' ratings for all items on a 5-point Likert scale.*

Dimension	Item	Mean	Median	Std. Deviation	Ratings (1, 2, 3, 4, 5)
Perceived visual quality	PVQ1	2.80	3	1.050	
	PVQ2	2.22	2	1.202	
	PVQ3	2.39	3	1.069	
	PVQ4	2.17	2	1.162	
	PVQ5	2.26	2	1.316	

	PVQ6	2.26	2	1.261	
Perceived spatial quality	PSQ1	2,99	3,00	1,351	
	PSQ2	3,74	4,00	1,297	
	PSQ3	2,87	3,00	,970	
	PSQ4	3,88	4,00	1,218	
	PSQ5	2,94	3,00	1,001	
	PSQ 6	2,91	3,00	1,187	
	PSQ 7	2,39	2,00	1,445	
	PSQ 8	3,04	3,00	1,428	
	PSQ 9	3,85	4,00	1,434	
	PSQ 10	3,07	3,00	1,544	
	PSQ 11	2,52	2,00	1,337	
Perceived comfort	PC1	2,90	3,00	1,025	
	PC2	2,73	3,00	,956	
	PC3	2,62	3,00	,986	
	PC4	3,10	3,00	1,080	
	PC5	3,01	3,00	1,139	
	PC6	3,08	3,00	1,069	
Perceived reliability	PR1	2,93	3,00	,932	

	PR2	2,60	3,00	1,215	
	PR3	3,07	3,00	1,105	
Perceived build quality	PBD1	2,41	2,00	1,229	
	PBD2	2,64	3,00	1,003	
	PBD3	3,00	3,00	1,396	
	PBD4	2,72	3,00	,931	

Table 5-16 provides a comprehensive overview of the descriptive statistics for the ratings given by all 200 participants in relation to the various dimensions of the perceived architectural quality. Overall, the respondents' ratings were moderate for perceived comfort, perceived reliability, and building quality items.

It is worth noting that item PC2, PR1, and BD4 showed the smallest deviation from the mean, suggesting that respondents' opinions regarding the quality of artificial lighting, energetic performance, and materials quality were relatively consistent and not highly dispersed. This indicates a certain level of agreement among the participants regarding these particular aspects of architectural quality.

The assessment of perceived visual quality yielded diverse ratings, displaying varied levels of appreciation for different aspects. Among the items evaluated, PVQ1, which gauges the general perception of the building's external aesthetics, obtained the highest score (M = 2.80, Mdn = 3, SD = 1.050). On the other hand, PVQ4, which measures whether the building's exterior design incorporates advanced techniques, received the lowest score (M = 2.17, Mdn = 2, SD = 1.162).

Contrarily, the participants' assessments of perceived spatial quality showed a wide range of ratings, spanning from low to high.

Notably, among all the items, item PSQ4, which pertains to the visibility and clear marking of the primary entrance of the building, received the most favorable ratings. The mean rating for this item was 3.88, with a median of 4 and a standard deviation of 1.218. This indicates that respondents generally perceived the main entrance of the building to be well marked.

5.3.3.1. Socio-demographic influence on perceived architectural quality dimensions

5.3.3.1.1. Gender

The Mann-Whitney U test, as outlined in **Table 5-17**, revealed a significant disparity in the perceived visual quality scores between males and females (U = 2856, Z = -3.499, p = 0.001).

The mean rank for males was 91.26, while females had a mean rank of 122.59. Similarly, there was also a notable difference in the perceived comfort levels (U = 2795, Z = -3.667, p< 0.001), with males having a mean rank of 90.82 and females having a mean rank of 123.63. Additionally, perceived reliability exhibited a statistically significant variance (U = 3353.5, Z = -2.178, p = 0.029), with males having a mean rank of 94.78 and females having a mean rank of 114.16.

These findings emphasize that males and females perceived visual quality, comfort, and reliability differently. The statistical analysis indicates that females generally had higher mean ranks.

Although there were no notable discrepancies in the subjective evaluation of spatial quality between males (with a mean rank of 95.77) and females (with a mean rank of 111.81), as indicated by the non-significant difference in perceived spatial quality score (U = 3492.5, Z = -1.789, p = 0.074), it is worth noting that the perceived build quality score also exhibited a similar pattern (U = 3469, Z = -1.857, p = 0.063).

The building quality score did not show a significant variation between males (with a mean rank of 95.6) and females (with a mean rank of 112.2).

Table 5-17: *Results of the Mann-Whitney U test.*

	Group	N	Mean Rank	U	Z	Sig.	r
Perceived visual quality	Males	141	91.26	2856	-3.499	<0.001***	-0.247
	Females	59	122.59				
	Total	200					
Perceived spatial quality	Males	141	95.77	3492.5	-1.789	0.074	-0.127
	Females	59	111.81				
	Total	200					
Perceived comfort	Males	141	90.82	2795	-3.667	<0.001***	-0.259
	Females	59	123.63				
	Total	200					
Perceived reliability	Males	141	94.78	3353.5	-2.178	0.029*	-0.154
	Females	59	114.16				
	Total	200					
Perceived build quality	Males	141	95.6	3469	-1.857	0.063	-0.131
	Females	59	112.2				
	Total	200					

**p<0.05; **p<0.01; ***p<0.001*

5.3.3.1.2. Age

A comprehensive analysis was conducted using the Kruskal-Wallis H test (refer to **Table 5-18**) to examine how respondents' age influences their perception of perceived architectural quality dimensions. The findings of the test revealed a statistically significant difference in the scores for perceived visual quality among various age groups ($\chi2(4) = 12.405$, $p = 0.015$, $\eta p^2 = 0.060$).

However, when applying Dunn's post-hoc analysis with Bonferroni correction, it was observed that there was no significant difference between age groups. This implies that while age does have an impact on perceived visual quality, the perceived differences between age groups were not found to be statistically significant.

The results of the study revealed interesting findings in terms of age groups and their perceived spatial quality scores. Upon analyzing the data, it was observed that respondents younger than the age of 20 had an average rank of 104.72. Moving on to the age group of 20-30, they scored an average rank of 93.64, while individuals between the ages of 30-40 had an average rank of 88.77. Surprisingly, the age group of 40-50 achieved a higher mean rank of 122.31, and those above the age of 50 scored the highest with an average rank of 126.68.

Furthermore, a statistical analysis was conducted to determine the significance of these findings. The results indicated that there is indeed a significant difference in perceived spatial quality scores among the age groups ($\chi2(4) = 16.909$, $p = 0.002$, $\eta p^2 = 0.080$). To provide a clearer understanding of these scores, it was found that respondents under the age of 20 obtained a mean rank of 80.06, whereas individuals in the 20-30 age group had a mean rank 97.40 for the age group of (20-30), 85.55 for the age group of (30-40), 124.38 for the age group of (40-50) and 131.94 for those that exceeded age 50.

According to the analysis conducted, it was observed that the mean ranks exhibited a higher tendency among the respondents belonging to the older age groups, specifically the age groups of 40-50 and those above 50. Conversely, the younger age groups, namely those under 20, the age group of 20-30, and the age group of 30-40 had lower ratings.

After conducting a statistical analysis, it was revealed that there was no significant difference in the perceived comfort scores among participants of different age groups. The results of the $\chi2(4)$ test indicated a p-value of 0.109, suggesting that the observed variations in comfort scores were not statistically significant.

Furthermore, the effect size (ηp^2) was calculated to be 0.037, indicating a small magnitude of difference between the age groups ($\chi2(4) = 7.561$, $p = 0.109$, $\eta p^2 = 0.037$). Upon examining the mean rank scores, it was found that individuals below the age of 20 had an average score of 110.67, group of, 98.62 for the age group of (20-30), 89.01 for the age group of (30-40), 110.38 for the age group of (40-50) and 126.79 for those that exceeded age 50.

In terms of perceived reliability scores, a statistically significant difference was observed ($\chi2(4) = 9.991$, $p = 0.041$, $\eta p^2 = 0.037$), signifying that there were variations among different age groups. The mean rank of those under the age of 20 was 91.06, while the age group of 20 to 30 had a mean rank of 102.25. The age group of 30 to 40, on the other hand, had the lowest mean rank of 85.53. Moving forward, the age group of 40 to 50 had a mean rank of 117.17, and for those aged 50 and above, the mean rank was the highest at 120.91.

As for perceived build quality scores, there was a significant difference ($\chi2(4) = 14.997$, $p = 0.005$, $\eta p^2 = 0.071$), with a mean rank of 96.67 for those less than age 20, 100.40 for the age group of (20-30), 83.86 for the age group of (30-40) which is the lowest of all mean ranks, 114.17 for the age group of (40-50) and 138.62 for those that exceeded age 50 which is the highest of all mean ranks. In general, older respondents, on average, exhibited higher mean ranks when compared to their younger counterparts.

Table 5-18: *Results of the Kruskal-Wallis H test for age groups.*

	Group	N	Mean Rank	χ2	df	Sig.	ηp²
Perceived visual quality	< 20	9	104.72	12.405	4	0.015*	0.060
	20-30	72	93.64				
	30-40	66	88.77				
	40-50	36	122.31				
	> 50	17	126.68				
	Total	200					
Perceived spatial quality	< 20	9	80.06	16.909	4	0.002**	0.080
	20-30	72	97.40				
	30-40	66	85.55				
	40-50	36	124.38				
	> 50	17	131.94				
	Total	200					
Perceived comfort	< 20	9	110.67	7.561	4	0.109	0.037
	20-30	72	98.62				
	30-40	66	89.01				
	40-50	36	110.38				
	> 50	17	126.79				
	Total	200					
Perceived reliability	< 20	9	91.06	9.991	4	0.041*	0.049
	20-30	72	102.25				
	30-40	66	85.53				
	40-50	36	117.17				
	> 50	17	120.91				
	Total	200					
Perceived build quality	< 20	9	96.67	14.997	4	0.005**	0.071
	20-30	72	100.40				
	30-40	66	83.86				
	40-50	36	114.17				
	> 50	17	138.62				
	Total	200					

**p<0.05; **p<0.01; ***p<0.001*

5.3.3.1.3. Residency

In **Table 5-19**, the outcome of the test revealed a noteworthy disparity in the perceived visual quality scores ($\chi2(2) = 6.017$, $p = 0.049$, $\eta p^2 = 0.030$). However, upon conducting Dunn's post-hoc analysis with Bonferroni correction, no significant distinction was observed between the residency groups. It is worth noting, though, that the respondents' mean ranks varied significantly: 90.91 for individuals residing near the building, 104.37 for those residing far from the building, and 118.94 for respondents living outside the city. This implies that the distance from the building and the location of residence might contribute to variations in perceived visual quality scores among the respondents.

In terms of spatial quality, the study found a noteworthy distinction among different groups of respondents. The statistical analysis demonstrated a significant difference in the perceived spatial quality score, as evidenced by the chi-square test results ($\chi2(2) = 6.737$, $p = 0.034$, $\eta p^2 = 0.033$). Specifically, respondents who lived near the building had a mean rank of 90.25, while those who lived farther away from the building had a slightly higher mean rank of 104.79. Surprisingly, respondents living outside the city reported the highest mean rank of 119.79, indicating a more favorable perception of spatial quality.

In contrast, the perceived comfort score did not exhibit a significant difference among the residency groups. The chi-square test results ($\chi2(2) = 4.020$, $p = 0.134$, $\eta p^2 = 0.020$) showed that there was no statistical distinction in terms of perceived comfort. Respondents living near the building had a mean rank of 94.24, while those living far from the building had an average rank of 100.73, and 118.29 for respondents living outside the city.

In analyzing the data, it was observed that there were no substantial disparities in the perceived reliability scores among the respondents based on their proximity to the building. This finding was established through statistical analysis, specifically the chi-square test ($\chi2$) ($\chi2(2) = 3.145$, $p = 0.208$, $\eta p^2 = 0.016$). The results revealed that the perceived reliability scores did not significantly vary among those who lived near the building, those who lived far from the building, and even those residing outside the city. The mean ranks for respondents living near the building, far from the building, and outside the city were 94.03, 102.40, 114.71 respectively.

In the analysis conducted, it was observed that there existed a significant variation in the perceived build quality scores among different residency groups ($\chi2(2) = 9.496$, $p = 0.009$, $\eta p^2 = 0.046$). The mean rank for respondents residing in close proximity to the building was recorded as 86.75, while for those living further away it was 111.88. Interestingly, respondents who lived outside the city had an even higher mean rank of 112.21.

This suggests that the perceived quality of the building was rated more favorably by individuals residing outside the city compared to those residing near it. This finding highlights the influence of residency on the perception of building quality.

Table 5-19: *Results of the Kruskal-Wallis H test for residency groups.*

	Group	N	Mean Rank	$\chi 2$	df	Sig.	ηp^2
Perceived visual quality	Near the building	91	90.91	6.017	2	0.049*	0.030
	Far from the building	78	104.37				
	Outside the city	31	118.94				
	Total	200					
Perceived spatial quality	Near the building	91	90.25	6.737	2	0.034*	0.033
	Far from the building	78	104.79				
	Outside the city	31	119.79				
	Total	200					
Perceived comfort	Near the building	91	94.24	4.020	2	0.134	0.020
	Far from the building	78	100.73				
	Outside the city	31	118.29				
	Total	200					
Perceived reliability	Near the building	91	94.03	3.145	2	0.208	0.016
	Far from the building	78	102.40				
	Outside the city	31	114.71				
	Total	200					
Perceived build quality	Near the building	91	86.75	9.496	2	0.009**	0.046
	Far from the building	78	111.88				
	Outside the city	31	112.21				
	Total	200					

**p<0.05; **p<0.01; ***p<0.001*

5.3.3.1.4. Level of education

Upon analysis of **Table 5-20**, it was observed that the test conducted did not yield any significant difference in the perceived visual quality scores among the participants ($\chi2(4) = 1.062$, $p = 0.900$, $\eta p^2 = 0.005$). The mean rank for those individuals with less than a high school degree was found to be 101.81, followed by 103.58 for respondents with a high school degree, and 104.96 for those with a bachelor's degree. Additionally, respondents with a master's degree had a mean rank of 94.03, while individuals holding a PhD degree had a mean rank of 104.78.

The perceived spatial quality scores did not show any notable variation among individuals with different educational backgrounds ($\chi2(4) = 4.296$, $p = 0.367$, $\eta p^2 = 0.022$). The mean rank for those with less than a high school degree was 100.68, whereas respondents with a high school degree had a mean rank of 79.00. Interestingly, respondents with a bachelor's degree scored an average rank of 108.11, while those with a master's degree scored 98.45. Furthermore, individuals with a PhD degree had the highest mean rank of 115.75.

Similarly, the perceived comfort scores did not exhibit any significant differences across education levels. The statistical analysis yielded a chi-square value of 1.983, indicating no statistical significance ($p = 0.739$, $\eta p^2 = 0.010$). The mean rank for those with less than a high school degree was 103.31, while respondents with a high school degree had a slightly lower mean rank of 94.97. For individuals with a bachelor's degree, the mean rank was 102.63, and for those with a master's degree, it was 93.42.

Notably, respondents with a PhD degree obtained the highest mean rank of 112.25. Therefore, the results suggest that educational attainment does not impact perceived spatial quality or comfort scores, as indicated by the lack of significant differences across educational levels.

In terms of perceived reliability scores, there was no significant variation observed ($\chi2(4) = 1.757$, $p = 0.780$, $\eta p^2 = 0.009$). The mean rank for individuals with less than a high school degree was 96.23, while respondents with a high school degree had a mean rank of 98.03. Those with a bachelor's degree reached a mean rank of 103.05, respondents with a master's degree scored a mean rank of 101.34, and individuals with a PhD degree obtained the highest mean rank of 115.39. This implies that there were negligible differences. In regards to the perceived build quality scores, it can be stated that no significant distinctions were observed ($\chi2(4) = 1.372$, $p = 0.849$, $\eta p^2 = 0.007$). This implies that there were no notable variations in the scores based on the level of education attained by the respondents. Specifically, the mean rank for individuals with less than a high school degree was calculated to be 97.55, while respondents with a high school degree had a mean rank of 102.72. Moreover, those with a bachelor's degree had a mean rank of 105.32, respondents with a master's degree had a mean rank of 97.67, and 112.69 for respondents with a PhD degree.

Table 5-20: *Results of the Kruskal-Wallis H test for education groups.*

	Group	N	Mean Rank	χ2	df	Sig.	ηp²
Perceived visual quality	< HSD	80	101.81	1.062	4	0.900	0.005
	HSD	18	103.58				
	BD	28	104.96				
	MD	56	94.03				
	PhD	18	104.78				
	Total	200					
Perceived spatial quality	< HSD	80	100.68	4.296	4	0.367	0.022
	HSD	18	79.00				
	BD	28	108.11				
	MD	56	98.45				
	PhD	18	115.75				
	Total	200					
Perceived comfort	< HSD	80	103.31	1.983	4	0.739	0.010
	HSD	18	94.97				
	BD	28	102.63				
	MD	56	93.42				
	PhD	18	112.25				
	Total	200					
Perceived reliability	< HSD	80	96.23	1.757	4	0.780	0.009
	HSD	18	98.03				
	BD	28	103.05				
	MD	56	101.34				
	PhD	18	115.39				
	Total	200					
Perceived build quality	< HSD	80	97.55	1.372	4	0.849	0.007
	HSD	18	102.72				
	BD	28	105.32				
	MD	56	97.67				
	PhD	18	112.69				
	Total	200					

Note. < HSD=less than High School Degree; HSD= High School Degree; BD= Bachelor's Degree; MD= Master's Degree. *p<0.05; **p<0.01; ***p<0.001

5.3.3.1.5. Profession

According to the analysis conducted, it was observed in **Table 5-21** that there exists a notable disparity in the scores pertaining to perceived visual quality. The statistical test revealed a significant difference with a chi-square value of 28.414 (df=9), demonstrating strong evidence to support this finding ($\chi2(9) = 28.414$, $p = 0.001$, $\eta p^2 = 0.129$). The calculated p-value of 0.001 further confirms the statistical significance of these results. The effect size, indicated by ηp^2 (eta squared), was calculated to be 0.129, highlighting the substantial impact of the respective professions on perceived visual quality scores.

Upon closer examination, respondents belonging to the Architecture profession obtained an average rank of 88.17, while those in the Art/Culture profession had an average rank of 156.50, 99.55 for respondents in Commerce profession, 65.00 for respondents in Engineering profession, 46.36 for respondents in Social work profession, and 120.70 for respondents in Administration profession.

The study observed a considerable variation in the scores related to the perceived spatial quality among different professional backgrounds. The statistical analysis indicated a significant difference ($\chi2(9) = 28.418$, $p = 0.001$, $\eta p^2 = 0.130$) in the mean ranks, with Architecture professionals having an average rank of 110.17, respondents from the Art/Culture profession scoring 153.65, those in Commerce profession obtaining a mean rank of 79.16, respondents from the Engineering profession having a score of 62.13, Social work professionals scoring 53.50, and Administration professionals obtaining a mean rank of 111.20.

Similarly, there was also a notable distinction in the perceived comfort scores among respondents from various professional backgrounds. The statistical analysis revealed a significant difference ($\chi2(9) = 21.469$, $p = 0.011$, $\eta p^2 = 0.102$) in the mean ranks. Architecture professionals had an average rank of 110.98, Art/Culture professionals scored 155.10, respondents from Commerce profession obtained a mean rank of 82.16, Engineering professionals had a score of 74.63, Social work professionals obtained 59.68, and Administration professionals achieved a mean rank of 105.32.

This indicates that the perceived spatial quality and comfort vary significantly among professionals from different fields.

The test revealed a noteworthy variation in the perceived reliability scores ($\chi2(9) = 23.149$, $p = 0.006$, $\eta p^2 = 0.109$) among various professional domains. A comprehensive analysis of the data indicated that respondents in the Architecture profession had a mean rank of 105.15, while respondents in the Art/Culture profession had a higher mean rank of 138.30. Similarly, respondents in the Commerce profession exhibited a mean rank of 97.98, while those in the Engineering profession had a comparatively lower mean rank of 73.00. Additionally, respondents in the Social work profession reported a mean rank of 36.

To conclude, the analysis reveals a substantial disparity in the assessment of perceived build quality scores ($\chi2(9) = 23.440$, $p = 0.005$, $\eta p^2 = 0.110$) among various professional fields. Specifically, when considering the mean ranks, it is noteworthy that respondents belonging to the Architecture profession achieved a mean rank of 109.87.

On the other hand, respondents from the Art/Culture profession attained a higher mean rank of 137.35, whereas those in the Commerce profession scored an average rank of 85.34. In comparison, individuals in the Engineering profession obtained a mean rank of 98.13, respondents in the Social work profession achieved a relatively lower mean rank of 35.55, and finally, those in the Administration profession obtained a mean rank of 111.47. It is worth highlighting that respondents associated with the Art/Culture profession demonstrated the highest mean ranks.

Table 5-21: *Results of the Kruskal-Wallis H test for profession groups.*

	Group N	N	χ2	df	Sig.	ηp²
Perceived visual quality	10[a]	200	28.414	9	0.001**	0.130
Perceived spatial quality	10	200	28.418	9	0.001**	0.130
Perceived comfort	10	200	21.469	9	0.011*	0.102
Perceived reliability	10	200	23.149	9	0.006**	0.109
Perceived build quality	10	200	23.440	9	0.005**	0.110

**p<0.05; **p<0.01; ***p<0.001. Note.* [a]*test groups: Architecture, Engineering, Art/Culture, Commerce, Education, Administration, Social work, Student, Unemployment, Other.*

5.3.4. Correlations between perceived architectural quality dimensions

In order to ascertain the connection between the perceived visual quality, perceived spatial quality, perceived comfort, perceived reliability, and building quality, a Spearman correlation test was conducted based on the scores of each dimension of the perceived architectural quality gathered from 200 participants. This test aimed to delve into the interrelationships among these five dimensions.

To visually represent these relationships, a scatter plot matrix (**Figure 5-17**) was created, which complements the correlation matrix (**Table 5-22**) where the correlation coefficients are displayed. By examining both the scatter plot matrix and the correlation matrix, we can gain a comprehensive understanding of how the perceived architectural quality dimensions are intertwined.

In the correlation test of the 200 participants, it was observed that there existed a robust and affirmative relationship between the perceived visual quality and the overall quality of buildings, denoted by a correlation coefficient of 0.702 (rho = 0.702, n = 200, $p<0.001$). Similarly, the perceived comfort was found to be strongly correlated with the perceived reliability of the buildings, exhibiting a correlation coefficient of 0.719 (rho = 0.719, n = 200, $p<0.001$).

Moreover, there was a moderate yet significant positive correlation between the perceived reliability of buildings and their perceived build quality (correlation coefficient rho = 0.690, n = 200, $p<0.001$), as well as between the perceived spatial quality and the perceived build quality (correlation coefficient rho = 0.667, n = 200, $p<0.001$). Additionally, a noteworthy correlation was identified between the perceived spatial quality and the perceived visual quality of the buildings (rho = 0.656, n = 200, $p<0.001$).

Table 5-22: *Correlation matrix of the perceived architectural quality dimension.*

	Perceived visual quality	***Perceived spatial quality***	***Perceived comfort***	***Perceived reliability***	***Perceived build quality***
Perceived visual quality *Sig. (2-tailed)* *95% CI*	1				
Perceived spatial quality *Sig. (2-tailed)* *95% CI*	0.656** <0.001 [0.575, 0.728]	1			
Perceived comfort *Sig. (2-tailed)* *95% CI*	0.609** <0.001 [0.500, 0.695]	0.607** <0.001 [0.497, 0.698]	1		
Perceived reliability *Sig. (2-tailed)* *95% CI*	0.637** <0.001 [0.541, 0.718]	0.607** <0.001 [0.499, 0.700]	0.719** <0.001 [0.613, 0.804]	1	
Perceived build quality *Sig. (2-tailed)* *95% CI*	0.702** <0.001 [0.611, 0.770]	0.667** <0.001 [0.579, 0.738]	0.604** <0.001 [0.486, 0.699]	0.690** <0.001 0[.597, 0.764]	1

*** Double asterisk = significant correlations. CI = confidence interval.*

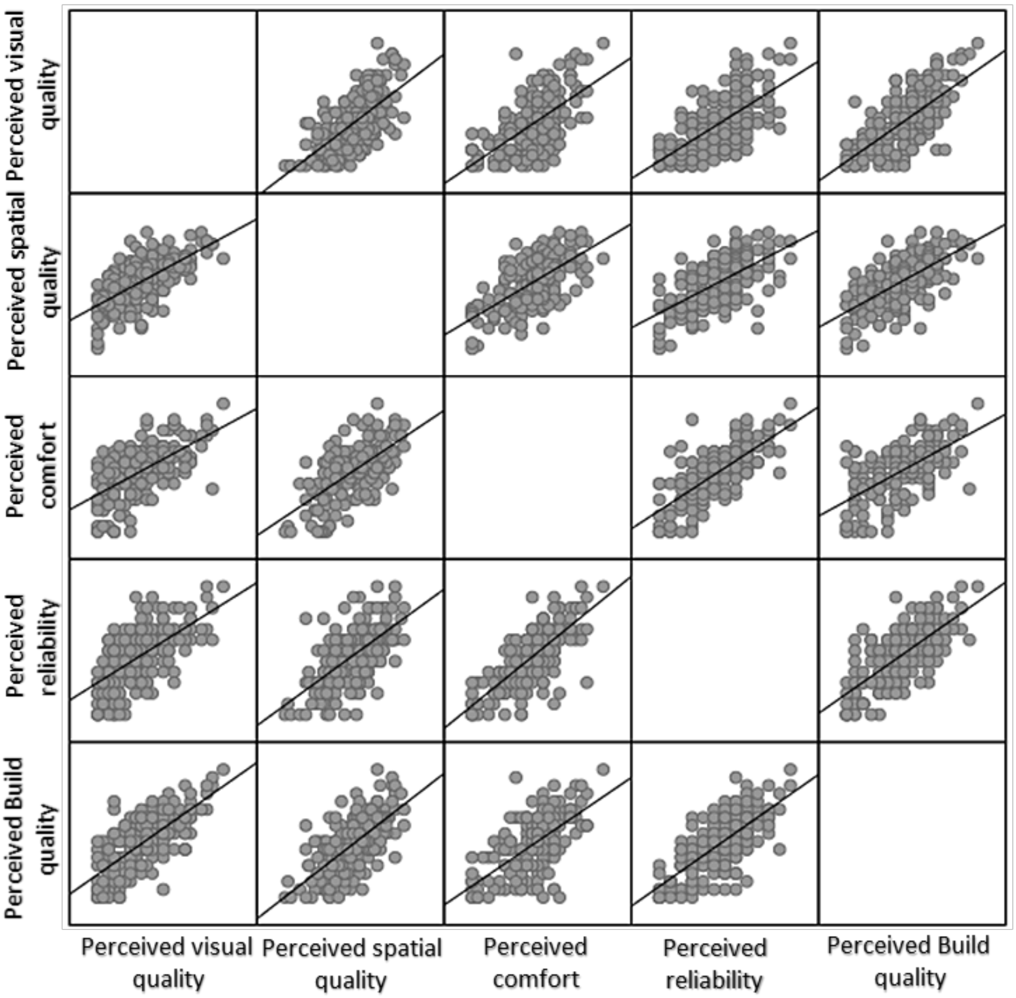


Figure 5-17. *Scatter plot matrix (Source: Author).*

5.3.5. Summary of results

It can be contended that the concept of perceived quality comprises multiple dimensions, making it a complex and multi-faceted notion. In order to fully evaluate this concept, it is imperative to undergo a thorough assessment of each of its constituent elements.

To accomplish this task effectively, it is essential to employ an appropriate method of analysis, considering the need for flexibility and versatility when addressing such a subjective matter (Rönn, 2014). By scrutinizing and delving into the various aspects that contribute to perceived quality, a comprehensive understanding of its true essence can be achieved.

According to the majority of participants, the cultural house building is generally regarded as having an intermediate level of architectural quality.

This belief is supported by the average scores given by respondents for factors such as perceived comfort, perceived build quality, spatial perception, and perceived reliability, which were found to be moderate. However, the aspect of aesthetic perception received a lower mean score in comparison. This suggests that while the cultural house building is generally perceived to have moderate architectural quality, its aesthetic appeal may not meet the users' expectations.

The assessment of perceived quality in buildings is influenced by socio-demographic variables such as gender, age, and residency, according to the research findings.

In particular, these variables were found to have a significant impact on respondents' choices when evaluating building quality. However, it is worth noting that the level of education was not found to have a significant influence on the perception of quality. This comprehensive study highlights the importance of considering socio-demographic factors in understanding how individuals assess the quality of buildings.

After a careful and comprehensive analysis, it can be inferred that four out of the five socio-demographic variables examined in this study have exerted a noteworthy impact on the respondents' attitudes towards the culture house building. It can be further extrapolated that these attitudes, in turn, have influenced the way the respondents assess the perceived quality of the said structure, as indicated in **Table 5-23**. The elucidation of these findings significantly enriches our understanding of the factors that shape individuals' views and evaluations of cultural establishments.

Table 5-23: *Socio-Demographic variables influence on perceived architectural quality*

Socio-demographic variable	***P-Value***	***Influence on perceived architectural quality***
Gender	0.003**	Supported
Age	0.003**	Supported
Residency	0.029*	Supported
Education	0.942	Not Supported
Profession	0.000***	Supported

**p<0.05; **p<0.01; ***p<0.001*

5.4. Discussion

5.4.1. Evaluation of the perceived architectural quality

According to the findings of the study, when evaluating the perceived architectural quality dimensions, the ratings provided by the respondents varied from poor to moderate. This assessment was made on a Likert scale with a neutral score of three (3). The results of the one-sample Wilcoxon signed-rank test and the descriptive analysis scores (**Figure 5-18**) further confirm this range of ratings.

When specifically looking at the perceived spatial quality, the respondents rated it slightly above the neutral value. On the other hand, the perceived comfort received ratings equal to the neutral value. However, the building did not receive strong ratings in terms of perceived visual quality, perceived reliability, and the overall perceived build quality. In fact, perceived visual quality showed the largest variability compared to the neutral score.

It is important to note that these findings suggest there is room for improvement in the perceived architectural quality of the building, particularly in terms of visual aesthetics and reliability.

The respondents provided moderate scores for the building's appearance, but they expressed dissatisfaction with its aesthetics, noting that it did not align with their personal preferences. Moreover, they felt that the design lacked authenticity and failed to showcase any elements of modern architectural style.

Moving on to the perceived reliability and quality of the building, the gathered results indicate that the scores did not precisely reach a neutral value, although they came quite close. This was especially evident in the assessment of whether the building exhibited expensive fit and finish and if its structure conveyed a sense of security and stability.

The perceived spatial quality of the building, while slightly better than average. received high ratings compared to other dimensions. In terms of the building's legibility, respondents noted that the visibility of the main entrance and the conformity of the workspace and interior areas to their respective purposes were only moderate.

It is important to note that the cultural edifice is considered a landmark in the city due to its unique and essential purpose. However, the respondents expressed their dissatisfaction with the building's integration with its surrounding environment.

The building's lack of harmony with its surroundings was a significant concern for the respondents. They emphasized the need for better integration to create a more cohesive and visually appealing urban landscape.

In terms of the comfort level perceived by the respondents, the perceived comfort score was found to be equal to the neutral value. This suggests that the scores of each item associated with the comfort (such as the quality of natural and artificial lighting. thermal comfort. and soundproofing) were all equal to three (3). This indicates that the respondents considered these aspects to be moderately acceptable regarding the building.

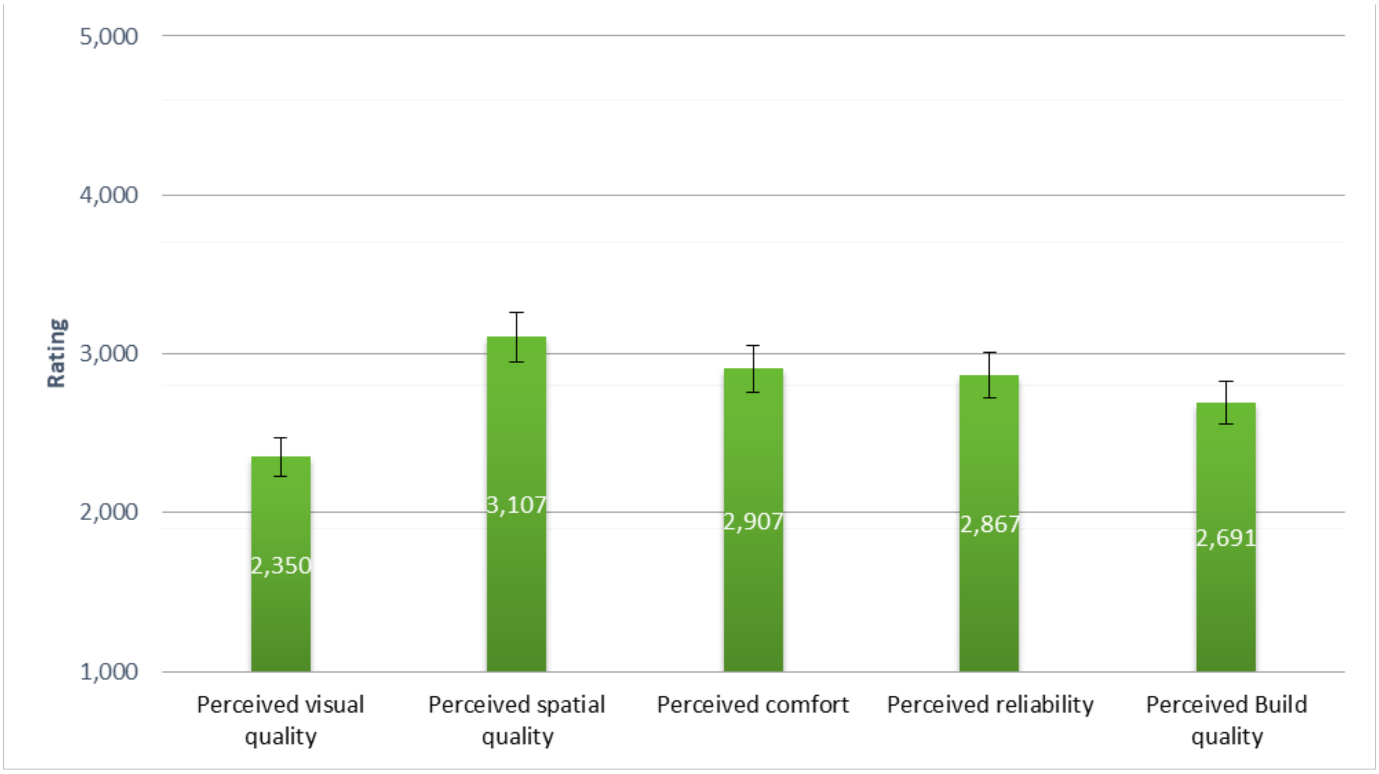


Figure 5-18. *Perceived architectural quality dimensions scores [a] on a 5-point Likert scale.*
[a] 5% error bars shown. (Source: Author).

5.4.2. Influence of socio-demographic factors

Table 5-24: *Summary of results of the parametric tests for perceived architectural quality.*

	Gender	Age	Residency	Education	Profession
	Sig.	*Sig.*	*Sig.*	*Sig.*	*Sig.*
Perceived architectural quality	0.003**	0.002**	0.031*	0.922	0.000***

*$p<0.05$; **$p<0.01$; ***$p<0.001$

According to the evaluation of the perceived quality of the cultural facility, it was found that various socio-demographic factors, including gender, age, residency, and profession, significantly influenced the dimensions of perceived architectural quality. These findings align with previous research (as indicated in **Table 5-24**). This suggests that the opinions and perceptions of individuals regarding the architectural quality of cultural facilities are shaped by their demographic characteristics. Understanding these influences is crucial for comprehensively assessing the perceived quality of cultural facilities and ensuring their enrichment.

Based on the analysis of standardized test results, it is evident that there exists a notable and statistically significant divergence in the perception of architectural quality, as well as in the scores of the five dimensions, when comparing males and females. Notably, the ratings assigned by female respondents surpass those of their male counterparts, highlighting a clear inclination towards superior evaluations made by females. This discrepancy emphasizes the influence of gender on the perception.

Regarding the socio-demographic variable of age, there were notable distinctions in the perceived architectural quality, perceived spatial quality, and building quality scores between the age groups of 30-40 and 40-50, as well as between the age group of 30-40 and those above the age of 50. This information is presented in Table 12. Additionally, there was a significant variation in the perceived reliability score, however, after conducting Dunn's post-hoc analysis with Bonferroni correction, no significant difference was found between any of the age groups. Furthermore, there were no significant differences observed between the groups in terms of perceived visual quality and perceived comfort scores. This phenomenon suggests that the perception of architectural and spatial elements is influenced by age, while reliability does not exhibit the same pattern. Overall, these findings provide a comprehensive understanding of the intricate relationship between age and perceptions of architectural and spatial qualities in this study. The assessments provided by older respondents tended to exhibit higher scores compared to those of their younger counterparts. This discrepancy can be attributed to the variances in life experience and emotional connection that accumulate over time. The extensive knowledge and deep-rooted attachment to certain aspects of the subject matter contribute to the elevated evaluations observed among older respondents.

Based on the residents' locations and in accordance with the research findings, it was observed that there existed a noteworthy disparity among respondents from different residential areas with respect to the perception of architectural quality, visual quality, spatial quality, and building quality scores. However, when Dunn's post-hoc analysis was conducted with Bonferroni correction, no significant difference was observed between residency groups in terms of perceived visual quality score. Furthermore, there was no significant variation in the perceived comfort and perceived reliability scores across different residential areas. This highlights the importance of considering the influence of residency on various aspects of quality perception in the built environment.

According to the comprehensive analysis conducted, it was observed that individuals who reside at a considerable distance from the culture house or outside the city tended to provide higher ratings for the building in all categories as opposed to respondents who live in close proximity. This finding suggests that geographical proximity may have an influence on the perception and evaluation of respondents.

It is indeed surprising that the level of education did not show any substantial impact on perceived architectural quality or its various dimensions. This could be attributed to the lack of noteworthy visual elements in the building's design or a failure to effectively communicate the intended message to the observer, It is possible that individuals with higher education might have been able to detect and interpret the underlying message better, but in this case, it seems that the design failed to transmit the intended message accurately. This suggests a potential discrepancy between the design's purpose and its actual interpretation, highlighting the importance of effective communication in architectural design.

Furthermore, the absence of a significant influence of education on perceived architectural quality raises questions about the role of education in shaping individuals' perceptual experiences. This finding challenges the commonly held notion that higher education leads to a more nuanced and sophisticated understanding of visual stimuli. Overall, this discovery calls for a deeper exploration of the factors that contribute to perceived architectural quality.

Regarding the socio-demographic variable of profession, it has a notable impact on the perceived quality of architecture and its various dimensions. Further analysis reveals that there are significant variations between respondents belonging to the Art/Culture profession and those in the social work profession across all dimensions.

Notably, individuals in the Art/Culture profession rated differently compared to other professional groups including Architecture, Administration, Engineering, and Commerce. In addition, respondents in the Architecture profession displayed a significant difference in perceived reliability and building quality scores when compared to individuals in the Social work profession. This suggests that the occupation or line of work can greatly influence how individuals perceive and evaluate architectural quality (**Table 5-25**).

Table 5-25: *Summary of the significant pairwise comparisons through Dunn's test and Bonferroni's significance.*

	Variable	Pairwise comparison	Test Statistic	SE	Std. Test Statistic	Sig.	Bonferroni's adjusted sig.
Perceived visual quality	Profession	Social work-Administration	74.336	20.361	3.651	0.000	0.012
		Social work-Art/Culture	110.136	25.239	4.364	0.000	0.001
		Engineering-Art/Culture	-91.5	27.4	-3.339	0.001	0.038
Perceived spatial quality	Age	(30-40)-(40-50)	-38.83	11.981	-3.241	0.001	0.012
		(30-40)-> 50	-46.396	15.727	-2.95	0.003	0.032
	Residency	NB - OC	-29.538	12.025	-2.456	0.014	0.042
	Profession	Social work-Art/Culture	100.15	25.265	3.964	0	0.003
		Engineering-Art/Culture	-91.525	27.429	-3.337	0.001	0.038
		Commerce-Art/Culture	74.489	21.029	3.542	0	0.018
Perceived comfort	Profession	Social work-Art/Culture	95.418	25.208	3.785	0	0.007
		Commerce-Art/Culture	72.939	20.981	3.476	0.001	0.023
Perceived reliability	Profession	Social work-Unemployment	-65.828	19.59	-3.36	0.001	0.035
		Social work-Architecture	68.698	21.035	3.266	0.001	0.049
		Social work-Education	75.909	21.189	3.582	0	0.015
		Social work-Administration	76.962	20.226	3.805	0	0.006
		Social work-Art/Culture	101.845	25.072	4.062	0	0.002
Perceived build quality	Age	(30-40)-> 50	-54.762	15.68	-3.493	0	0.005
	Residency	NB - FB	-25.132	8.895	-2.825	0.005	0.014
	Profession	Social work-Unemployment	-66.916	19.681	-3.4	0.001	0.03
		Social work-Architecture	74.324	21.134	3.517	0	0.02
		Social work-Administration	75.921	20.32	3.736	0	0.008
		Social work-Education	79.318	21.288	3.726	0	0.009
		Social work-Art/Culture	101.805	25.189	4.042	0	0.002

Only significant pairwise comparisons are shown ($p<0.05$). NB = near the building. FB = Far from the building. OC = outside the city.

5.4.3. Relationships between dimensions

One of the objective of the study was to explore the interconnectedness of various dimensions of perceived architectural quality, and to determine whether enhancing one dimension could positively influence another, thereby elevating the overall perceived quality of a building. The research findings unequivocally highlight the significance of visual quality as a fundamental component of perceived architectural quality, showcasing its vital association with all other dimensions. This highlights the crucial role that visual aesthetics play in shaping the overall perception and evaluation of architectural excellence. These crucial insights underscore the need for architects and designers to prioritize the visual aspects of a structure, as improvements in visual quality can have a cascading effect on the holistic perception and appraisal of the building as a whole.

The conclusions presented in **Figure 5-19** align with prior research on the correlation between visual perception and spatial cognition, which, in turn, affects the functional aspects of a building. The integration of visual and spatial capabilities enables the formation of mental models that aid in recognizing the functionality of a space. As a result, the visual characteristics of a building play a significant role in assessing its spatial quality.

This association between visual and spatial perception underscores the importance of considering both aspects when evaluating the overall functionality and appeal of architectural structures. By comprehensively exploring the interplay between visual and spatial perception, researchers contribute to a deeper understanding of how design elements impact the way individuals perceive and navigate through built environments.

The results obtained from the research align with the study conducted by Tractinsky et al. (2000). Their study demonstrated a strong correlation between how users perceive the aesthetic aspects of an interface and their overall perception of the system's usability. This connection between perceived visual characteristics and user satisfaction can also be observed in the realm of architecture. Similar to how a visually appealing building creates the impression of being constructed with high-quality materials, the subjective perception of a building's physical visual qualities is intertwined with the observer's interpretation of the materials and textures employed, as well as the level of fit and finish and adherence to established standards and norms. This intricate relationship between visual aesthetics and perceived quality enhances users' understanding and appreciation of both interfaces and physical structures.

The analysis of perception and the integration of models can be considered essential components of the automatic phase of evaluation. On the other hand, the cognitive mastering process and the subsequent interpretation can be viewed as integral aspects of the deliberate phase of evaluation. It is important to note that perceiving and integrating models play a significant role in the initial stages of evaluation.

The perception of visual quality in architecture is influenced by various factors and can be correlated with the perception of comfort. Through the translation of building performance, particularly in terms of thermal and acoustic aspects.

A visually appealing building can create an impression of comfort that is equivalent to other sensory experiences. This indicates that the visual qualities of a building play a significant role in shaping the overall perception of comfort.

Undoubtedly, the visual appeal of a building plays a crucial role in shaping people's perception of its durability and reliability. A building that exhibits strong visual characteristics not only creates an impression of strength and dependability but also instills a sense of trust and safety in individuals.

The message and purpose of a building can be symbolically represented and characterized by both the architect and the user in a given context. The perception and interpretation of a building's meaning are inherently tied to its location and the subjective state of the observer. Therefore, it is a subjective and context-dependent matter, varying from one building to another and from one user to another. When considering a building's intended function, its symbolism and message can vary significantly, influenced by factors such as the architect's vision and the individual experiences and perspectives of its users.

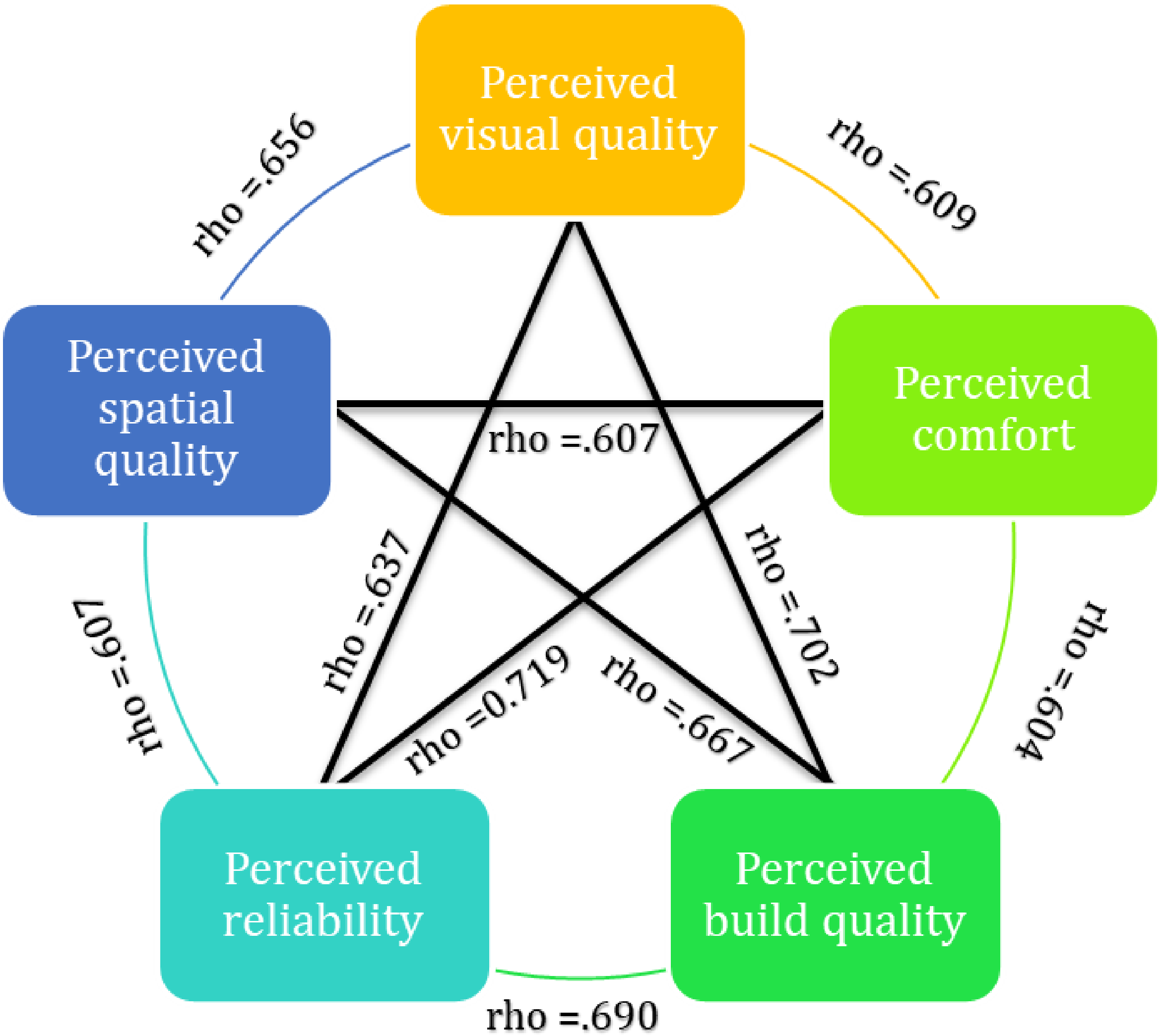


Figure 5-19. *Correlations between Perceived architectural quality dimensions (Source: Author).*

5.4.4. Respondents' opinions on whether the building's appearance needs amelioration or not

Table 5-26: *Distribution of respondents' ratings for items Q34 on a 5-point Likert scale.*

Item	Mean	Median	Std. Deviation	Ratings: ■ 1 ■ 2 ■ 3 ■ 4 ■ 5
Q34	1.73	1.00	1.065	

Table 5-26 provides a comprehensive overview of the descriptive statistics pertaining to the item Q34, which has been rated by a total of 200 respondents. The results of this analysis indicate that a majority of the respondents have expressed the view that there is room for improvement in the appearance of the building. As statistical measures demonstrate (M = 1.73, Mdn = 1, SD = 1.065).

Table 5-27: *Results of the Mann-Whitney U test.*

Item	U	Z	Sig.	r
Q34	3642	-1.57	0.116	-0.111

*p<0.05; **p<0.01; ***p<0.001

The results of the experimental test, as presented in **Table 5-27**, demonstrate that there is no considerable variation in Q34 scores between male and female participants (U = 3642, Z = -1.57, p = 0.116). Additionally, no statistically significant distinctions were observed among various socio-demographic groups, including age, residency, education, and profession, suggesting that respondents from diverse backgrounds share a common belief that the building design requires certain enhancements. These findings imply that gender, age, residency, education, and profession do not substantially influence the perception of respondents regarding the need for improvements in the building design (**Table 5-28**).

Table 5-28: *Results of the Kruskal-Wallis H test.*

Factors	$\chi2$	df	Sig.	ηp^2
Age	5.6	4	0.231	0.028
Residency	1.165	2	0.559	0.006
Education	6.397	4	0.171	0.032
Profession	12.983	9	0.163	0.064

**p<0.05; **p<0.01; ***p<0.001*

5.4.5. Attachment and visit frequency

Table 5-29: *Distribution of respondents' ratings for items Q12 and Q13 on a 5-point Likert scale.*

Item	Mean	Median	Std. Deviation	Ratings (1, 2, 3, 4, 5)
Q12	2.53	2.00	1.550	
Q13	1.91	1.00	1.312	

Table 5-29 presents an analysis of the respondents' ratings of items Q12 and Q13, providing comprehensive descriptive statistics. The data reveals that overall, the respondents gave poor ratings for attachment, with a mean rating of 2.53, a median rating of 2, and a standard deviation of 1.550 (M = 2.53, Mdn = 2, SD = 1.550).

Similarly, the ratings were lower for visit frequency, indicated by a mean rating of 3.07, a median rating of 1, and a standard deviation of 1.312 (M = 3.07, Mdn = 1, SD = 1.312).

The Mann-Whitney U test was conducted to analyze the data and determine if there were any significant differences in the attachment scores (Q12) between males and females. The results of the test, as shown in Table 6, revealed that there was indeed a statistically significant difference (U = 3377.500, Z = -2.193, p = 0.028).

On the other hand, when it came to the visit frequency scores (Q13), there was no statistically significant difference observed between the two genders (U = 3597, Z = -1.667, p = 0.095).

The findings from the Kruskal-Wallis H test revealed a notable level of statistical significance in both attachment scores ($\chi2(4) = 12.711$, p = 0.013, $\eta p^2 = 0.061$) and visit frequency ($\chi2(4) = 13.614$, $p = 0.009$, $\eta p^2 = 0.065$). However, a subsequent Dunn's post-hoc analysis, incorporating the Bonferroni correction, did not yield any significant differences between age groups.

The outcome of the Kruskal-Wallis H test demonstrated that there were statistically significant differences in attachment scores among the groups ($\chi2(2) = 6.384$, $p = 0.041$, $\eta p^2 = 0.031$). Further analysis using Dunn's post-hoc test with Bonferroni correction revealed a significant distinction between the *Near the building* and *Outside the city* groups (adj $p = 0.035$). However, no significant differences were observed in visit frequency scores across residency groups ($\chi2(2) = 3.578$, $p = 0.167$, $\eta p^2 = 0.018$). Moreover, the results indicated no statistical significance in attachment or visit frequency scores among individuals from various educational backgrounds.

The findings from the Kruskal-Wallis H test indicate a significant statistical difference in attachment scores ($\chi2(9) = 30.499$, $p = 0.000$, $\eta p^2 = 0.138$) and visit frequency ($\chi2(9) = 31.160$, $p = 0.000$, $\eta p^2 = 0.141$). Further analysis using Dunn's post-hoc test with Bonferroni correction revealed a noteworthy contrast specifically between the Art/Culture group and the various other profession groups.

In this study, the researcher employed a Spearman correlation test to examine the association between attachment and visit frequency among a sample of 200 respondents. The test took into consideration the scores of both items (Q12. Q13) in the assessment. The results revealed a significant and robust positive correlation between visit frequency and attachment, with a coefficient of 0.530 (rho = 0.530, n = 200, $p<0.001$). This finding suggests that there is a meaningful relationship between individuals' perception of attachment and visit frequency, indicating that these factors are interrelated (**Table 5-30**).

Table 5-30: *Correlation matrix between Attachment and Visit frequency.*

	Attachment	***Visit frequency***
Attachment	1	
Sig. (2-tailed)		
95% CI		
Visit frequency	0.530**	1
Sig. (2-tailed)	<0.001	
95% CI	[0.691. 0.814]	

5.4.6. The elements of perceived quality that particularly attracted the attention of respondents

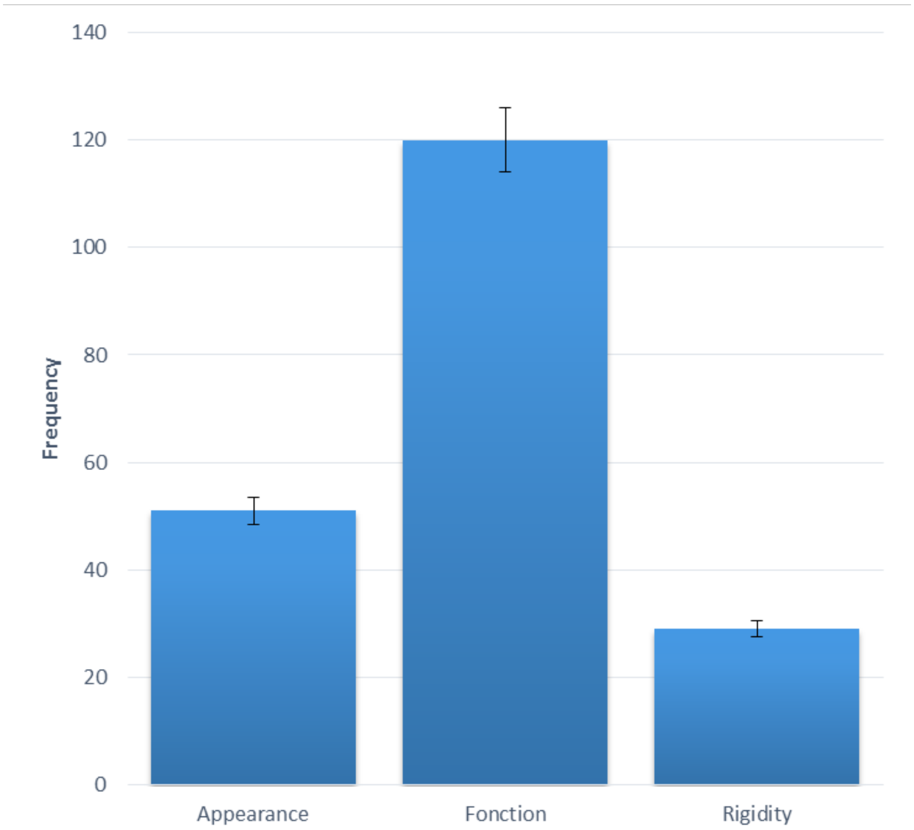


Figure 5-20. *Appearance. Function. Rigidity scores [a] on a 5-point Likert scale. [a]5% error bars shown (Source: Author).*

By examining the responses of the majority of participants regarding item Q40 (**Figure 5-20**). It was evident that they primarily focused on the functional aspect of the cultural building as the key element influencing their perception of quality.

Following this, the aspect of appearance was found to be of secondary importance, while rigidity was considered the least significant.

These findings align with the results obtained from tests conducted on perceived architectural quality and cognitive response, wherein both perceived function and perceived spatial quality received higher ratings than perceived visual quality.

Thus, it can be concluded that the primary attention of respondents was drawn towards the functionality of the cultural building, with appearance playing a supporting role, while rigidity had the least impact.

This statement adheres to the principle of "Use singularity." which emphasizes the distinctiveness of a building's function, whether it involves a single unique purpose or multiple buildings collectively serving the same purpose (Evans et al,. 1982).

There was no significant difference in respondents' scores for Q40 regarding the following sociodemographic groups: Gender (U = 4122.500, Z = -0.113, p = 0.910), age ($\chi2(4) = 4.609$, p = 0.330, $\eta p^2 = 0.023$), residency ($\chi2(2) = 3.847$, p = 0.146, $\eta p^2 = 0.019$), profession ($\chi2(9) = 12.615$, p = 0.181, $\eta p^2 = 0.062$). However, it is worth noting that there was a noteworthy distinction among education groups.

More specifically, respondents with a Master's Degree had a mean rank of 87.81, whereas respondents with a degree higher than Master's Degree (PhD) had a mean rank of 126.83.

This contrast was confirmed by the outcomes of the Dunn's post-hoc analysis with Bonferroni correction. Despite the absence of significant differences in the other sociodemographic categories, education level emerged as a significant factor influencing the responses (**Table 5-31**).

Table 5-31: *Results of Dunn's test and Bonferroni's significance.*

	Variable	Pairwise comparison	Test Statistic	SE	Std. Test Statistic	Sig.	Bonferroni's adjusted sig.
Q40	Education	MD - PhD	-39.021	13.711	-2.846	0.004**	0.044

**p<0.05; **p<0.01; ***p<0.001. Note. MD= Master's Degree*

5.4.7. Perceived architectural quality dimensions' ratings distribution

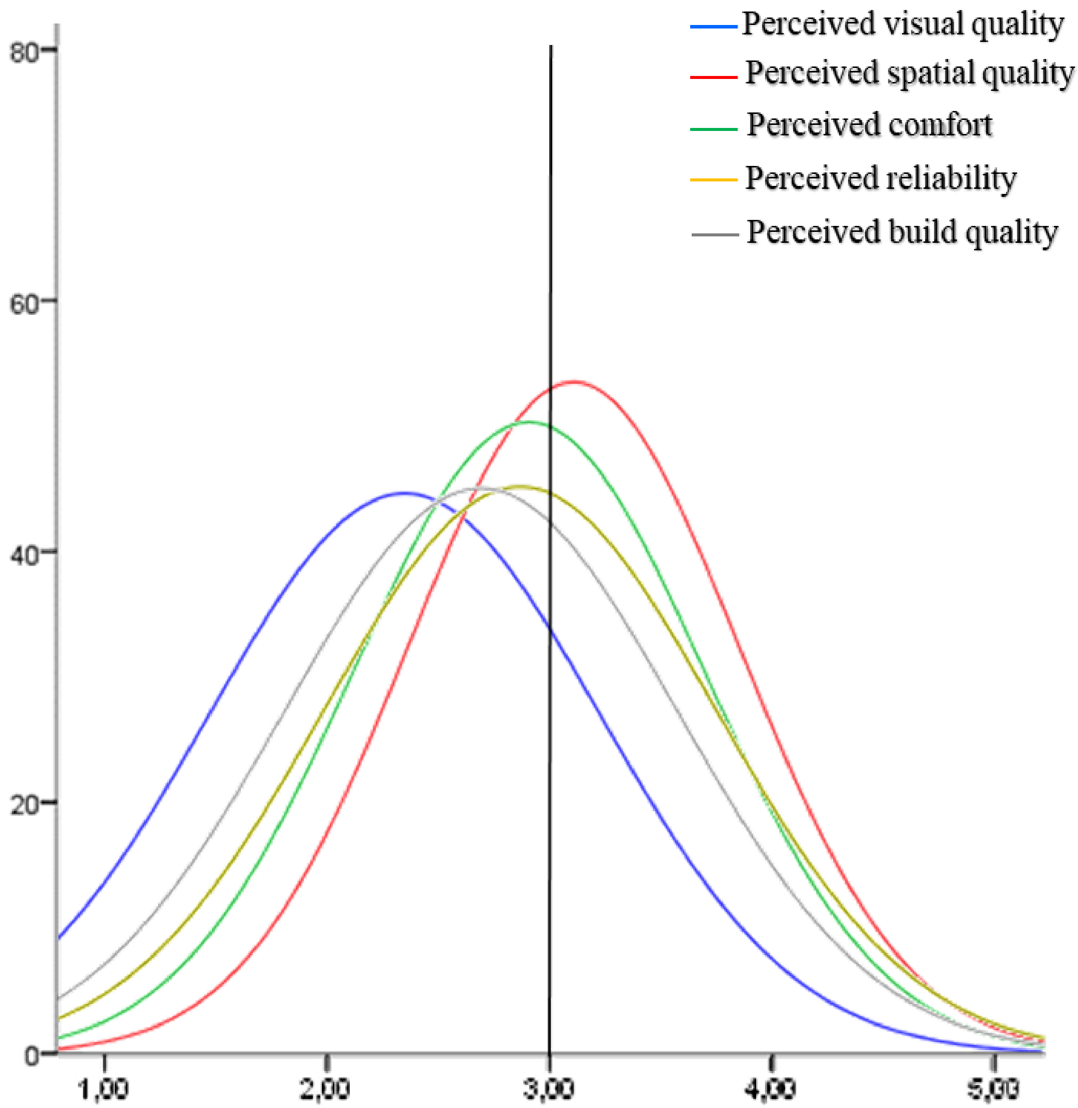


Figure 6-21. *Perceived architectural quality dimensions scores distribution (Source: Author).*

Based on the data illustrated in **Figure 6-21**, the average ratings for perceived visual quality, perceived comfort, perceived reliability, and perceived build quality were all found to be lower than the neutral value of 3.00. However, perceived spatial quality received higher ratings above the neutral value, with relatively minimal fluctuations compared to the other dimensions. These findings indicate that participants generally perceived lower levels of visual quality, comfort, reliability, and building quality, while spatial quality was perceived more positively and consistently. This suggests that there may be room for improvement in the aforementioned dimensions.

Upon conducting a comprehensive analysis of the data, it has come to light those the respondents' perceptions regarding visual quality, comfort, reliability, and build quality have shown a noticeable decline, ultimately falling short of what is typically regarded as a neutral.

5.4.8. Limitations and future directions

In future studies, there is a tremendous potential for delving deeper into the evaluation of various cultural establishments in diverse settings, each with its own unique cultural attributes, by employing the conceptual framework of perceived architectural excellence that has been introduced. This comprehensive exploration will entail a detailed examination of different cultural facilities, considering their historical, social, and artistic contexts.

Through the conduction of a methodical examination, it will be clarified that the frequency of visits and the intention to revisit have a profound influence on various aspects. Furthermore, it is crucial to delve into the intricate concept of perceived quality, as it is responsible for generating a range of evocations, memories, and emotions that significantly affect how the recipient assesses and evaluates the subject matter at hand.

By strategically integrating the contrasting aspects of natural light during the day and artificial lighting at night, as well as the interplay between light and shadow, and the balance between solid mass and empty space, within the architectural design of a building, and complementing it with thoughtfully selected visual and spatial configurations, it becomes possible to cultivate and shape the desired ambience and atmosphere. This method not only evokes emotional responses but also enhances the perceived quality of the experience, elevating it to new heights.

Partial Least Squares Structural Equation Modeling (PLS-SEM) could be used to analyze perceived architectural quality and its dimensions, which is a method utilized in structural equation modeling to estimate intricate cause-and-effect relationships. It serves as an alternative to the commonly employed covariance-based SEM (CB-SEM) and is particularly beneficial in scenarios where the analysis aims to test a theoretical framework with a predictive perspective. PLS-SEM proves advantageous when dealing with complex structural models, path models incorporating formatively measured constructs, and research involving ratios or similar data artifacts. This methodology's popularity has grown across various fields due to its capability to handle small sample sizes and accommodate the usage of formative indicators.

In PLS-SEM, the estimation of cause-and-effect relationships becomes possible while accounting for the complexity of the underlying structural model. This method is especially valuable when researchers focus on predicting outcomes based on a theoretical framework.

Furthermore, PLS-SEM excels when the path model incorporates one or more formatively measured constructs, suggesting that the relationship between independent and dependent variables is not solely based on covariance but rather on the combination of their constituent indicators.

Nonetheless, this study has limitations. Firstly, when considering the assessment of quality subjectively, a significant challenge arises due to the reliance on individuals' judgments to evaluate multifaceted constructs. The perceived quality of a building is heavily influenced by how users perceive its various aspects. It is important to note that these perceptions can be subject to modification based on the timing and context in which the information is received. Moreover, they are likely to evolve over time due to a variety of factors such as an individual's knowledge and experiences. The subjective evaluation of quality is intricate and entails considering diverse viewpoints and parameters that contribute to shaping one's perception of quality within architectural contexts. It is crucial to acknowledge the dynamic nature of these perceptions and how they are influenced by external factors.

Secondly, further exploration can be undertaken beyond the factors already examined to delve into additional socio-demographic variables, thereby enriching the scope of the analysis.

Furthermore, the objective of the research was to evaluate the perceived architectural quality and its underlying components of a specific establishment within a designated city. It is crucial, however, to extend this evaluation to similar facilities located in various cities to facilitate comparative analyses leveraging the data acquired. Conducting such comparative studies will not only enhance the depth of understanding but also contribute to a comprehensive assessment of architectural quality across different urban locales. The significance of broadening the scope of evaluation lies in gaining insights into the diverse architectural characteristics prevalent in different contexts.

5.5. Conclusion

The findings of the research indicate that the assessment of architectural quality is a complex and multi-faceted phenomenon, which can be influenced by factors such as gender, age, and residency. The perception of architectural quality plays a crucial role in the identification and evaluation of this concept. Individuals perceive buildings in diverse ways, influenced by their socio-demographic profiles, personal preferences, and social backgrounds.

Therefore, enhancing the perceived quality of architecture involves a thorough examination of users' perceptions and its implications in the field. This broad examination allows for a better understanding of how to improve architectural designs and meet the diverse needs and preferences of users.

Architects play a significant role in evaluating the perceived value of buildings, which encompasses design, functionality, and social aspects.

They must recognize that a substantial portion of the design process should prioritize the user's needs and preferences. This entails a comprehensive understanding of how a building is perceived and valued by its occupants and the surrounding community. By emphasizing the user-centric approach, architects can enrich the design process and create buildings that meet the highlighted requirements.

To enhance the perceived architectural excellence, it is imperative to involve users in the process of providing constructive feedback, which ultimately leads to the success of the project. Users hold the power to significantly contribute to the refinement and improvement of various aspects of the building by emphasizing its strengths, identifying weaknesses, and suggesting suitable solutions. These proposed solutions can be implemented after thorough analysis by professionals to ensure their effectiveness. By embracing user involvement and actively seeking their valuable insights, projects can achieve a higher level of architectural quality and meet the expectations of all stakeholders involved.

CHAPTER VI: ASSESSING THE USER'S COGNITIVE RESPONSE AS AN INDICATOR OF THE PERCEIVED ARCHITECTURAL QUALITY OF THE CULTURE HOUSE OF THE CITY OF KHENCHELA

6.1. Introduction

Cognitive response and perceived architectural quality depend heavily on the perceptions and judgments of users about the perceived quality of the stimuli and its different aspects, which are essential for judging the building's architectural value. Therefore, the aim of the study is to assess the cognitive response and explore the compound relationships between the dimensions that compose it. This chapter is structured around a conceptual model based on a multidisciplinary approach that examines the psychological literature on perception and cognition as well as the marketing perspective on perceived quality and satisfaction with regard to the architectural building as a subject of interest. The participants gave their judgments regarding the perceived architectural qualities of the cultural facility. The results suggest that factors like gender, age, and residency, except for education, have influenced the cognitive response and that the three dimensions (perceived visual quality, perceived function, and perceived symbolism) were found to have strong correlations and were also susceptible to the influence of socio-demographic variables. It can be concluded that respondents' opinions can be translated into a cognitive response that, by extension, can be considered an indicator of perceived architectural quality.

6.1.1. Problem statement

Cognitive perception is a mental process where the user structures the perceived information and associates it with meanings and connotations (Bittencourt et al., 2015); the compound process resulting from the interaction between cognition and perception incorporates information gathered about the building through perception and gives it a more convoluted meaning and significance using cognitive abilities like memory, attention, learning, thinking, intelligence, communication, and language. The cognitive response is based on the perceptions of users regarding the perceived qualities of an object and its different aspects.

Therefore, it was essential to effectuate a reconceptualization of perceived quality as a novel concept in architecture to be able to evaluate the cognitive response considering that perceived architectural quality is a measurable entity of multidimensional nature (Myers and Shockers, 1981; Petrick, 2002) and in view of the complex relationship between the user's perception and cognition relative to the architectural building itself. Aaker (1991) has expounded the concept of perceived quality, along with other researchers (e.g., Aaker and Jacobson, 1994; Hellofs and Jacobson, 1999; Rao et al., 1999; Wolfinbarger and Gilly, 2003), but there are no empirical studies that explore this concept thoroughly and define its implications in architecture as a multidisciplinary field that seeks to respond to the user's various needs, whether they are functional, psychological, cognitive, ergonomic, climatic, or economical (Akin, 2001). Thus, cognitive response and perceived architectural quality were treated from a multidisciplinary point of view, taking into account the psychological literature on perception and cognition and the marketing perspective on perceived quality in relation to the architectural building as a subject of interest; moreover, it is necessary to integrate these concepts in architecture and adapt them to the particularities of the field in order to develop a globalized conceptual model for cognitive response.

Following the aforementioned literature insights, this study aims to:

- Propose a model for cognitive response inspired by previous work that can be used in architectural quality research.
- Evaluate the respondents' cognitive response to the building's various architectural quality aspects based on the new established model.
- Examine how socio-demographic factors affect the user's cognitive response.
- Explore the relationship between the dimensions composing the cognitive response.

6.2. Methodology

6.2.1. A new framework to apprehend cognitive response in architecture

The author’s framework of cognitive response assessment is inspired by Norman’s (2004) and Crilly, Moultrie, and Clarkson’s (2004) models, it is based on a multidisciplinary approach while taking into consideration being congruent to the architectural discipline.

By evaluating the user’s cognitive response, it is feasible to give an assessment of the perceived architectural quality, considering that cognitive response can be viewed as an indicator of perceived architectural quality and because both concepts are based on the user’s judgment of the perceived information from an object or a product (Crilly et al., 2004).

The model of Crilly et al. (2004) builds on the Shannon (1948) and Monö (1997) models and presents a comprehensive definition of its three types of response: cognitive response, affective/emotional response, and behavioural response, rendering it more adaptable in other fields.

Crilly et al. (2004) divide the cognitive response into three categories based on the precedent work of Crozier (1994), Cupchik (1999), Lewalski (1988), Baxter (1995), and Norman (2004). The first category is the "*aesthetic impression*," which is the aesthetic aspects of an object and its perceived visual attractiveness.

This refers to Norman’s “*visceral design*.” The second category is "*semantic representation*," which relates to the function, mode of use, performance, efficiency, and ergonomics of a product and how it can be identified. This refers to Norman’s “*behavioural design*.” The third category is "*symbolic association*," which can be defined as the ability of a product to send a message that can be interpreted by the perceiver while they interact with each other and the meaning this product holds. This refers to Norman’s “*reflective design*.”

This model can be flexible enough to be integrated into architecture and can relatively represent a first step in the process of developing a sensory analysis or satisfaction survey to assess cognitive response or perceived architectural quality.

In view of this, the author defines the model categories in a way that suits the physicality of the building and the architectural requirements; thus, the cognitive response towards a building is the observer’s interpretation of the sensory characteristics of a building.

These attributes, either objective or subjective, can transfer signals, messages, and connotations that may be implicit and unrecognizable at first glance and need to be processed to be understood. These signals are interpreted by the perceiver and deciphered according to his cultural level, experience, and memories.

Therefore, a conceptual model that can be adapted into architecture is proposed for cognitive response (**Figure 6-1 and 6-2**), and it incorporates three dimensions that represent a cognitive interpretation of the building qualities, ruled by the user's perception (Wrigley, 2013).

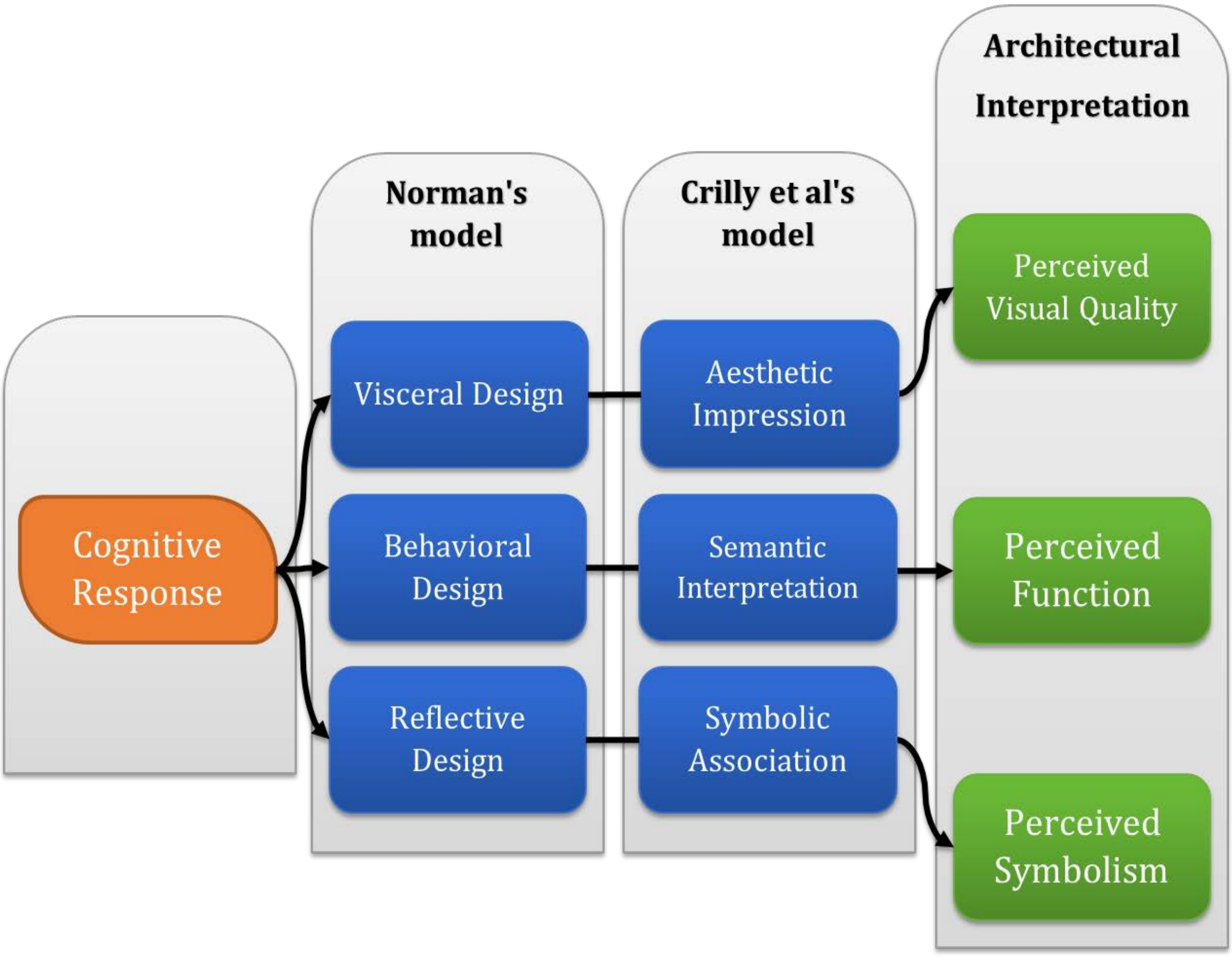


Figure 6-1. *A conceptual model of cognitive response in architecture, inspired by Author from Norman (2004), and Crilly et al. (2004).*

6.2.1.1. Perceived visual quality

This refers to the inherent traits of a building and how they can satisfy the visual senses of the perceiver, like shape, size, symmetry, proportions, colours, and complexity (Higuera-Trujillo et al., 2021). The subjective interpretation of the building’s physical characteristics influences the aesthetic experience of the user according to his knowledge, personal preferences, and culture (Chatterjee and Vartanian, 2014).

6.2.1.2. Perceived function

It refers to the building's function, usability, perceived spatial qualities, identification, and how the spatial organization contributes to defining the functional quality of the building and the corresponding activities. As function is one of the pillars of the architectural quality triad (Pollio and Morgan, 1960; Blondel, 1777).

6.2.1.3. Perceived symbolism

Perceived symbolism is the meaning intended for the building by the architect or the personal, cultural, and social interpretation attached to it by the user himself. An object must hold a certain meaning for the perceiver, whether practical or emotional, to be able to perceive its connotations. If the architectural building design holds no meaning, the observer will not produce the expected cognitive response towards it and will not try to give it any further interpretations (Lynch, 1960).

Besides Crilly et al.'s (2004) “*symbolic association*,” the author also adapts the definition of Norman's (2004) “*reflective design*.” Norman considers it to be the message that the object conveys about itself, about culture, the thought it generates, and the emotions it evokes. This definition displays more adequacy with the symbolic side of architecture that uses techniques like simile, metaphor, analogy, and symbolism to convey a message of different interpretations depending on the regional and cultural environment, the personal, social, and historic context of the user and the architect, and what ideology he tries to express in his work.

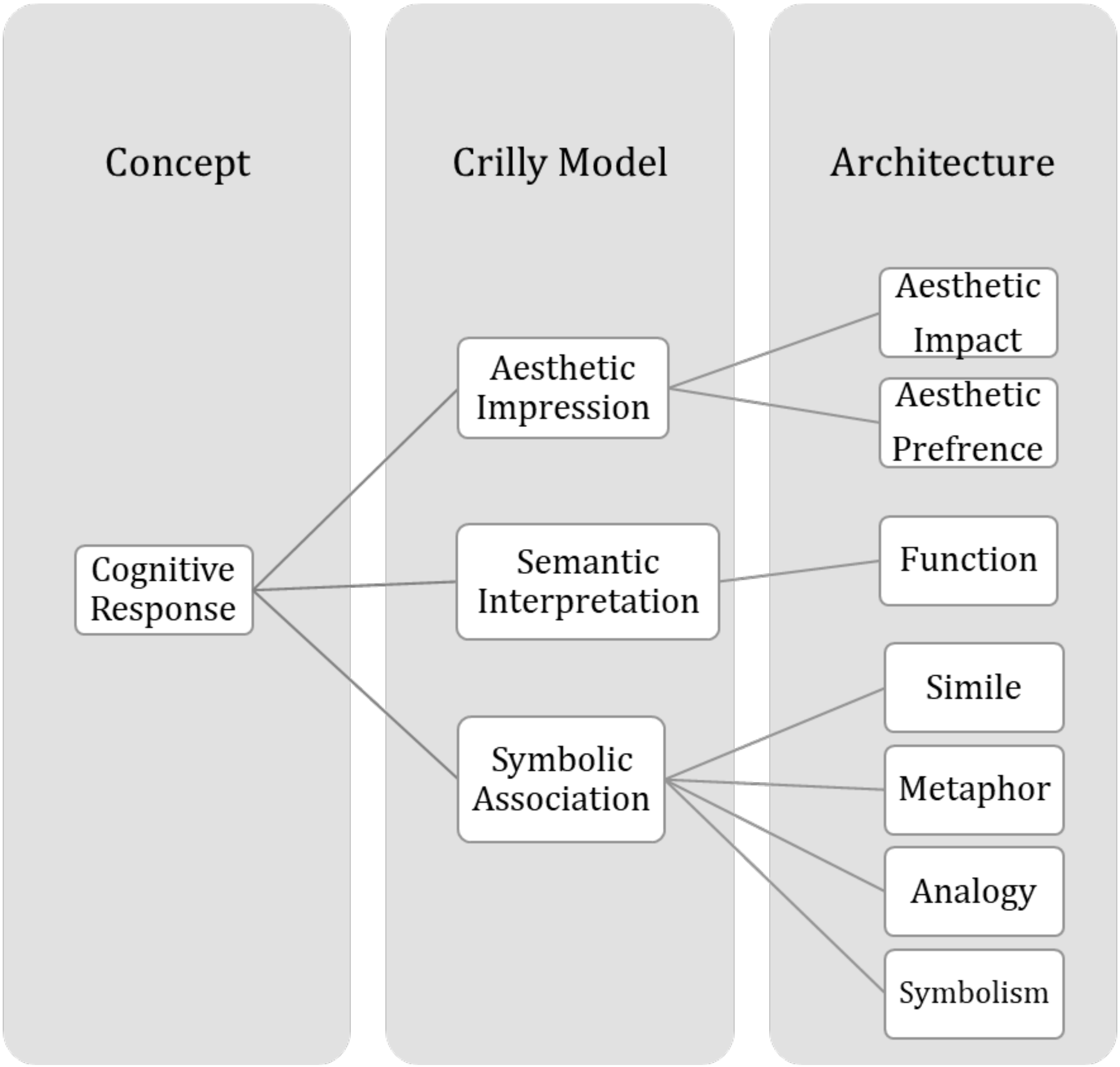


Figure 6-2. *A theoretical model expounding on cognitive response in architecture, inspired by the model of Crilly et al. (2004).*

6.2.2. Participants

Power analysis using G*Power 3.1.9.4 (Faul et al., 2007) was conducted to determine the appropriate sample size to execute each test. G*Power indicated a sample size of 35-94 is needed to run a one-sample Wilcoxon signed-rank test with effect size = 0.3-0.5, power = 0.8 and α = 0.05; a sample size of 134-178 is needed to run a two-sided Mann-Whitney U test with effect size = 0.5, power = 0.8, α = 0.05 and ratio = 1-3; a sample size of 80-200 is needed to run a two-sided Kruskal-Wallis test for five groups with effect size = 0.25-0.4, power = 0.8 and α = 0.05; and a sample size of 84 is needed to run two-tailed correlations with effect size = 0.3, power = 0.8 and α = 0.05.

Therefore, the stratified questionnaire was distributed via simple random selection to 200 participants of different age groups, various residencies, and education levels (**Table 6-1**) to analyse the different points of view and tendencies of each stratum and to assess their cognitive response to the perceived quality of the cultural facility.

Table 6-1: *Respondent's socio-demographic overview.*

Gender		Age		Residency		Education	
Male	141	< 20	9	Near the building	91	< High School Degree	80
Female	59	20-30	72	Far from the building	78	High School Degree	18
		30-40	66	Outside the city	31	Bachelor's Degree	28
		40-50	36			Master's Degree	56
		> 50	17			PhD Degree	18

6.2.3. Case Study

As mentioned in the previous chapter, the cultural facility known as ALI-SOUAIHI (35°25'47.1"N 7°08'57.2"E) located in the city of Khenchela (35°25'51.582"N 7°08'48.1452"E) northeast of Algeria is the subject of study. The building, located in the heart of a city, has special cultural and functional value since it is the city's only edifice with a significant cultural identity; therefore, its citizens consider it as a landmark. Since its opening on February 17, 2003, the culture house has undergone renovations to enhance its standing within the community. In addition to renovating its appearance, an enclosure wall was constructed around it to set it apart from its surroundings. Through their architectural designs and functional congruence, culture houses often represent the city's cultural and social ideals; such an aspect has to be extensively investigated to confirm its validity in this particular case.

6.2.4. Procedure

The questionnaire was structured around the theoretical concepts examined in the literature review; the questions were measured by a five-point Likert scale from 1 = totally unsatisfied to 5 = totally satisfied; and a pilot test was conducted where the questionnaire was distributed to 10 participants who proceeded to answer the pre-test questions. After the feedback, necessary improvements were made to every question formulation, and any ambiguous or unclear questions were treated and rendered more intelligible. Then, the questionnaire was administered to 200 individuals, who filled out their information and were asked to provide ratings for the various cognitive response aspects.

6.2.5. Data analysis

Cognitive response and the composing dimensions data deviate from a normal distribution, as confirmed by the results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests (**Table 6-2**), which put forward the use of non-parametric tests. A one-sample Wilcoxon signed-rank test for cognitive response and its three dimensions was conducted to determine the differentiation in the sample scores.

A Mann-Whitney U test was used to check if there is a significant difference between male and female respondents' scores, while a Kruskal-Wallis test was used to check whether age, residency, and education groups differ significantly from each other. Dunn's post-hoc analysis with Bonferroni correction was used to reduce type I error.

The effect size r for the one-sample Wilcoxon signed-rank test and the Mann-Whitney U was computed using the expression $r=Z/\sqrt{N}$ proposed by Rosenthal (1991), while in Kruskal–Wallis H with three or more groups (k), the effect size was calculated by transforming chi^2 into an F value with k-1 numerator degrees of freedom (dfn) and N-k denominator degrees of freedom (dfd), according to the expression $F\ (dfn,dfd) = chi^2/(k-1)$ modified from Murphy and Myors (2014). Then, partial eta squared was calculated according to the equation $\eta p^2 = (F \times dfn) / (F \times dfn + dfd)$ (Lakens, 2013) using the previously calculated F (dfn,dfd). IBM SPSS version 28.0 was used to explore the data and execute the appropriate statistical tests.

Table 6-2: *Normality tests for cognitive response and its categories.*

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Perceived visual quality	0.081	200	0.003	0.965	200	<0.001
Perceived function	0.081	200	0.003	0.973	200	<0.001
Perceived symbolism	0.123	200	<0.001	0.932	200	<0.001
Cognitive response	0.071	200	0.016	0.975	200	0.001

Respondent's ratings of each item forming a dimension (RDI) were averaged to form a User's Dimension Mean (RDM) as indicated in the formula:

$$R_1D_1M = (R_1D_1I_1 + R_1D_1I_2 + \ldots + R_1D_1I_n)/\text{number of dimension items.}$$

Then the Respondent's Cognitive Response Mean (RCRM) was calculated by averaging the Respondent's Dimension Means (RDM) as designated in the following formula:

$$R_1CRM = (R_1D_1M + R_1D_2M + \ldots + R_1D_nM)/\text{number of dimensions.}$$

All items composing each dimension were analysed through Cronbach's alpha internal consistency test, demonstrating good reliability with significant alpha values ranging from 0.800 to 0.840 (**Table 6-3**).

Table 6-3: *Reliability test for cognitive response and its categories.*

Construct	**Dimension**	**Item**	**Item description**	**Cronbach's Alpha**
Cognitive response	Perceived visual quality	PVQ1	On the overall impression of the exterior appearance of this building.	0.840
		PVQ2	If the building design is authentic.	
		PVQ3	On the colours used in the building.	
		PVQ4	If the building's exterior design incorporates advanced techniques.	
		PVQ5	If the architectural style of the building seems modern.	
		PVQ6	If the building design meets the aesthetic preferences of the respondents.	
	Perceived function	PF1	On the legibility of the cultural facility.	0.800
		PF2	If the building gives the impression of being a cultural facility.	
		PF3	On the overall assessment of the workspace ergonomics.	
		PF4	If the interior spaces of the building correspond to its intended functions.	
		PF5	If the building is considered a landmark.	
	Perceived symbolism	PS1	If the building has a message to convey.	0.815
		PS2	If the building has any personal meanings attached to its design.	
		PS3	If the design expresses ideas or connotations.	
		PS4	If the building has any perceived symbols in its design.	

6.3. Results

6.3.1. General assessment of cognitive response

Table 6-4: *Results of the one-sample Wilcoxon signed-rank test.*

	N	Median	χ2	Z	Sig.	r
Perceived visual quality	200	2.333	2453.5	-8.441	0.000***	-0.597
Perceived function	200	3.000	6553.5	-2.167	0.030*	-0.153
Perceived symbolism	200	2.125	2654.5	-7.988	<0.001***	-0.565
Cognitive response	200	2.528	4134	-7.081	<0.001***	-0.501

*Note. Test value = 3. *p<0.05; **p<0.01; ***p<0.001*

A one-sample Wilcoxon signed-rank test (**Table 6-4**) was used to determine the differentiation in the sample scores for cognitive response and its three dimensions: perceived visual quality, perceived function, and perceived symbolism, by comparing the scores to a hypothesized value of H0 = 3, which represents the neutral value on a Likert scale, to establish if the observed values are below or above it.

The test demonstrated that the cognitive response median was significantly different from H0 = 3 with a negative standardized test statistic (Z = -7.081, $p<0.001$); the test also showed comparable results for the perceived visual quality score that displayed the largest deviation from the middle value (Z = -8.441, p = 0.000), followed by perceived symbolism where the score showed a similar deviation (Z = -7.988, $p<0.001$), while the perceived function score had the smallest deviation from the test value (Z = -2.167, p = 0.030).

Although the observed value of perceived function is equal to the hypothesized value, the test showed that there is a statistically significant difference, and that's because the scores are not symmetrically distributed around the hypothesized value. In light of this finding, it is worth noting that the majority of respondents had poor to moderate attitudes about the perceived qualities of the cultural facility, as evidenced also by the descriptive statistics for each element (**Figure 6-3 to 6-13**).

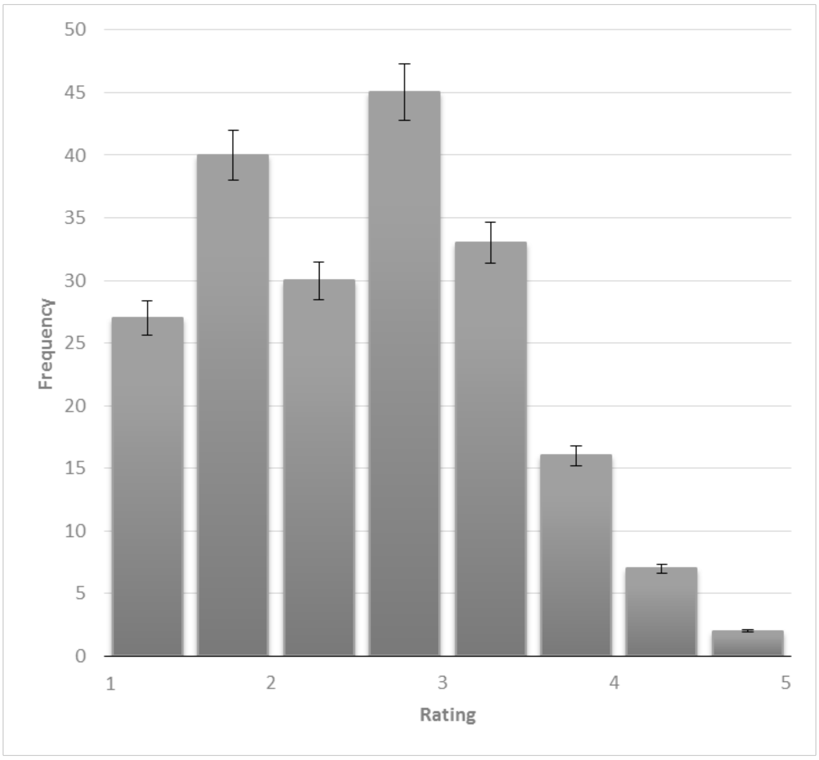


Figure 6-3. *Distribution of respondents' ratings[a] for cognitive response on a 5-point Likert scale; 1 = totally unsatisfied to 5 = totally satisfied. [a]5% error bars shown (Source: Author).*

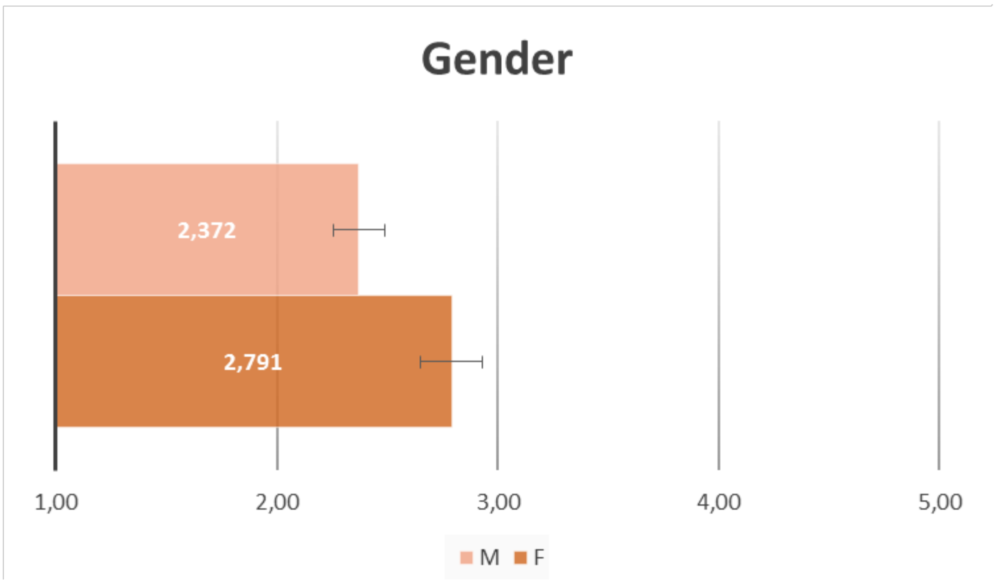


Figure 6-4. *Cognitive response scores[a] for Gender groups. [a]5% error bars shown. Note. M=Male; F= Female (Source: Author).*

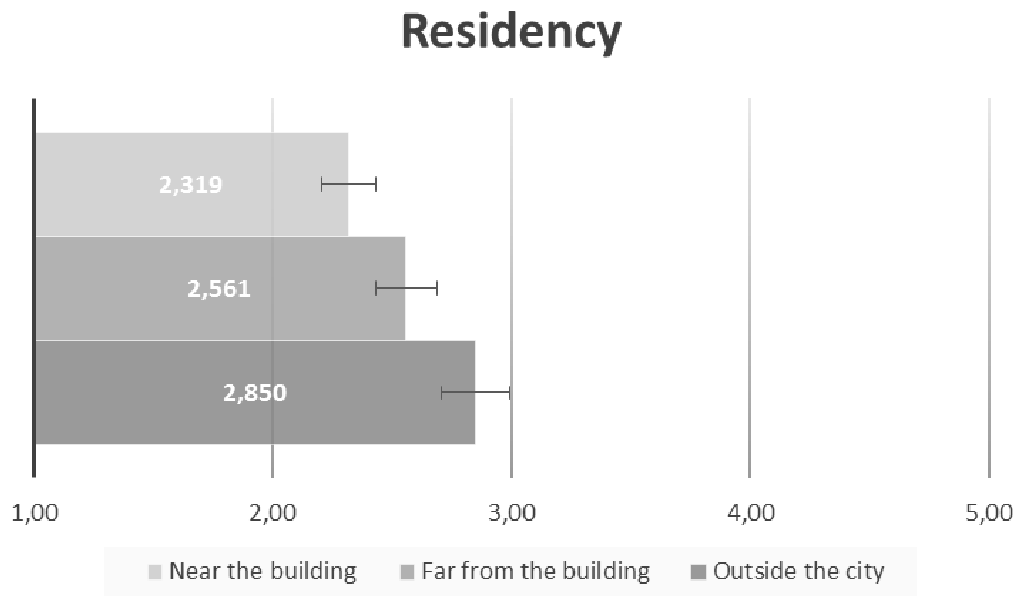


Figure 6-5. *Cognitive response scores [a] for Residency groups. [a]5% error bars shown (Source: Author).*

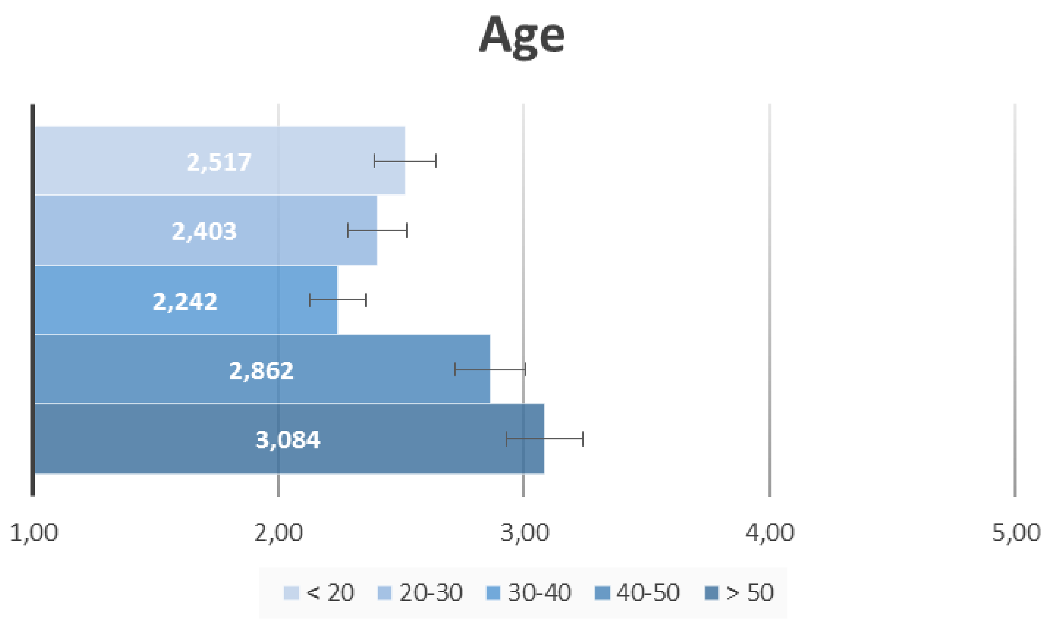


Figure 6-6. *Cognitive response scores [a] for Age groups. [a]5% error bars shown (Source: Author).*

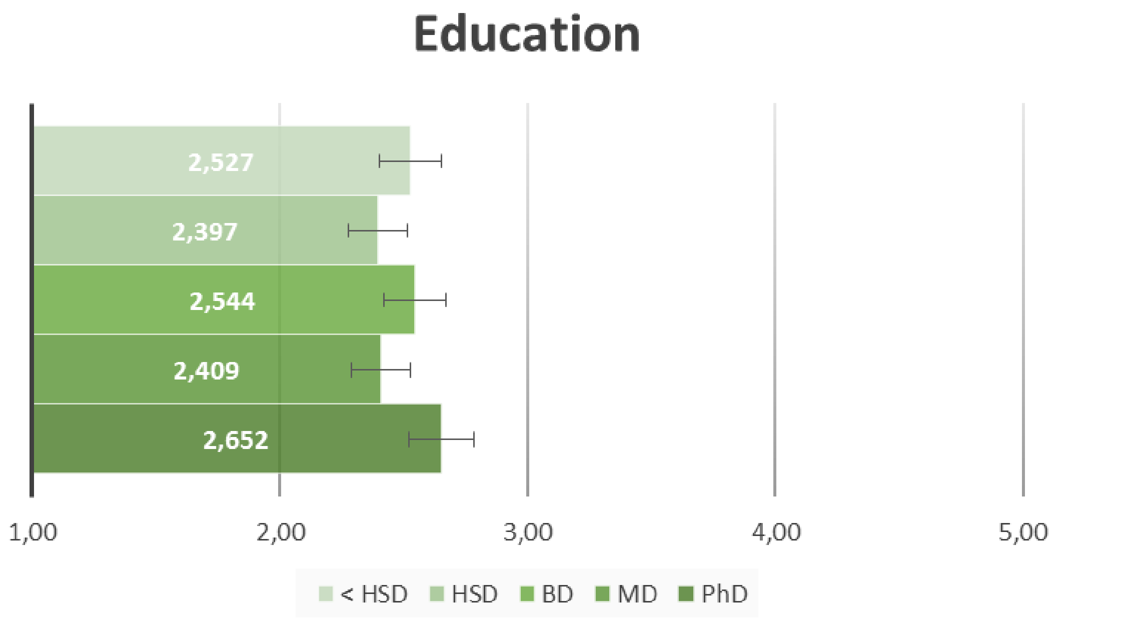


Figure 6-7. *Cognitive response scores [a] for Education groups. [a]5% error bars shown. Note. < HSD=less than High School Degree; HSD= High School Degree; BD= Bachelor's Degree; MD= Master's Degree (Source: Author).*

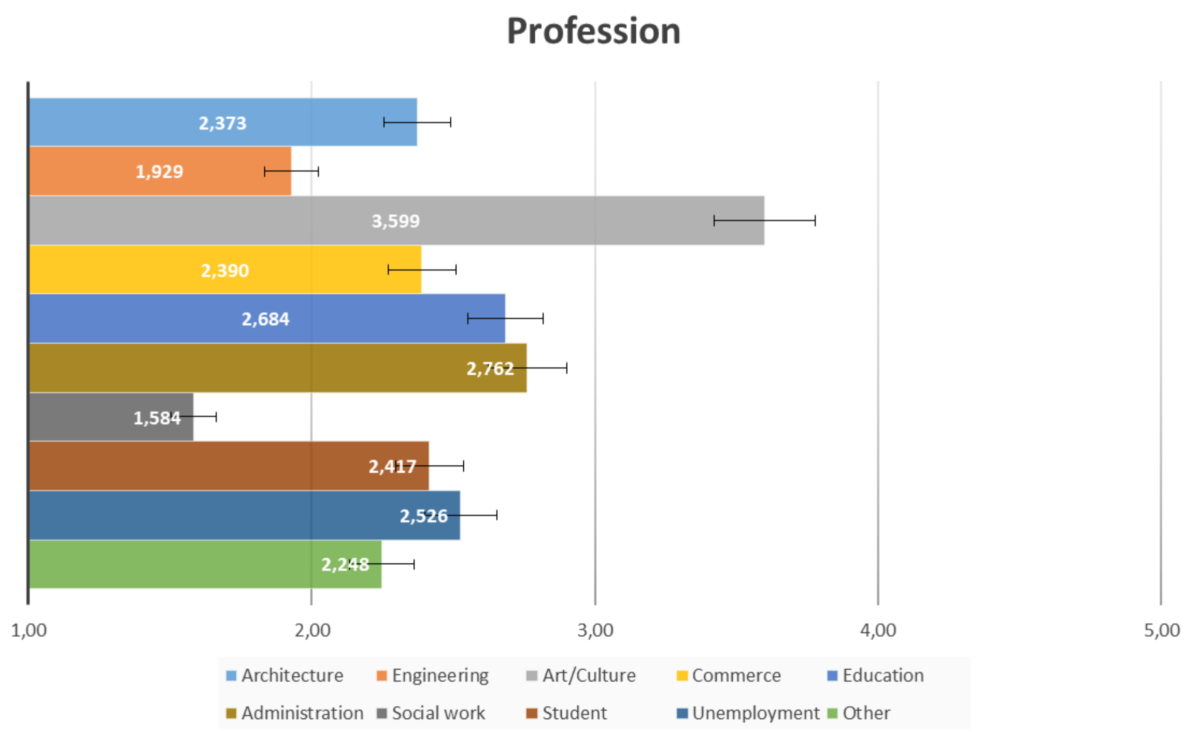


Figure 6-8. *Cognitive response scores [a] for Profession groups. [a]5% error bars shown (Source: Author).*

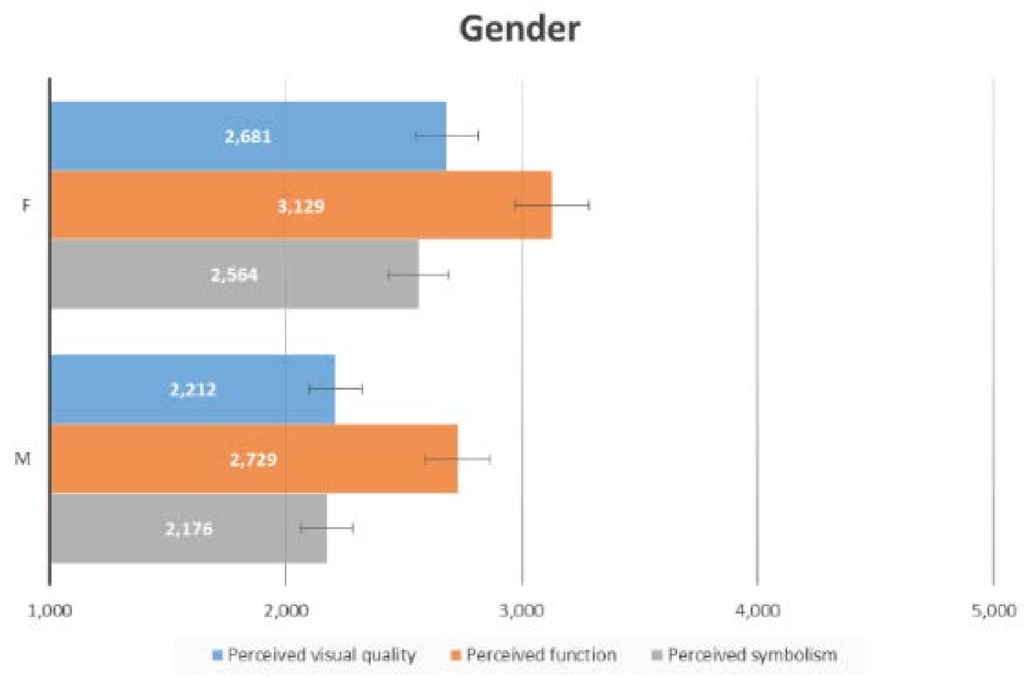


Figure 6-9. *Perceived visual quality, perceived function, and perceived symbolism scores [a] for Gender groups. [a]5% error bars shown. Note. M=Male; F= Female (Source: Author).*

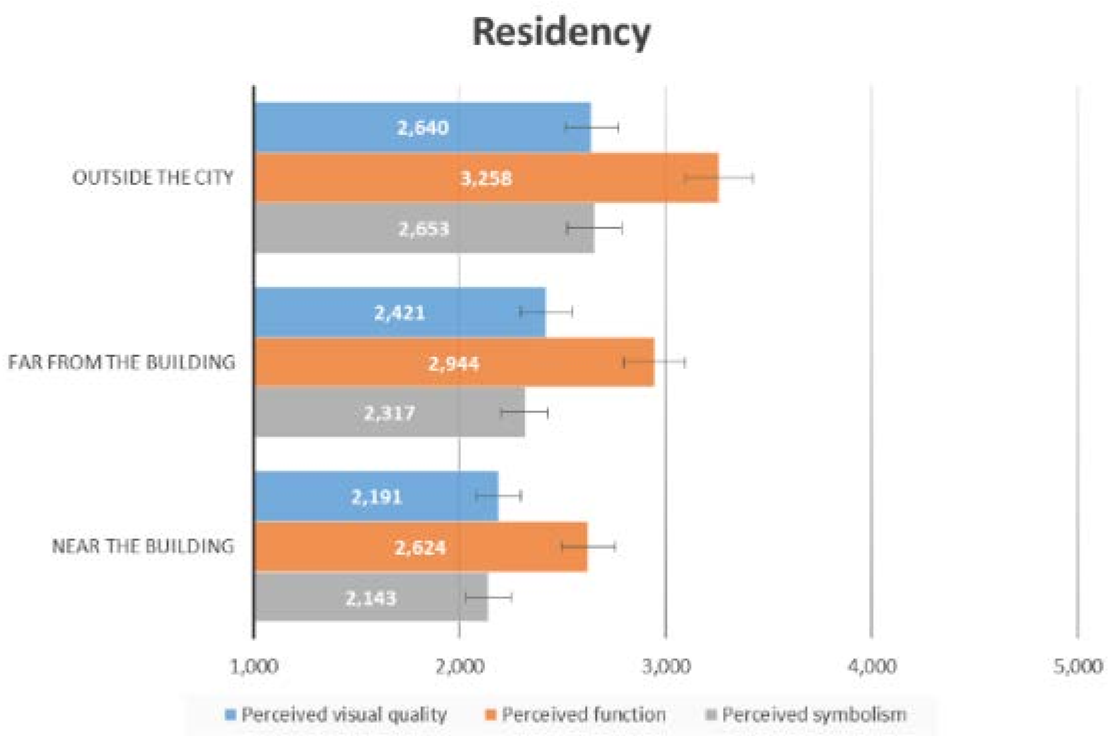


Figure 6-10. *Perceived visual quality, perceived function, and perceived symbolism scores [a] for Residency groups. [a]5% error bars shown (Source: Author).*

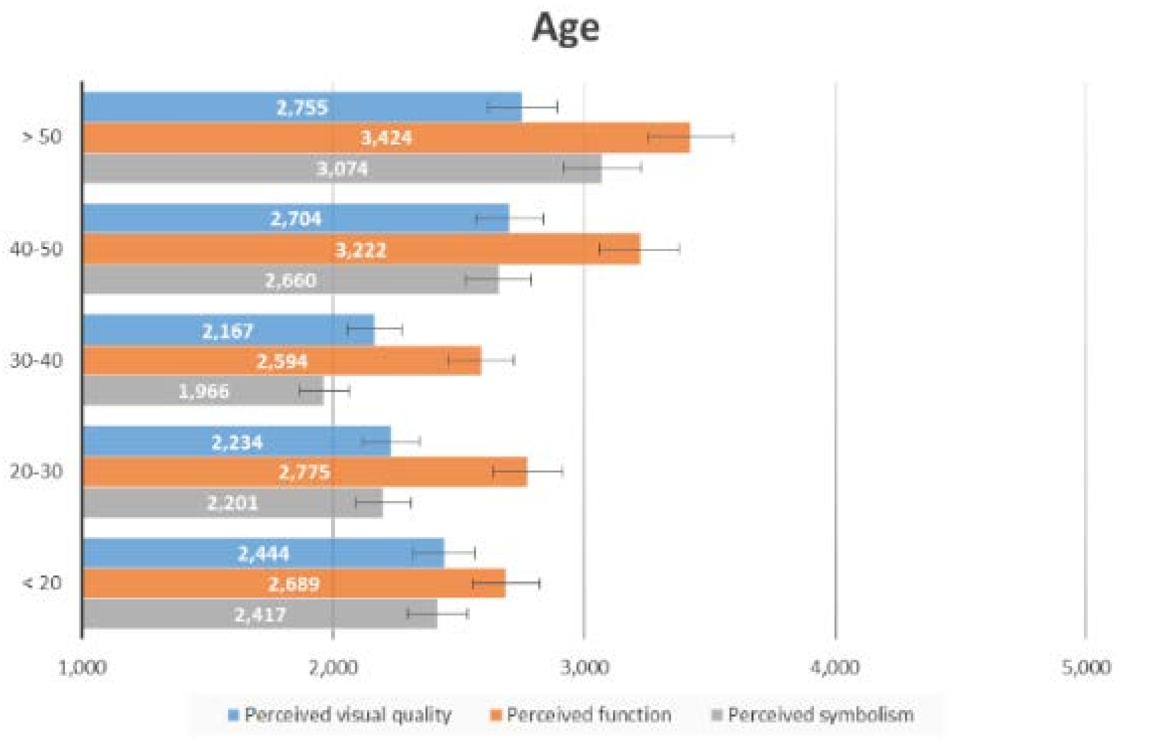


Figure 6-11. *Perceived visual quality, perceived function, and perceived symbolism scores [a] for Age groups. [a]5% error bars shown (Source: Author).*

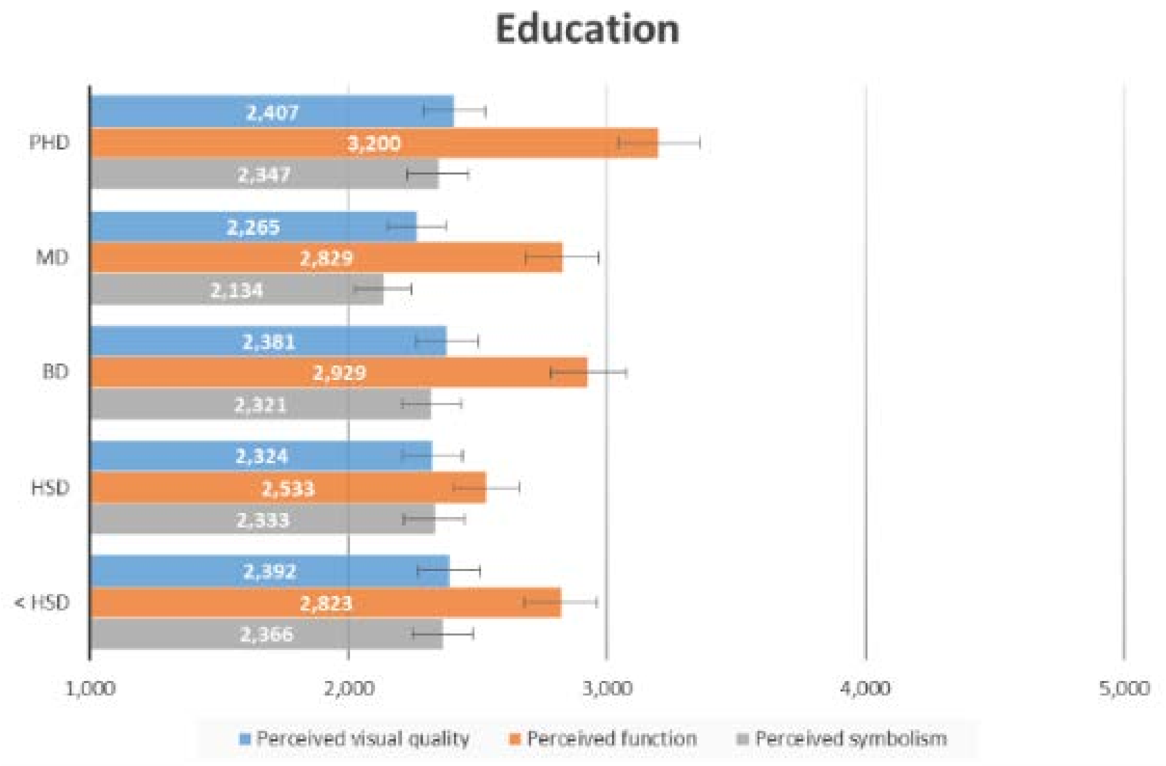


Figure 6-12. *Perceived visual quality, perceived function, and perceived symbolism scores [a] for Education groups. [a]5% error bars shown. Note. < HSD=less than High School Degree; HSD= High School Degree; BD= Bachelor's Degree; MD= Master's Degree (Source: Author).*

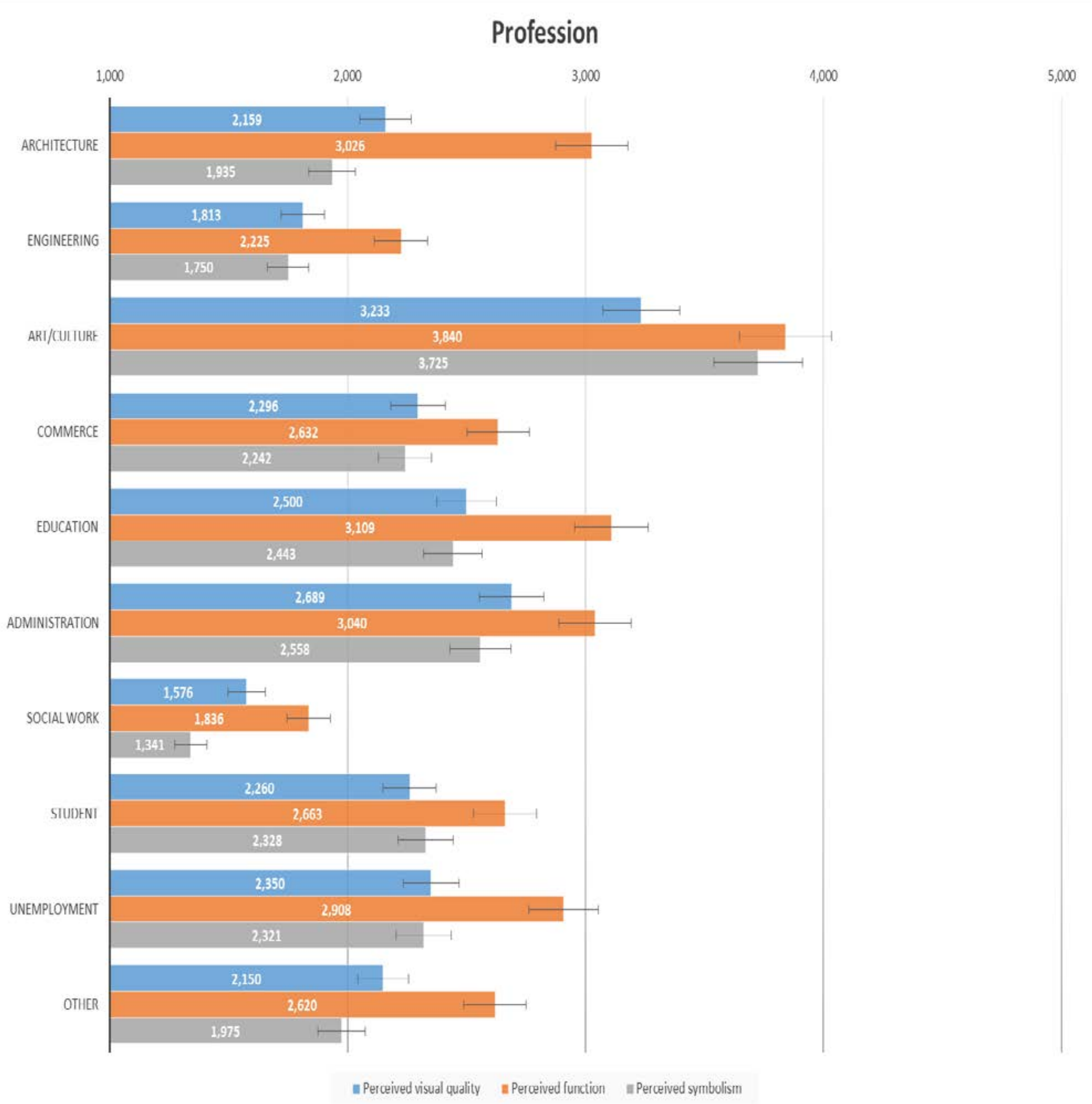


Figure 6-13. *Perceived visual quality, perceived function, and perceived symbolism scores* [a] *for Profession groups.* [a]*5% error bars shown (Source: Author).*

Table 6-5: *Distribution of respondents' ratings for all items on a 5-point Likert scale.*

Dimension	Item	Mean	Median	Std. Deviation	Ratings (1, 2, 3, 4, 5)
Perceived visual quality	PVQ1	2.80	3	1.050	
	PVQ2	2.22	2	1.202	
	PVQ3	2.39	3	1.069	
	PVQ4	2.17	2	1.162	
	PVQ5	2.26	2	1.316	
	PVQ6	2.26	2	1.261	
Perceived function	PF1	2.87	3	0.970	
	PF2	2.45	2	1.366	
	PF3	2.94	3	1.001	
	PF4	2.91	3	1.187	
	PF5	3.07	3	1.544	
Perceived symbolism	PS1	2.16	2	1.191	
	PS2	2.39	2	1.291	
	PS3	2.22	2	1.260	
	PS4	2.39	2	1.445	

Table 6-5 outlines the descriptive statistics for all 200 participants' ratings of the items in each dimension. In general, respondents gave moderate ratings for perceived function items, with item PF5 (if the building is considered a landmark) being rated the highest among all items (M = 3.07, Mdn = 3, SD = 1.544); the ratings were higher compared to perceived visual quality and perceived symbolism items.

Perceived visual quality had varying ratings, with item PVQ1 (the overall impression of the exterior appearance of the building) scoring the highest (M = 2.80, Mdn = 3, SD = 1.050) and PVQ4 (if the building's exterior design incorporates advanced techniques) scoring the lowest (M = 2.17, Mdn = 2, SD = 1.162). On the other hand, respondents gave poor ratings for perceived symbolism, with item PS1 (if the building has a message to convey) receiving the least ratings among all items (M = 2.16, Mdn = 2, SD = 1.191).

6.3.2. Socio-demographic influence on respondents' cognitive response

6.3.2.1. Gender

The Mann-Whitney U test (**Table 6-6**), showed that there was a statistically significant difference in cognitive response scores between males and females (U = 2945.5, Z = -3.252, p = 0.001) with a mean rank of 91.89 for males and 121.08 for females; as well as the composing dimensions, perceived visual quality (U = 2856, Z = -3.499, p <0.001) with a mean rank of 91.26 for males and 122.59 for females; perceived function (U = 3072, Z = -2.92, p = 0.003) with a mean rank of 92.79 for males and 118.93 for females; and perceived symbolism (U = 3211, Z = -2.553, p = 0.011) with a mean rank of 93.77 for males and 116.58 for females.

Table 6-6: *Results of the Mann-Whitney U test.*

	Group	N	Mean Rank	U	Z	Sig.	r
Perceived visual quality	Males	141	91.26	2856	-3.499	<0.001***	-0.247
	Females	59	122.59				
	Total	200					
Perceived function	Males	141	92.79	3072	-2.92	0.003**	-0.206
	Females	59	118.93				
	Total	200					
Perceived symbolism	Males	141	93.77	3211	-2.553	0.011**	-0.181
	Females	59	116.58				
	Total	200					
Cognitive response	Males	141	91.89	2945.5	-3.252	0.001**	-0.230
	Females	59	121.08				
	Total	200					

**p<0.05; **p<0.01; ***p<0.001*

6.3.2.2. Age

A Kruskal-Wallis H test (**Table 6-7**) was performed to compare the effect of respondents' age on cognitive response and its composing dimensions. The test revealed that there was a statistically significant difference in cognitive response scores between different age groups ($\chi2(4) = 20.527$, $p<0.001$, $\eta p^2 = 0.095$), with a mean rank of 97.67 for those less than age 20, 95.58 for the age group of (20-30), 82.92 for the age group of (30-40), 125.54 for the age group of (40-50) and 138.06 for those that exceeded age 50. The mean ranks were higher among older respondents (age groups of 40-50 and >50) and lower among younger groups (less than 20, age group of 20-30 and age group of 30-40). The test showed borderline statistical significance in perceived visual quality scores ($\chi2(4) = 12.405$, $p = 0.015$, $\eta p^2 = 0.060$), however, Dunn's post-hoc analysis with Bonferroni correction didn't show a significant difference between age groups. Respondents younger than age 20 had a mean rank of 104.72, 93.64 for the age group of (20-30), 88.77 for the age group of (30-40), 122.31 for the age group of (40-50) and 126.68 for those who exceeded age 50. There was a statistically significant difference in perceived function scores ($\chi2(4) = 17.9$, $p = 0.001$, $\eta p^2 = 0.084$), with a mean rank of 86.89 for those less than age 20, 95.42 for the age group of (20-30), 85.81 for the age group of (30-40), 124 for the age group of (40-50) and 136.5 for those that exceeded age 50. In the case of perceived symbolism scores, there was a significant difference ($\chi2(4) = 19.213$, $p<0.001$, $\eta p^2 = 0.090$), with a mean rank of 109.5 for those less than age 20, 96.35 for the age group of (20-30), 82.64 for the age group of (30-40) which is the lowest of all mean ranks, 120.92 for the age group of (40-50) and 139.41 for those that exceeded age 50 which is the highest of all mean ranks. In a similar way to the cognitive response score, older respondents had higher mean ranks compared to younger respondents in all three categories.

Table 6-7: *Results of the Kruskal-Wallis H test for age groups.*

	Group	N	Mean Rank	χ2	df	Sig.	ηp²
Perceived visual quality	< 20	9	104.72	12.405	4	0.015*	0.060
	20-30	72	93.64				
	30-40	66	88.77				
	40-50	36	122.31				
	> 50	17	126.68				
	Total	200					
Perceived function	< 20	9	86.89	17.9	4	0.001**	0.084
	20-30	72	95.42				
	30-40	66	85.81				
	40-50	36	124				
	> 50	17	136.5				
	Total	200					
Perceived symbolism	< 20	9	109.5	19.213	4	<0.001***	0.090
	20-30	72	96.35				
	30-40	66	82.64				
	40-50	36	120.92				
	> 50	17	139.41				
	Total	200					
Cognitive response	< 20	9	97.67	20.527	4	<0.001***	0.095
	20-30	72	95.58				
	30-40	66	82.92				
	40-50	36	125.54				
	> 50	17	138.06				
	Total	200					

**p<0.05; **p<0.01; ***p<0.001*

6.3.2.3. Residency

The result of the test in **Table 6-8** showed a significant difference in cognitive response scores between respondents of different residencies from the building ($\chi2(2) = 9.807$, $p = 0.007$, $\eta p^2 = 0.047$), with a mean rank of 88.2 for respondents who live near the building, 105.5 for respondents who live far from the building, and 124.02 for respondents living outside the city. The mean ranks were higher among respondents who live outside the city compared to those living near the building.

There was a significant difference in perceived visual quality scores ($\chi2(2) = 6.017$, $p = 0.049$, $\eta p^2 = 0.030$), although Dunn's post-hoc analysis with Bonferroni correction didn't show a significant difference between residency groups.

The respondents' mean ranks were as follows: 90.91 for respondents who live near the building, 104.37 for respondents who live far from the building, and 118.94 for respondents living outside the city.

There was a significant difference in perceived function scores ($\chi2(2) = 11.814$, $p = 0.003$, $\eta p^2 = 0.057$), with a mean rank of 86.73 for respondents who live near the building, 106.7 for respondents who live far from the building, and 125.34 for respondents living outside the city.

In contrast, the test showed no significant difference in perceived symbolism score between residency groups ($\chi2(2) = 5.504$, $p = 0.064$, $\eta p^2 = 0.027$), with a mean rank of 92.46 for respondents who live near the building, 102 for respondents who live far from the building, and 120.34 for respondents living outside the city.

Table 6-8: *Results of the Kruskal-Wallis H test for residency groups.*

	Group	N	Mean Rank	χ2	df	Sig.	ηp²
Perceived visual quality	Near the building	91	90.91	6.017	2	0.049*	0.030
	Far from the building	78	104.37				
	Outside the city	31	118.94				
	Total	200					
Perceived function	Near the building	91	86.73	11.814	2	0.003**	0.057
	Far from the building	78	106.7				
	Outside the city	31	125.34				
	Total	200					
Perceived symbolism	Near the building	91	92.46	5.504	2	0.064	0.027
	Far from the building	78	102				
	Outside the city	31	120.34				
	Total	200					
Cognitive response	Near the building	91	88.2	9.807	2	0.007**	0.047
	Far from the building	78	105.5				
	Outside the city	31	124.02				
	Total	200					

**p<0.05; **p<0.01; ***p<0.001*

6.3.2.4. Level of education

In **Table 6-9**, the test revealed no significant difference in cognitive response scores between respondents of different levels of education ($\chi2(4) = 1.884$, $p = 0.757$, $\eta p^2 = 0.010$), with a mean rank of 101.86 for those with less than a high school degree, 95.28 for respondents with a high school degree, 104.84 for respondents with a bachelor's degree, 94.04 for respondents with a master's degree, and 113 for respondents with a PhD degree.

The mean ranks were higher among respondents with a bachelor's degree and a PhD degree and lower among respondents with a high school degree and a master’s degree.

The test also showed no significant difference in perceived visual quality scores ($\chi2(4) = 1.062$, $p = 0.900$, $\eta p^2 = 0.005$), with a mean rank of 101.81 for those with less than a high school degree, 103.58 for respondents with a high school degree, 104.96 for respondents with a bachelor's degree, 94.03 for respondents with a master's degree, and 104.78 for respondents with a PhD degree, there was no significant difference in perceived function scores ($\chi2(4) = 5.409$, $p = 0.248$, $\eta p^2 = 0.027$), with a mean rank of 98.66 for those with less a than high school degree, 82.56 for respondents with a high school degree, 105.16 for respondents with a bachelor's degree, 98.57 for respondents with a master's degree, and 125.39 for respondents with a PhD degree and similarly, no significant difference in perceived symbolism scores ($\chi2(4) = 1.93$, $p = 0.749$, $\eta p^2 = 0.010$),with a mean rank of 104.43 for those with less than a high school degree, 104.33 for respondents with a high school degree, 102.38 for respondents with a bachelor's degree, 91.49 for respondents with a master's degree, and 104.33 for respondents with a PhD degree.

Table 6-9: *Results of the Kruskal-Wallis H test for education groups.*

	Group	**N**	**Mean Rank**	**χ2**	**df**	**Sig.**	**ηp²**
Perceived visual quality	< HSD	80	101.81	1.062	4	0.900	0.005
	HSD	18	103.58				
	BD	28	104.96				
	MD	56	94.03				
	PhD	18	104.78				
	Total	200					
Perceived function	< HSD	80	98.66	5.409	4	0.248	0.027
	HSD	18	82.56				
	BD	28	105.16				
	MD	56	98.57				
	PhD	18	125.39				
	Total	200					
Perceived symbolism	< HSD	80	104.43	1.93	4	0.749	0.010
	HSD	18	104.33				
	BD	28	102.38				
	MD	56	91.49				
	PhD	18	104.33				
	Total	200					
Cognitive response	< HSD	80	101.86	1.884	4	0.757	0.010
	HSD	18	95.28				
	BD	28	104.84				

MD	56	94.04
PhD	18	113
Total	200	

*p<0.05; **p<0.01; ***p<0.001. Note. < HSD=less than High School Degree; HSD= High School Degree; BD= Bachelor's Degree; MD= Master's Degree.

6.3.2.5. Profession

Based on the analysis that was done, **Table 6-10** shows that there is a significant difference in the ratings for perceived visual quality. With a chi-square value of 28.414 (df=9), the statistical test found a significant difference, providing strong evidence for this conclusion ($\chi 2(9) = 28.414$, $p = 0.001$, $\eta p^2 = 0.129$). The p-value of 0.001 indicates that the results are statistically significant. The effect size, represented by ηp^2 (eta squared), was computed to be 0.129, demonstrating the significant influence of the corresponding vocations on the scores for perceived visual quality.

A closer look revealed that respondents in the profession of architecture received an average rank of 88.17, compared to 156.50 for those in the profession of art/culture, 99.55 for those in the profession of commerce, 65.00 for those in the profession of engineering, 46.36 for those in the profession of social work, and 120.70 for those in the profession of administration.

The study revealed that across individuals with various professional backgrounds, there was a significant variance in the Perceived function ratings. A statistical analysis revealed a significant difference ($\chi 2(9) = 36.000$, $p = 0.000$, $\eta p^2 = 0.159$) in the mean ranks between respondents in the Art/Culture profession (162.65), Architecture profession (109.33), Commerce profession (85.45), Engineering profession (60.88), Social work profession (40.18), and Administration profession (114.05.

Likewise, a significant variation was seen in the perception of symbolism scores across participants with different occupational backgrounds. A significant difference in the mean rankings was found by statistical analysis ($\chi 2(9) = 34.446$, $p = 0.000$, $\eta p^2 = 0.153$). Architecture professionals scored 79.98 on average, followed by Art/Culture professionals at 171.70, Commerce professionals at 100.27, Engineering professionals at 71.75, Social work professionals at 43.50, and Administration professionals at 113.60.

This suggests that professionals in various disciplines have substantially diverse perceptions of perceived symbolism.

To sum up the test showed significant differences between professional domains in the Cognitive response scores ($\chi2(9) = 37.539$, $p = 0.000$, $\eta p^2 = 0.164$).

Following a thorough examination of the data, respondents in the field of architecture had a mean rank of 92.15, but those in the field of art and culture had a higher mean rank of 171.10. In a similar vein, respondents who identified as engineers had a mean rank of 62.31, much lower than those in the commerce sector, which displayed a mean rank of 94.58. Furthermore, social work professionals who responded indicated a mean rank of 36.82.

Table 6-10: Results of the Kruskal-Wallis H test for profession groups.

	Group N	N	χ2	df	Sig.	ηp²
Perceived visual quality	10[a]	200	28.414	9	0.001**	0.129
Perceived function	10	200	36.000	9	0.000***	0.159
Perceived symbolism	10	200	34.446	9	0.000***	0.153
Cognitive response	10	200	37.539	9	0.000***	0.164

**p<0.05; **p<0.01; ***p<0.001. Note.* [a] *Test groups: Architecture, Engineering, Art/Culture, Commerce, Education, Administration, Social work, Student, Unemployment, Other.*

6.3.3. Correlations between cognitive response dimensions

Taking the scores of each dimension of the cognitive response of the 200 respondents, a Spearman correlation test was used to determine the relationship between perceived visual quality, perceived function, and perceived symbolism. The correlation matrix is presented in **Table 6-11**, along with a scatter plot matrix in **Figure 6-14**, to indicate the relationships between the three correlated elements. There was a strong positive correlation between perceived visual quality and perceived symbolism, which was statistically significant (rho = 0.784, n = 200, p<0.001), as well as between perceived visual quality and perceived function (rho = 0.759, n = 200, p<0.001). While there was a moderately strong and positive correlation between perceived function and perceived symbolism (rho = 0.689, n = 200, p<0.001).

Table 6-11: *Correlation matrix of the three dimensions.*

	Perceived visual quality	***Perceived function***	***Perceived symbolism***
Perceived visual quality		0.759**	0.784**
Sig. (2-tailed)		<0.001	<0.001
95% CI		[0.691, 0.814]	[0.722, 0.833]
Perceived function	0.759**		0.689**
Sig. (2-tailed)	<0.001		<0.001
95% CI	[0.691, 0.814]		[0.606, 0.757]
Perceived Symbolism	0.784**	0.689**	
Sig. (2-tailed)	<0.001	<0.001	
95% CI	[0.722, 0.833]	[0.606, 0.757]	

** Double asterisk = significant correlations. CI = confidence interval.

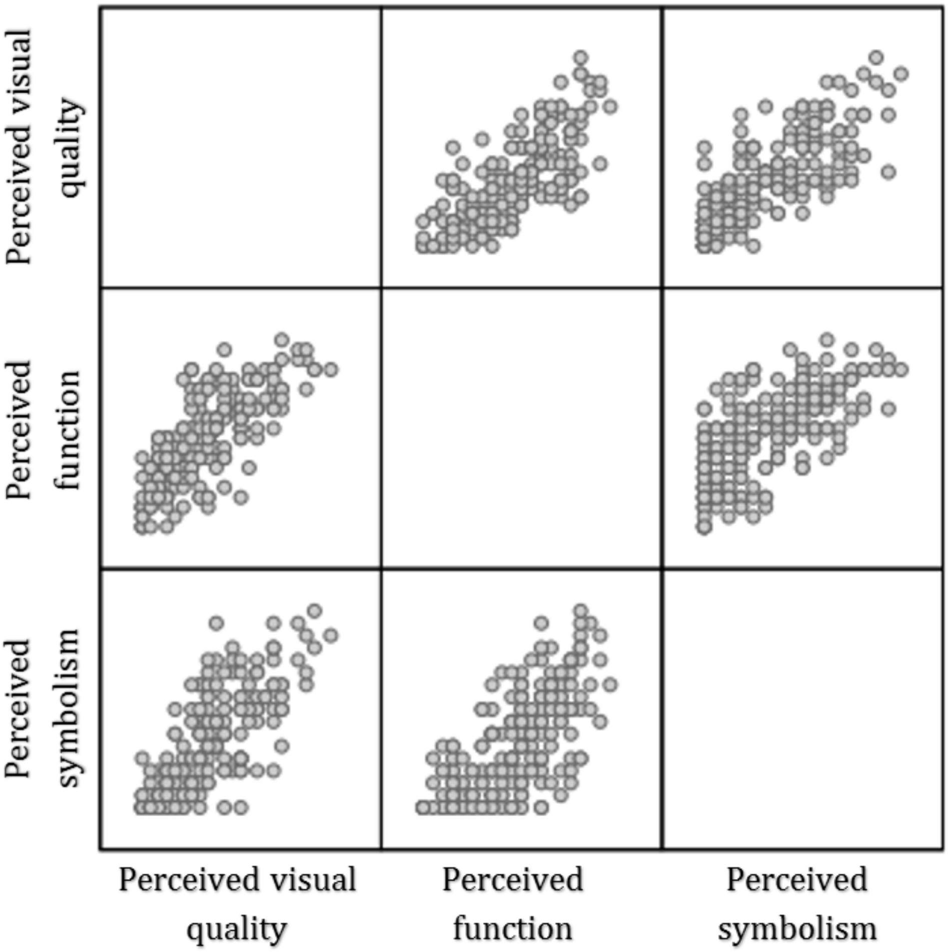


Figure 6-14. *Scatter plot matrix (Source: Author).*

6.4. Discussion

6.4.1. Evaluation of cognitive response

The respondents' ratings for the cognitive response, along with perceived visual quality, perceived function, and perceived symbolism, were considered to be poor to moderate compared to a neutral score of 3, as revealed by the results of the one-sample Wilcoxon signed-rank test and the relatively low scores (**Figure 6-15**). The largest variability from the neutral score was observed in perceived visual quality scores; while respondents had moderate ratings for the building's external appearance, they did not find it to correspond to their aesthetic preferences, nor did they consider the design to be authentic or the architectural style to show signs of modernity.

The respondents did not give the building strong ratings regarding the perceived symbolism and its constituting items, indicating that they did not seem to have strong impressions of the building's expressivity and symbolism, nor the message it seeks to convey. However, scores for perceived function did not deviate significantly from the test value and received higher ratings compared to the other two dimensions. Respondents were moderately satisfied with the building's legibility, the workspace, and the correspondence of interior spaces to their related functions. Respondents also considered the cultural facility a landmark, as it is the only building in the city that is illustrative of a vital function, as noted beforehand.

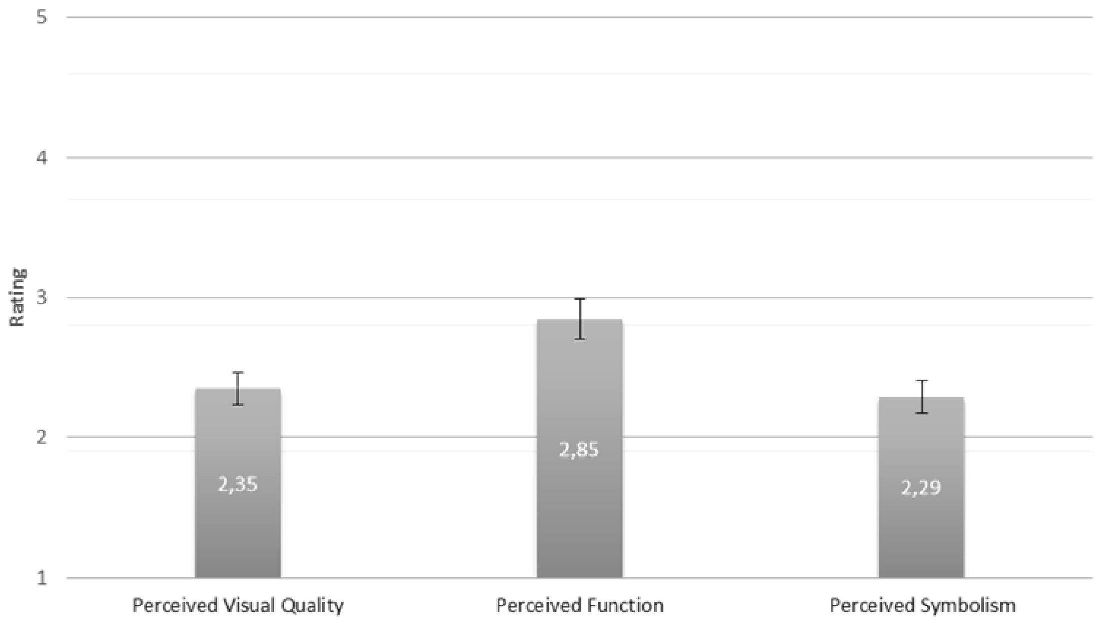


Figure 6-15. *Perceived visual quality, perceived function, and perceived symbolism scores [a] on a 5-point Likert scale. [a]5% error bars shown (Source: Author).*

6.4.2. Influence of socio-demographic factors

Table 6-12: *Summary of results of the non-parametric tests for cognitive response.*

	Gender	**Age**	**Residency**	**Education**	**Profession**
	Sig.	*Sig.*	*Sig.*	*Sig.*	*Sig.*
Cognitive response	0.001**	<0.001***	0.007**	0.757	0.000***

**p<0.05; **p<0.01; ***p<0.001*

The socio-demographic variables: gender, age, and residency were found to have a significant impact on cognitive response regarding the assessment of the cultural facility's perceived quality (**Table 6-12**), corresponding to the findings of previous work (de Tommaso et al., 2008; Nadal and Skov, 2013; Jankowski et al., 2018). In terms of the scores of cognitive response and its dimensions according to the respondent's gender, there was a statistically significant difference between males and females, with higher ratings among female respondents compared to male respondents, as indicated by the standardized test statistics. In respect of the socio-demographic variable age, there was a statistically significant difference in cognitive response, perceived function, and perceived symbolism scores between age groups 30–40 and 40–50, as well as between age groups 30–40 and > 50 (**Table 6-13**); however, there was no significant difference between groups in the perceived visual quality score.

In general, older respondents had higher ratings compared to younger respondents, possibly due to factors such as the difference in experience and the degree of attachment over time. According to respondents' residential dwelling and in line with the findings, there was a significant difference between respondents of different residencies regarding cognitive response and perceived function scores, while there was no significant difference regarding the perceived symbolism score. Dunn's post-hoc analysis with Bonferroni correction didn't show a significant difference between residency groups in the case of perceived visual quality score.

Compared to respondents who live nearby, respondents who live either far from the cultural facility or outside the city gave the building higher ratings in each category. Surprisingly, the level of education had no significant influence on cognitive response or any of its dimensions, and this is possibly linked to the fact that the building itself doesn't have any notable visual elements to its design or any message to convey to the perceiver, which at least can be detected by users with higher education, or that the message behind the design was not transmitted the way it was meant to be and thus was not interpreted appropriately.

The profession of individuals has a noteworthy influence on how architecture affects the cognitive response of the building users across various aspects. A detailed examination reveals significant disparities between respondents from the Art/Culture field and those in social work, encompassing all dimensions. Particularly, individuals working in Art/Culture express distinct evaluations compared to professionals in Architecture, Administration, Engineering, and Commerce.

Additionally, respondents in the Architecture profession exhibit a noteworthy divergence in their assessment of function, perceived function, and cognitive response in comparison to those in social work. These findings suggest that one's occupation or line of work can considerably shape their cognitive response to architecture.

Table 6-13: *Summary of the significant age, residency, and profession and pairwise comparisons through Dunn's test and Bonferroni's significance.*

	Variable	Pairwise comparison	Test Statistic	SE	Std. Test Statistic	Sig.	Bonferroni's adjusted sig.
Perceived visual quality	Profession	Sw-Ad	74.336	20.361	3.651	0.000	0.012
		Sw-AC	110.136	25.239	4.364	0.000	0.001
		E-AC	-91.500	27.400	-3.339	0.001	0.038
Perceived function	Age	(30-40)-(40-50)	-38.189	11.964	-3.192	0.001	0.014
		(30-40)-(> 50)	-50.689	15.705	-3.228	0.001	0.012
	Residency	NB-OC	-38.613	12.008	-3.216	0.001	0.004
	Profession	Sw-Un	-64.318	19.713	-3.263	0.001	0.050
		Sw-Ar	69.144	21.168	3.266	0.001	0.049
		Sw-Ad	73.868	20.353	3.629	0.000	0.013
		Sw-Ed	80.000	21.323	3.752	0.000	0.008
		Sw-AC	122.468	25.230	4.854	0.000	0.000
		E-AC	-101.775	27.390	-3.716	0.000	0.009
		Co-AC	77.198	21.000	3.676	0.000	0.011
		St-AC	76.088	23.277	3.269	0.001	0.049
Perceived symbolism	Age	(30-40)-(40-50)	-38.273	11.936	-3.207	0.001	0.013
		(30-40)-(> 50)	-56.768	15.668	-3.623	<0.001	0.003
	Profession	Sw-Ad	70.100	20.305	3.452	0.001	0.025
		Sw-AC	128.200	25.170	5.093	0.000	0.000
		E-AC	-99.950	27.325	-3.658	0.000	0.011
		Ar -AC	-91.722	21.821	-4.203	0.000	0.001
		O-AC	89.500	25.763	3.474	0.001	0.023
		Co-AC	71.426	20.950	3.409	0.001	0.029
		Un - AC	68.469	20.419	3.353	0.001	0.036
Cognitive response	Age	(30-40)-(40-50)	-42.617	11.992	-3.554	<0.001	0.004
		(30-40)-(> 50)	-55.135	15.742	-3.502	<0.001	0.005
	Residency	NB-OC	-35.813	12.036	-2.975	0.003	0.009
	Profession	Sw-Un	-67.272	19.759	-3.405	0.001	0.030
		Sw-Ed	78.864	21.373	3.690	0.000	0.010

	Sw-Ad	79.665	20.401	3.905	0.000	0.004
	Sw-AC	134.282	25.289	5.310	0.000	0.000
	E-AC	-108.788	27.454	-3.963	0.000	0.003
	O-AC	88.000	25.884	3.400	0.001	0.030
	Ar -AC	-78.948	21.923	-3.601	0.000	0.014
	St-AC	77.100	23.331	3.305	0.001	0.043
	Co-AC	76.519	21.049	3.635	0.000	0.012
	Un - AC	67.010	20.515	3.266	0.001	0.049

Only significant pairwise comparisons are shown (p<0.05). NB = near the building, OC = outside the city. Test groups: Ar =Architecture, E =Engineering, AC =Art/Culture, Co =Commerce, Ed =Education, Ad =Administration, Sw =Social work, St =Student, Un =Unemployment, O =Other.

6.4.3. Relationships between dimensions

The purpose of investigating the relationships between perceived visual quality, perceived function, and perceived symbolism was to determine whether the aforementioned cognitive dimensions are linked and whether any improvement that targets one dimension can also affect another, resulting in an improvement in the overall user's cognitive response.

The findings in **Figure 6-16** follow previous work on the relationship between visual and spatial perception and, by extension, the functional aspect of the building (Jennath and Nidhish, 2016; Posner et al., 1976; De Beni et al., 2005).

The combination of visual and spatial abilities allows for the development of spatial mental models that facilitate functional identification; hence, the visual quality of the building itself contributes to the evaluation of its spatial quality.

Visual quality is based on perceived visual characteristics that can have a parallel interpretation and, thus, be associated with particular meanings and connotations within the personal and cultural context of the perceiver (Jankowski et al., 2018). A poor visual quality correlates with a poor perceived symbolism; buildings with unplanned aesthetic design elements tend to have neither graspable meanings nor messages to convey.

The perceived symbolism of the building can give hints of its function and highlights its cultural context, its social and historic value, and its identity, as the results suggest, corresponding with previous findings (Lynch, 1960; Johnston and Pashler, 1990; Garden et al., 2002; Brunyé and Taylor, 2008).

A building's intended function could be symbolized and referred to through the message assigned to it by the architect or the user within a certain context. Perception is bound to hold significance and meaning, and it is interpreted according to the location and context (Määttänen, 2017) of the perceived object and the state of the perceiver, so it is a subjective and relative matter that differs from one building to another and from one user to another.

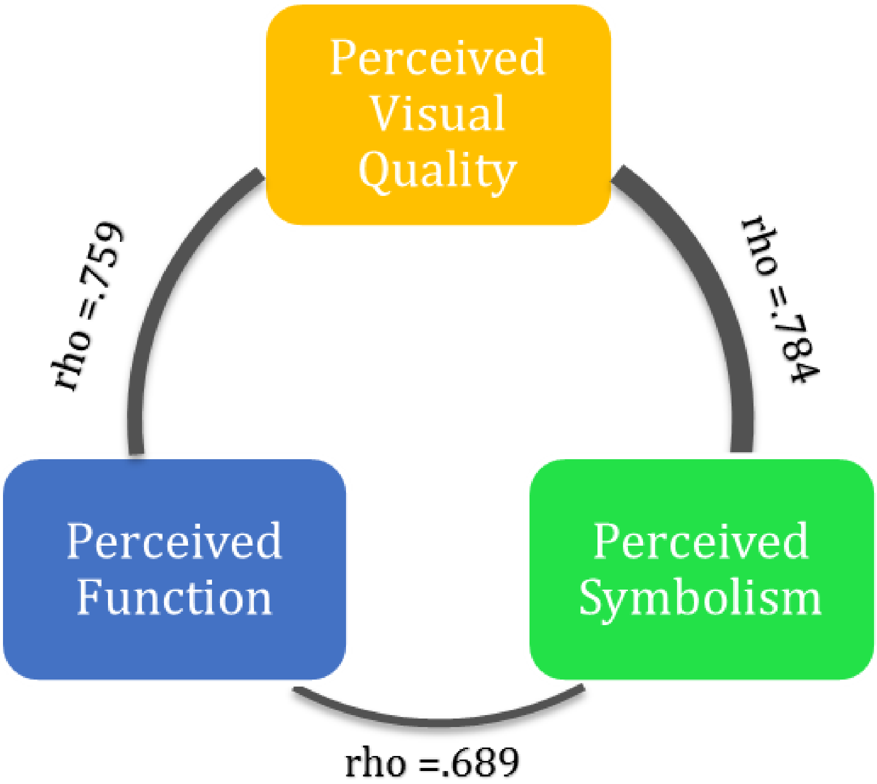


Figure 6-16. *Correlations between cognitive response dimensions (Source: Author).*

6.4.4. Perceived architectural quality and cognitive response comparison

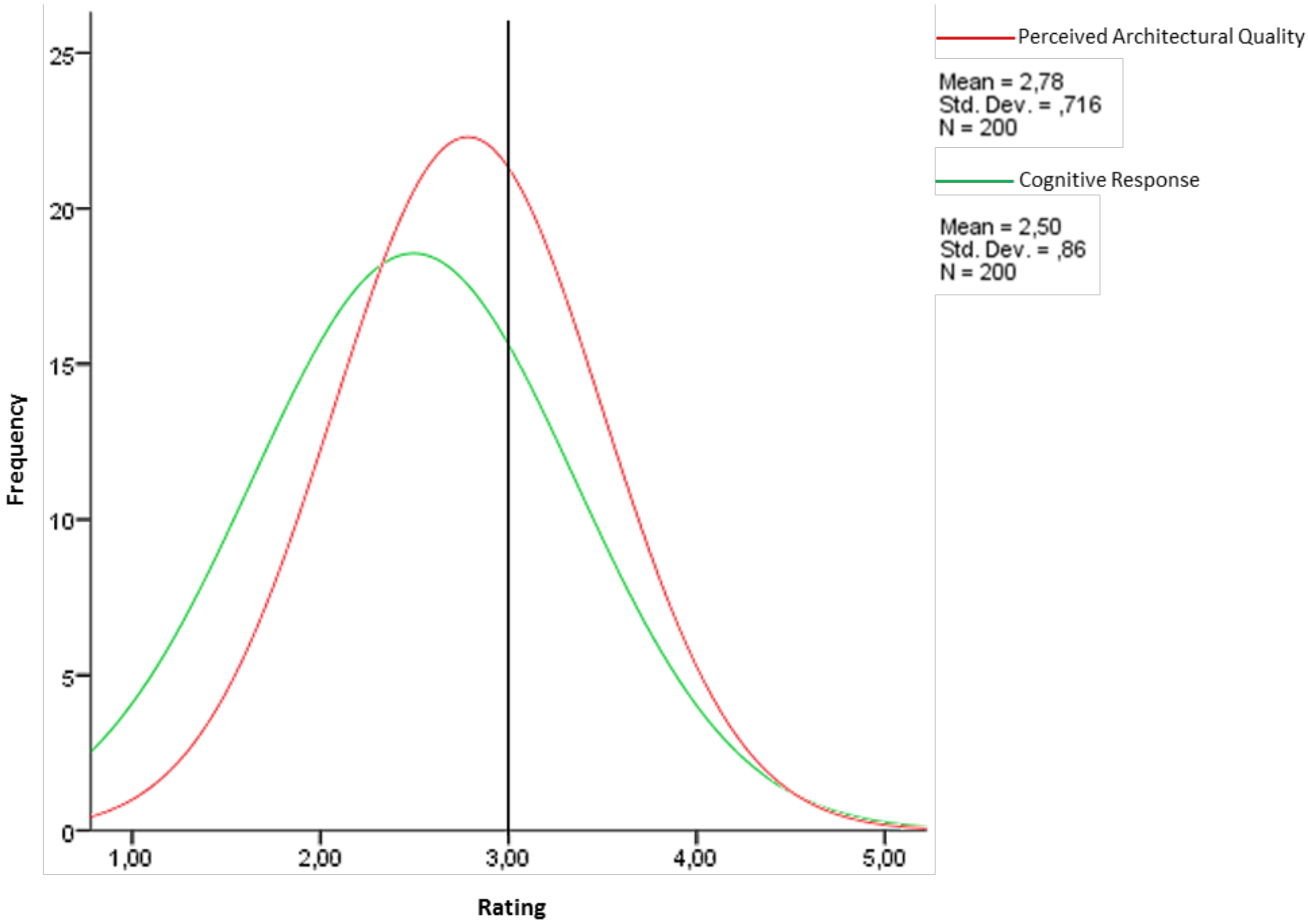


Figure 6-17. *Perceived architectural quality and cognitive response ratings distribution (Source: Author).*

In the representation presented in **Figure 6-17**, it is clear that both the ratings for perceived architectural quality and cognitive response are lower than the neutral value of 3.00. However, there is a significant difference between the two data sets (**Figure 6-18**).

The scores for perceived architectural quality demonstrate less variation and follow a normal distribution pattern. In contrast, the cognitive response scores exhibit a greater dispersion around their average value. This suggests that individuals' cognitive reactions vary to a considerable extent.

It is worth noting that the measurements for architectural quality and cognitive response are below the neutral value, indicating that there is room for improvement in both aspects. The data also highlights the importance of understanding the diverse cognitive responses of individuals when evaluating architectural designs in order to enhance their quality and overall experience.

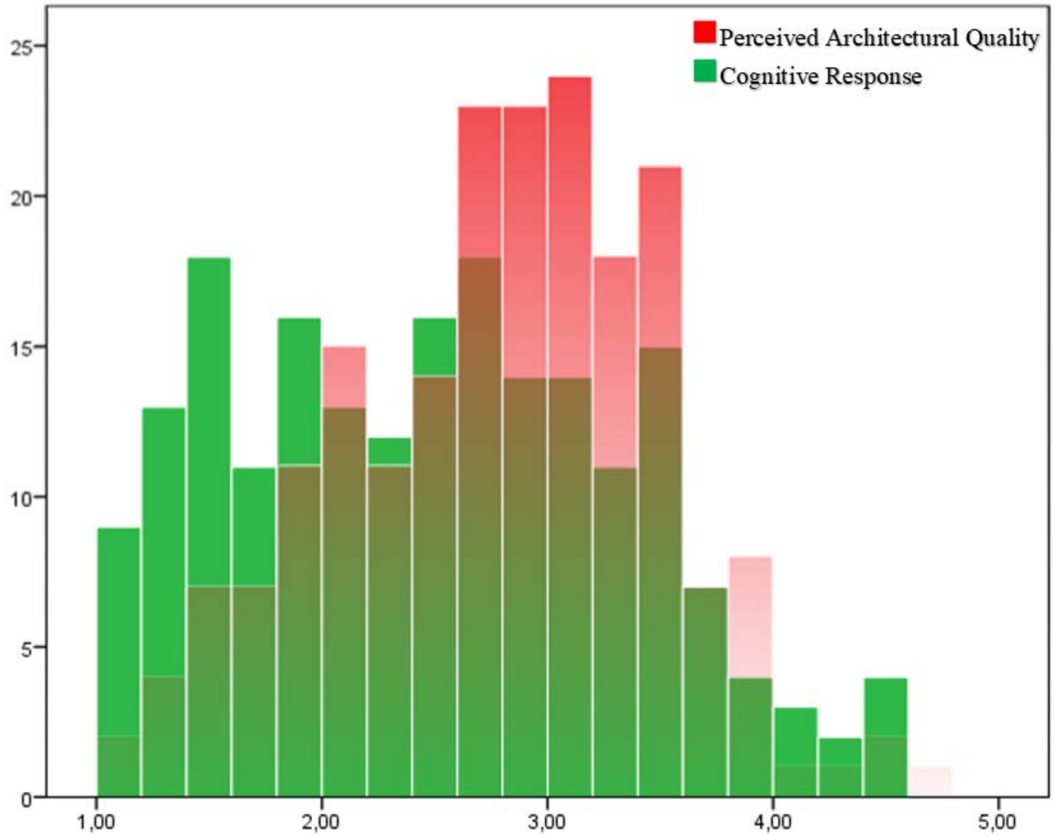


Figure 6-18. *Cumulative frequency histogram (Source: Author).*

The distribution curve graph (**Figure 6-19**) displaying the ratings provided by the respondents illustrates a noteworthy observation: the perceived visual quality of the content falls significantly below the average score, indicating a clear negative deviation.

In contrast, the perceived function, demonstrates a lesser deviation. This indicates that the respondents perceived the visual quality as being lower than expected, while function was perceived to be better compared to the aforementioned dimension.

In the pursuit of optimizing architectural quality in buildings through parametric techniques, special emphasis will be placed on elevating visual quality.

This aspect holds utmost importance as it has been identified as a key area requiring improvement, based on its low ratings. Furthermore, it is worth noting the strong connection between visual quality and the various dimensions that contribute to architectural quality.

Therefore, any enhancements made to visual quality are expected to have a beneficial influence on other aspects as well, resulting in a comprehensive enhancement of the overall perceived architectural quality.

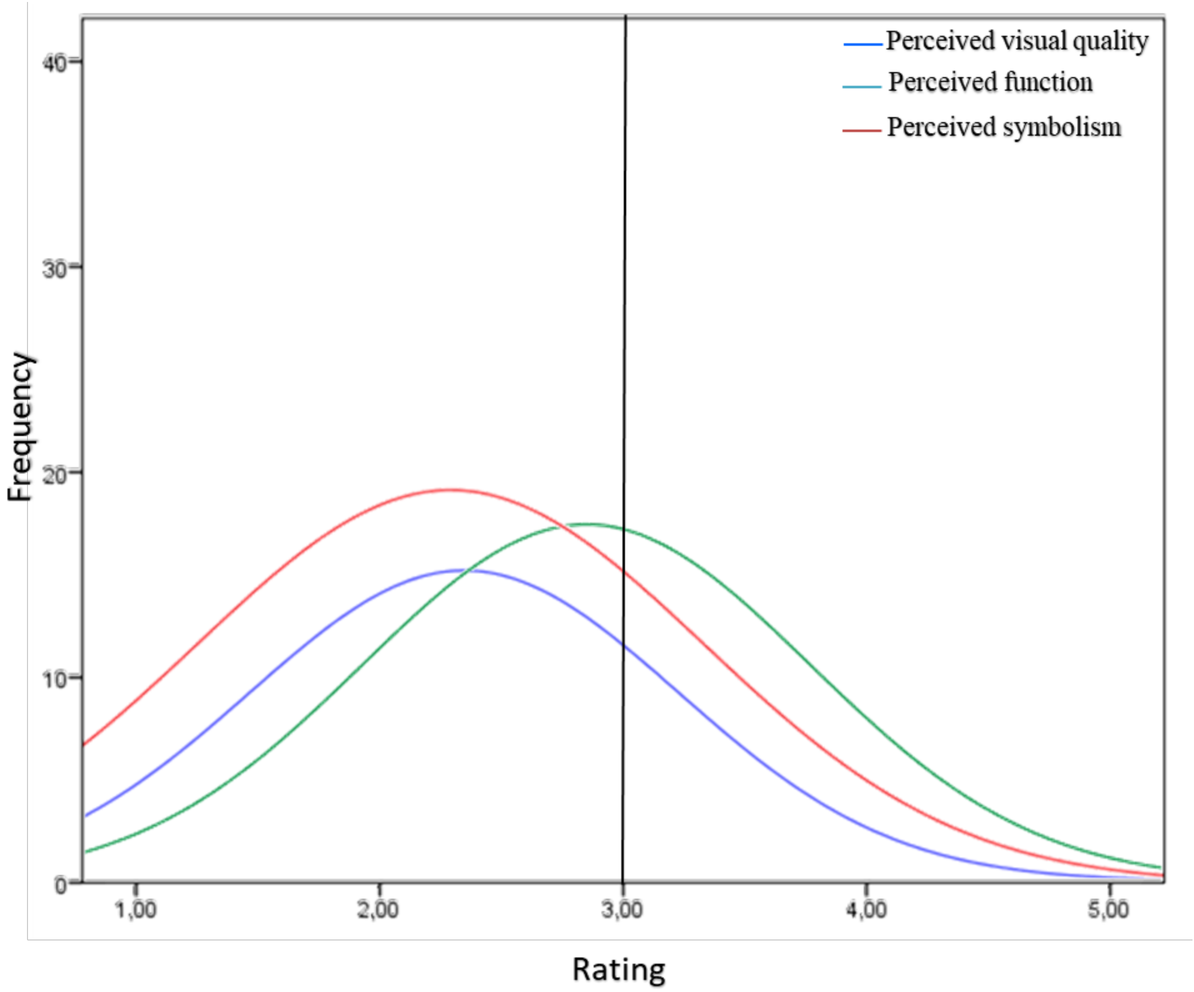


Figure 6-19. *Cognitive response dimensions scores distribution (Source : Author).*

According to the data depicted, it has been observed that the average ratings for perceived visual quality, perceived function, and symbolism were all below the neutral value of 3.00. In other words, the respondents rated these factors relatively lower compared to the benchmark level. This finding suggests that there is room for improvement.

The ratings for perceived function were higher in comparison to perceived visual quality, and perceived symbolism with a close proximity to the neutral value. The variations in perceived function and perceived symbolism were relatively minimal as compared to the perceived visual quality scores. These findings highlight that participants generally perceived lower levels of visual quality and symbolism, while perceiving function more positively and consistently. Therefore, there is an exigent need for improvement in both perceived visual quality and perceived symbolism. This equally indicates that there is scope for enhancing the overall perception of the building in terms of its visual appeal and symbolic representation.

The analysis of the data reveals that participants expressed a higher preference for perceived function, suggesting that they found the building’s functionality to be near satisfactory although, there is always a room for improvement.

After conducting an extensive examination and analysis of the data, it has become evident that the participants' viewpoints on visual quality, functionality, and symbolism have experienced a discernible decrease, ultimately not reaching the expected neutral level. However, it is worth noting that the perceived functionality received comparatively better scores, which aligns with the scores of perceived spatial quality demonstrated in the previous chapter.

6.4.5. Limitations and future directions

Future research may extend to the evaluation of the affective and behavioural responses. The behavioural response towards a building is either attraction or aversion, which is affected by the cognitive and affective responses, and by the perceived quality itself (Tsiotsou, 2006). It can be assessed by the visit frequency and the revisit intention. On the other hand, the affective response is more complex and is induced by the atmosphere of the building itself and how it can generate evocations, memories, and feelings that affect the perceiver’s evaluation (Daucé and Rieunier, 2002). Building daylighting and night lighting, combined with the appropriate colour schemes, can create the desired ambiance, eliciting an affective response and possibly a sensory congruency (Spence, 2020). According to Norman (2013), cognition and emotion are inseparable from each other and share a reciprocal interaction; cognition gives meaning and significance to what is perceived, while emotion determines the evaluation and judgments accordingly.

A good design with notable spatial qualities generates positive cognitive thoughts and produces positive emotions. (Jang and Namkung, 2009). Emotions and feelings influence perception and cognition processes (Damasio, 1994; Laird, 2012), as also stated by other researchers (Barrett et al., 2018; Philippot and Schaefer, 2001), and therefrom the perceiver can make judgments based on the interdependency of the cognitive-emotional mechanism (Storbeck and Clore, 2007; Liu et al., 2009). Researchers have highlighted (Chalup et al., 2010; Sussman and Hollander, 2015) the constant interaction between human perception and the perceived visual attributes of the building and how this can influence the perceiver's affective state on a large scale, as in the case of the Pareidolia phenomenon. (Chalup et al., 2010) Hence, each visual characteristic of the building participates in shaping the recipient’s experience; for example, the general shape, the architectural style, the scale, the arrangement of openings, colours, symmetrical patterns, and by extension, the combinations of all those elements, influence the perceiver's visual perception.

Positively perceived aspects of the building, especially visual aspects, contribute to overcoming negative aspects. The imageability (Lynch, 1960) can be used to describe the appearance of a building and its ability to evoke emotions and form impressions. A building can be visually and aesthetically appealing, but it does not evoke a strong sensation of aesthetic impression because it doesn’t conform to the user’s aesthetic taste and preference. The building design must be based on an equilibrium of creativity and familiarity; too much atypicality may reduce perceived quality, and on the other hand, too much standardization can lead to the same outcome; therefore, the “high touch” aspect needs to be harmoniously present in the design (Kotler, 1984).

Aesthetic impression is a complex process that includes aesthetic emotions and the profound interpretation of the building's imagery, expressivity, and symbolism and how they harmonize with the user’s aesthetic preference; it requires special attentiveness, imagination, and other perceptual abilities (Savoie, 2015). According to the model of Küller (1992), interacting with space (which can be inside or outside space) and exploring its components provokes an affective-emotional response.

A connection is formed between the observer and the building, achieving a state of “aesthetic empathy”, where the observer projects his emotions onto an object. Experience, personal feelings, and memories play a key role in defining the outcome of this procedure (Küller, 1992).

However, this study has three main limitations. Firstly, the challenge with the subjective evaluation of quality is that it relies on people's judgments to analyse multidimensional constructs; thus, users' perceptions of the building's different aspects have a significant impact on its perceived quality (Tsiotsou, 2006; Ariffin et al., 2016; Steenkamp, 1990).

These perceptions can be altered depending on when and where the information is received (Asshidin et al., 2016) and are likely to change over time as a result of diverse parameters like knowledge and experience (Zeithaml, 1988). Secondly, in addition to the factors studied, further analysis can be done on other socio-demographic factors.

Third, the study was conducted to assess the cognitive response to the perceived quality of a particular facility in a single city; however, it would be beneficial to evaluate the quality of other similar facilities in different cities and make comparative studies based on the collected data.

6.5. Conclusion

The study adds to the understanding of the user's cognitive response and demonstrates the adaptability of the Norman (2004) and Crilly et al. (2004) models in architecture. The respondents demonstrated a range of cognitive responses to various perceived architectural attributes of the building based on their perceptions and judgments. These responses were influenced by various factors like gender, age, and residency, while education had no significant influence. Perceived visual quality showed a strong correlation with both perceived function and perceived symbolism, indicating the relationship between the aesthetic visuals of the building and its function and symbolic meaning.

Analysing the user's cognitive response is a major factor in the process of identifying and assessing the perceived architectural quality and, therefore, improving the perceived value of buildings. It is essential that the orientation of evaluating quality follow the user's perception rather than solely focusing on objective quality indicators and self-centred predetermined standards that sometimes fail to provide the subjective quality that users seek. Perceptions are the translation of the users' wants and needs (Juran and Godfrey, 1999), and they can differ from one person to another. An object considered to be of high quality by a certain user can be considered to be of poor quality by another (Oxenfeldt, 1950). Therefore, architects need to fully understand the user's perceptions of quality with regard to architectural phenomena in order to improve the final product and equally respond to users' expectations (Garvin, 1988).

CHAPTER VII: PARAMETRIC MODELING AND OPTIMIZATION OF THE CULTURE HOUSE

7.1. Introduction

This chapter delves into various aspects of the intricate relationship between culture and architectural design in order to provide a comprehensive understanding. It thoroughly explores how cultural ideas, values, and perspectives influence the interaction between culture and its architectural expressions. This chapter aims to enrich our knowledge and shed light on the profound impact of culture on the field of architectural design.

The role of architectural design in reflecting and influencing culture is a crucial topic. It highlights the dynamic relationship between culture and architectural design, emphasizing the importance of understanding this connection in order to grasp the essence of societal identities. Moreover, it suggests that architects bear the responsibility of bridging the gaps between different cultures and design styles.

They should strive to create works that seamlessly integrate both traditional and contemporary elements, thereby promoting a harmonious blend of past and present. Such an approach not only enriches the architectural landscape but also fosters a deeper appreciation for cultural heritage while embracing the innovations of the modern world.

Digital technology can be harnessed to foster and celebrate cultural diversity through immersive cultural events. One effective approach is the creation of virtual experiences that allow individuals to explore and engage with a plethora of distinct cultures. For instance, the utilization of digital tools can enable the development of virtual tours of museums and historical landmarks, providing tourists with an immersive and enlightening encounter with various cultural aspects.

7.2. Concept genesis

7.2.1. *Nemencha Chaoui carpet and parametric modeling concept*

The Algeria culture includes a particular style of carpets called Chaoui carpet. It belongs to an Algerian ethnic group of Berbers known as the Chaoui. Handwoven Chaoui carpets are available in a wide range of colors and designs. Warm colors like orange and yellow and colorful, energizing patterns are frequently used. Chaoui jewelry is another distinctive component of Algerian arts and crafts in addition to carpets.

Knotting, tufting, and hooking are carpet-weaving techniques. The most popular method of rug weaving is pile or knotted weaving. Setting up the warps and a few early rows of wefts, then adding a horizontal row of knots, is the method of weaving a pile rug.

The knots are made up of a knot collar that wraps around the warps and ends that are wrapped around two adjoining warps. Kilim rug[1] weaving and soumak rug[2] weaving are two additional rug-weaving processes.

Nemencha Chaoui carpets have the following characteristics:

- They are available in a number of colors, including warm hues such as orange and yellow.
- They are known for their intricate designs, complex patterns and geometric shapes
- They frequently have colorful and lively designs.
- They are weaved by hand.
- They are also available in tapestry form.
- Chaouia women have been widely producing traditional Algerian crafts such as woven carpets.

Nemencha Chaoui carpets are typically rectangular and are often used as:

- Floor coverings
- Wall hangings
- Furniture coverings

Therefore, one of its uses is as a cover.

[1] Kilim rug, a traditional weaving craft predominantly practiced by nomadic tribes, boasts a remarkable level of versatility. Beyond being a floor covering, it serves as a multifunctional piece that can enhance the aesthetics of living spaces

[2] Soumak is a sophisticated and intricate tapestry weaving method that is primarily employed in creating durable and ornamental textiles, commonly utilized in the construction of carpets, rugs, household pouches, and bedding materials. Fabrics produced using the soumak technique for bedding are specifically referred to as soumak mafrash.

This type of carpets as mentioned earlier includes in its ornamentation the use of simple elements like points, straight lines, polylines, polycurves to achieve complex configurations. Basic shapes such as squares, triangles, and diamond are often used.

In the same context, many design principle are integrated in designing the Chaoui carpet like:

- Repetition
- Translation
- Symmetry
- Contrast
- Duality of positive and negative

7.2.2. Culture and architectural design

Culture and architectural design are essential components of any society's socialization process. The interaction between the two elements serves as the foundation for harmonious growth within a community and its surroundings. From a cultural standpoint, it refers to the many ideas, habits, and values that constitute a civilization, which are subsequently reflected via a variety of architectural buildings ranging from modest dwellings to massive complexes. It also demonstrates a people's aesthetics: the kind of ornamental features, chosen colors, and materials employed. Architectural design then acts as a cultural canvas for character identities and the portrayal of ideals like class, community, and style.

Given the variety of roles and meanings associated with culture and architectural design, the purpose of this thesis is to investigate their consequences in various circumstances. It investigates how architecture has traditionally been used to define social standards and represent societal ideals. It examines the interplay of culture, environment, and behavior in the context of residential and urban development. Finally, it explores how modern urbanization tendencies have changed the character of design in terms of style, materials, and architectural usefulness.

This thesis examines several facets of the interaction between culture and architectural design to give a thorough picture. It looks at how cultural ideas, values, and views shape the interaction between culture and its architectural manifestations. It also investigates how societal ideals, such as class, community, and prestige, might influence the aesthetic, form, and usefulness of diverse constructions. Furthermore, it assesses the necessity to include cultural components into current design processes and ideas such as sustainability and modernism.

The study closes by demonstrating how architectural design reflects culture and has the power to influence it. It contends that culture and architectural design have a two-way interaction, and that comprehending this link is critical to understanding societal identities. It also implies that architects have a responsibility to transcend the cultural and design divides while developing works that integrate elements of tradition and contemporary.

Culture and architecture are two subjects that are inextricably linked. Indeed, architecture reflects a society's culture at a specific point in its history. Buildings, monuments, and public places provide testament to a city's or country's history and culture. Architecture may also affect culture by creating areas that encourage social and cultural connections. Computing and other new technologies have an influence on architecture and culture. Emerging digital cultures have given rise to digital architecture, which designs buildings and public spaces using computer technologies. This architectural progress has permitted new kinds of cultural expression and contributed to the construction of new meeting and exchange places. In short, culture and architecture are mutually beneficial professions.

7.2.3. An architecture for promoting culture variety

Architecture may help to conserve and promote culture in a variety of ways:

- The preservation of historic buildings and monuments is a method of maintaining a city's or country's cultural legacy. To encourage local culture, historic buildings might be refurbished and converted into museums, cultural centers, or exhibition spaces.
- New building design can also represent local culture. Architects can draw inspiration from an area's history and culture to design structures that represent the community's cultural characteristics.
- Squares and parks, for example, can be built to promote social and cultural connections. To promote local culture, cultural activities such as festivals and concerts might be held in these locations.
- Culture may also be promoted through digital architecture. Buildings and public places that represent local culture can be designed using computer technologies. Digital technology may also be utilized to create immersive cultural experiences, such as virtual tours of museums and historical sites.
- In numerous ways, architecture may be utilized to foster cultural variety:

- Buildings that represent a community's cultural variety might help to foster that diversity. Buildings can be constructed to represent diverse cultural architectural traditions or to integrate design aspects that are relevant to different cultural groups.
- Public areas can be created to encourage cross-cultural contact. In these venues, cultural activities such as festivals and concerts can be held to promote diversity in culture.
- Cultural diversity may also be promoted through digital architecture. Computer technologies may be used to design structures and public spaces that represent a community's different cultural backgrounds. Digital technology may also be utilized to create immersive cultural experiences that celebrate cultural diversity

7.2.4. *Cultural themes*

Cultural themes may be included into architectural designs in a variety of ways:

1. Architects can draw inspiration from an area's history and culture to develop structures that represent the community's cultural character. They might include design aspects that are significant to various cultural cultures.
2. Public areas can be created to encourage cross-cultural contact. In these venues, cultural activities such as festivals and concerts can be held to promote cultural variety.
3. Using digital technology, architects may create immersive cultural experiences that highlight cultural variety. Virtual tours of museums and historical landmarks, for example, might be constructed to allow tourists to experience diverse cultures.
4. To encourage local culture, old structures might be refurbished and converted into exhibitions, cultural centers, or galleries. Architects may collaborate with local communities to create places that reflect the history and culture of the area.
5. Local materials and traditional construction techniques may also be used by architects to create structures that represent local culture. This can aid in the preservation of cultural traditions while also developing buildings that are appropriate for their environment.

Figure 7-1. *Chaoui carpet motifs examples (Source: https://www.facebook.com/numidiathikerchet/posts/1746158238873608/)*

7.3. Model components

Architects may include a wide range of cultural aspects into their designs. Here are a couple such examples:

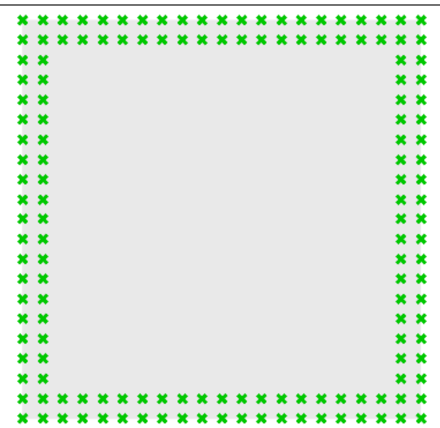
- Architectural traditions of a region can be included into the design of new structures to represent the community's cultural identity.

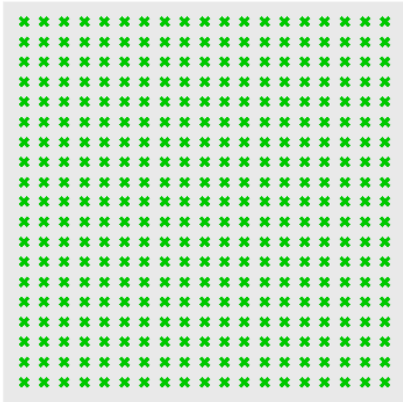
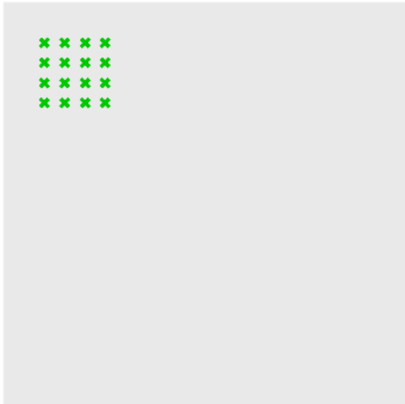
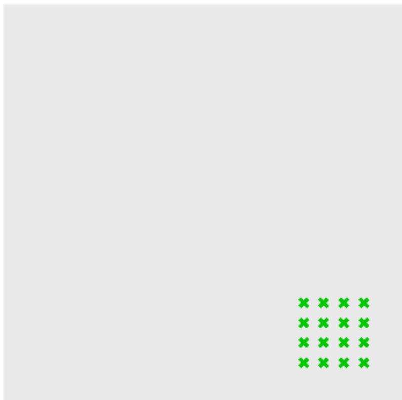
- To express cultural diversity, design features relevant to diverse cultural populations can be included into structures.

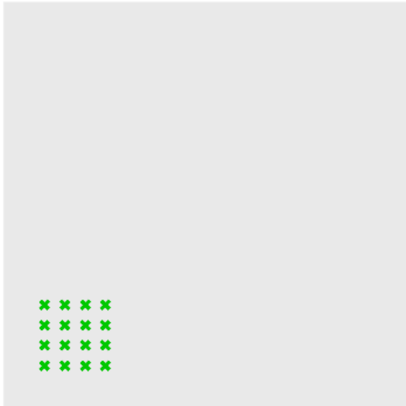
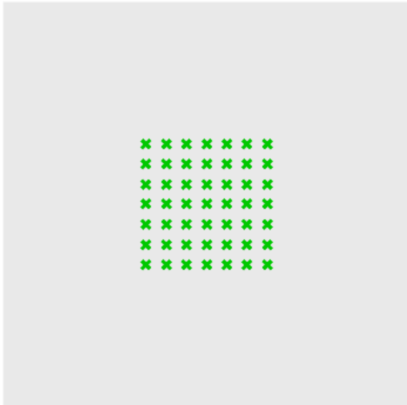
- Buildings that represent local culture can be constructed using local materials and traditional construction techniques.

- To encourage local culture, historic buildings might be refurbished and converted into museums, cultural centers, or exhibition spaces. Public areas can be created to promote cross-cultural contact. Cultural activities like festivals and concerts can be held in these locations to promote cultural variety. Immersive cultural events that promote diversity in culture may be created using digital technology. Virtual tours of museums and historical landmarks, for example, might be constructed to allow tourists to experience diverse cultures. Therefore, the model consists of the following components (**Table 7-1**):

Table 7-1: *Model components' domains and representation*

Component	**Domain**		**Representation**
	U direction	V direction	
الحاشية ***Border***	inverting	inverting	

الفراش ***Bedding***	[x-(x-1), x-1]	[x-(x-1), x-1]	
المشرف الصغير1 ***Almusharaf1***	[x-(x-2), x/3-2]	[x*2/3+2, x-2]	
المشرف الصغير2 ***Almusharaf2***	[x*2/3+2, x-2]	[x*2/3+2, x-2]	
المشرف الصغير3 ***Almusharaf3***	[x*2/3+2, x-2]	[x-(x-2), x/3-2]	

المشرف الصغير4 ***Almusharaf4***	[x-(x-2), x/3-2]	[x-(x-2), x/3-2]	
المحراب ***Mihrab***	[x/3, x*2/3]	[x/3, x*2/3]	

The dimensions of the different components can be adjusted in proportion to meet specific needs, whether they are related to structural integrity, functionality, or visual appeal. This adaptability allows for a certain degree of freedom where every aspect can be modified without disrupting the general form (**Figure 7-2 to 7-4**).

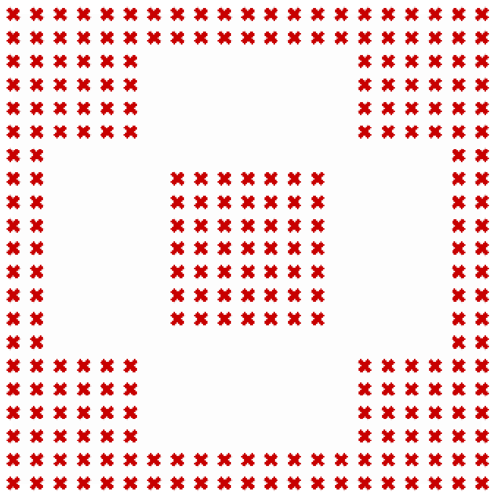


Figure 7-2. *Grid size: 20x20* (Source: Author).

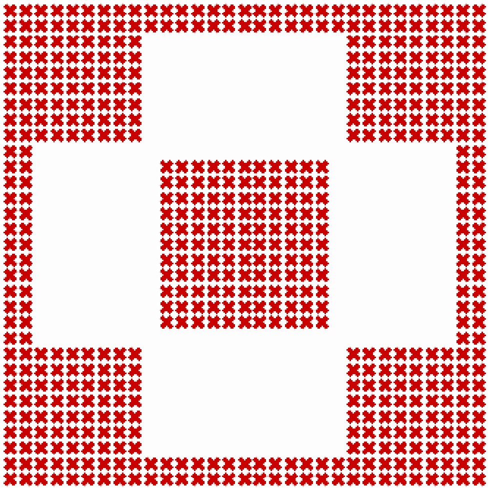


Figure 7-3. *Grid size: 30x30* (Source: Author).

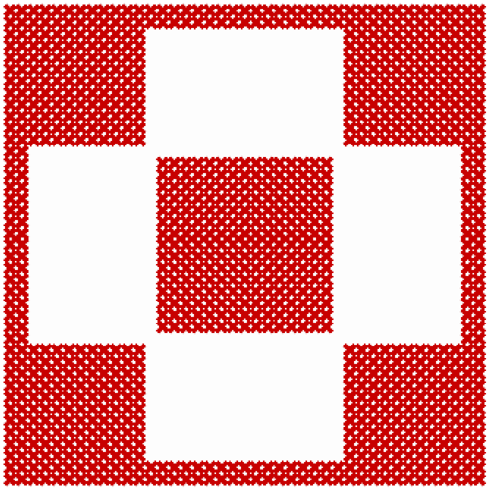


Figure 7-4. *Grid size : 40x40* (Source: Author).

7.4. Structural system

Parametric design is a powerful approach that utilizes parameters, algorithms, and scripts to facilitate the creation of three-dimensional models with a wide range of form and shape variations. This comprehensive system of interrelated parameters controls the geometric transformations by assigning unique values to each parameter. The resulting designs are enriched through the consideration of this methodology, providing a neutral and thorough understanding of how parametric systems operate (**Figure 7-5**).

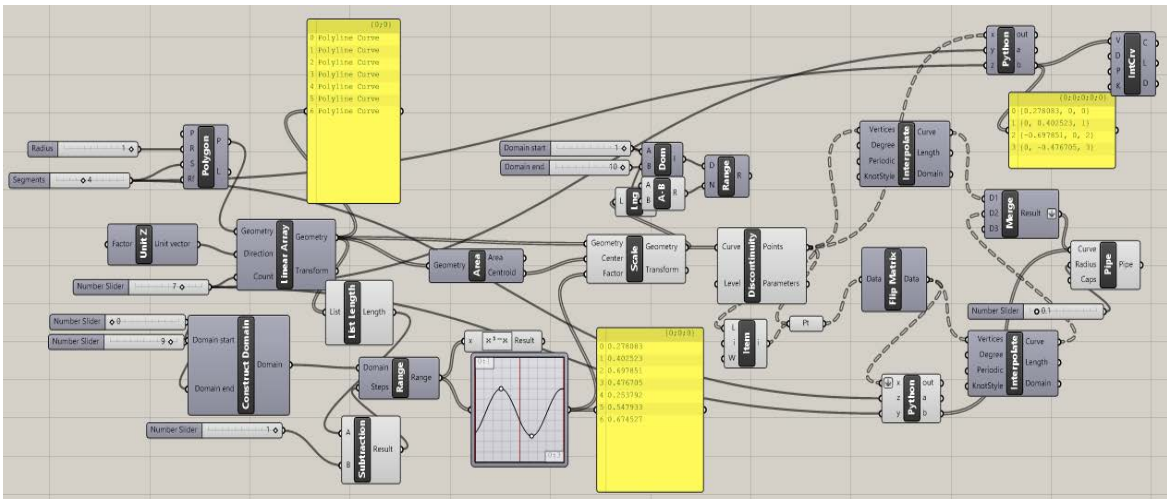


Figure 7-5. *The parametric system responsible for the Structural variations (Source: Author).*

The component polygon plays a significant role in defining the horizontal profile shape of the vertical bearing element (**Figure 7-6**). It offers the ability to control the radius of the profile and the way it is divided into segments. In conjunction with the linear array component, it determines the spacing between each polygon and allows for the selection of an appropriate number of polygons. To add further variety and uniqueness to the design, each polygon is later adjusted using the graph mapper by applying a distinct scaling factor. This process contributes to the creation of diverse variations in the overall shape and appearance of the element.

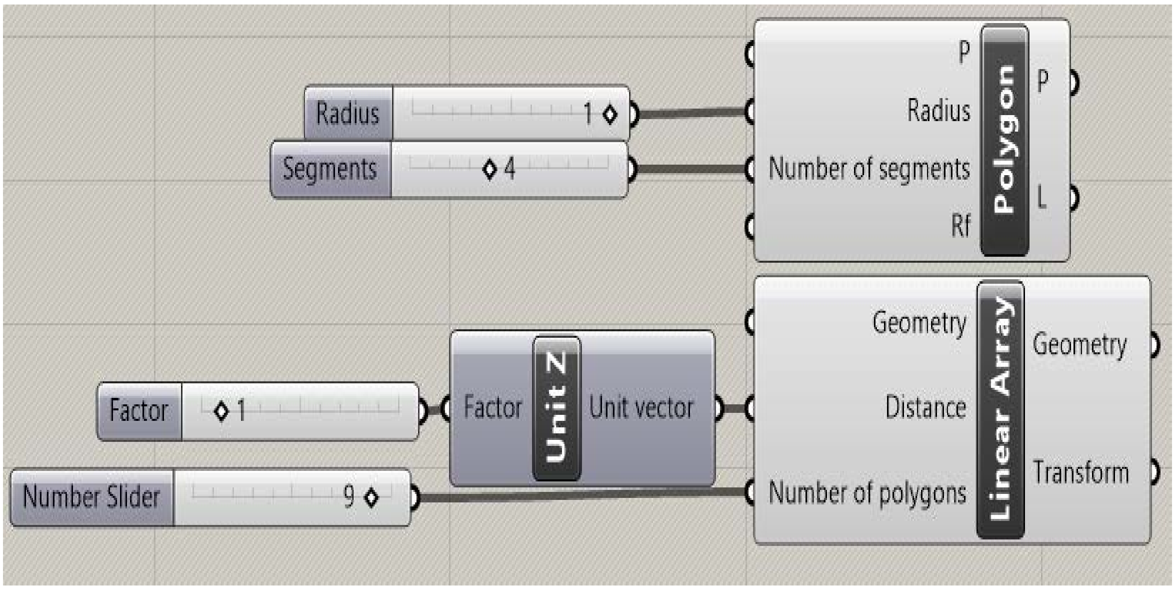


Figure 7-6. *The component polygon's horizontal profile shape control (Source: Author).*

7.4.1. Graph Mapper

A collection of integers can be remapped using graph mapper objects. The x and y domains of a graph function are by default unit domains (0.0 to 1.0), however they can be tweaked using the Graph Editor. Graph mappers are restricted to having one mapping function, which is accessible via the context menu. Graphs commonly include control circles that may be used to manipulate the values that determine the graph equation. A graph mapper object on itself includes no graph and conducts a one-to-one mapping of values (**Figure 7-7**).

Control circles are often incorporated into graphs to allow manipulation of the values that determine the resulting graph equation. It's worth mentioning that a graph mapper object on its own does not contain a graph, but instead facilitates a one-to-one mapping of values. This means that each input value is directly associated with a corresponding output value. To summarize, graph mapper objects serve as a means to transform collections of integers by adjusting the x and y domains, utilizing a single mapping function, and allowing for control of the input values through the use of control circles.

The building relies on pillars that are generated based on specific parameters, allowing for flexibility in adjusting their characteristics such as height, radius, and number of segments. These parameters can be manipulated through the use of mathematical equations, such as the sine and cosine functions. This parametric approach enables the pillars to be easily modified and tailored to meet the desired design requirements (**Table 7-2 and 7-3**).

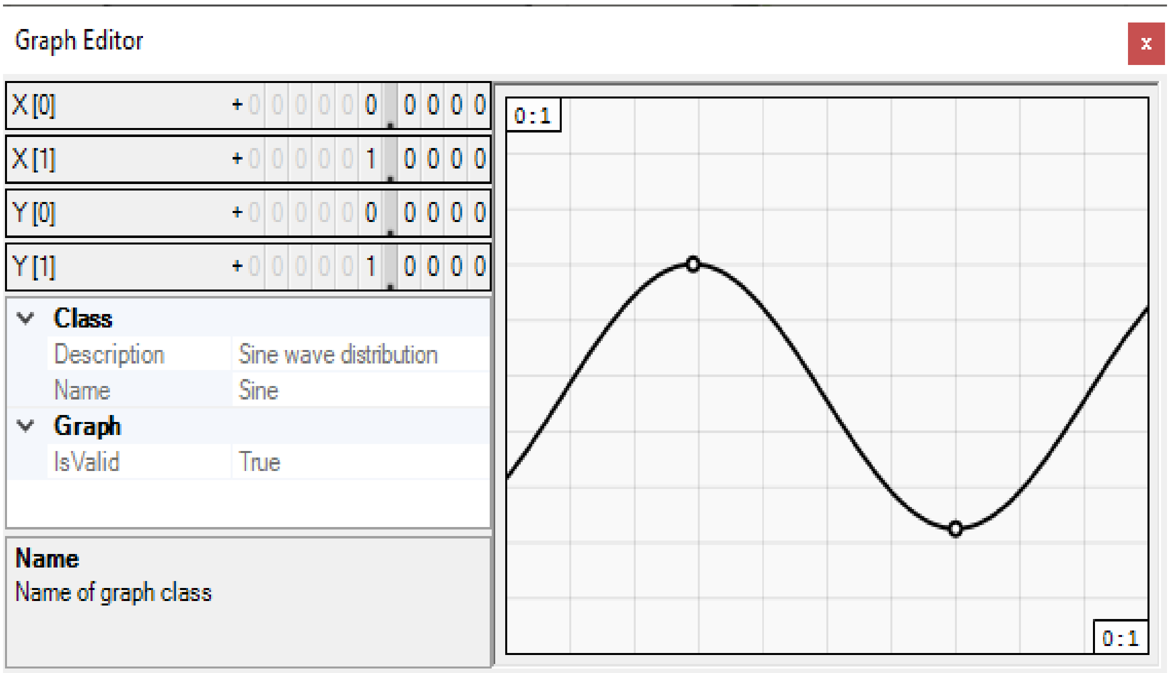
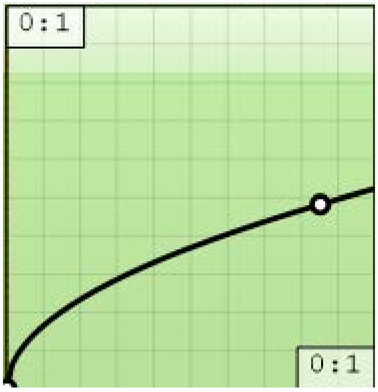
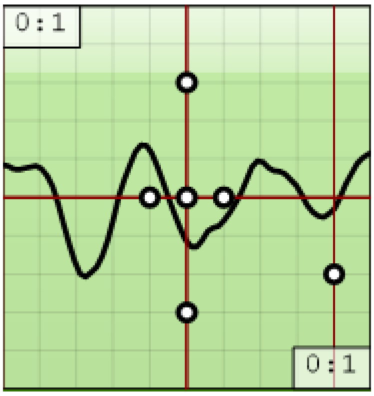
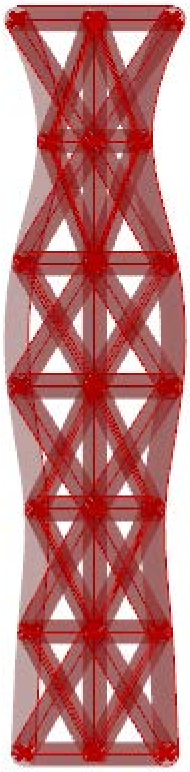


Figure 7-7. *Graph editor with a sine wave distribution (Source: Author).*

Table 7-2: *Structural variations generated from manipulating the graph type*

Graph type	Graph mapper	Visualization
Square Root		
Perlin		

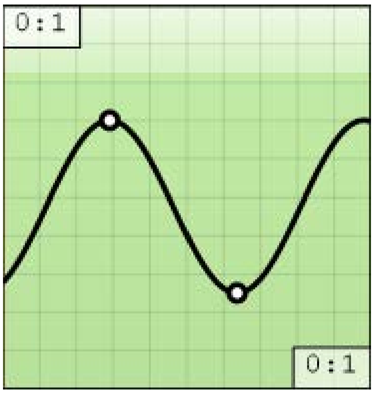
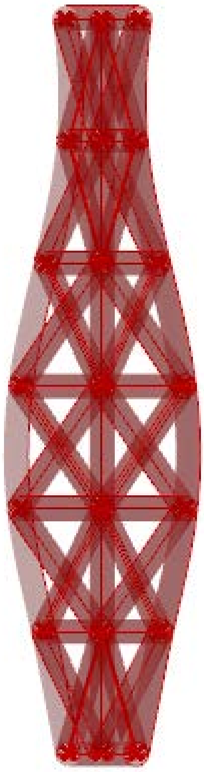
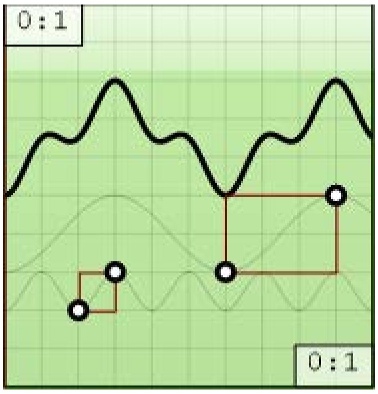
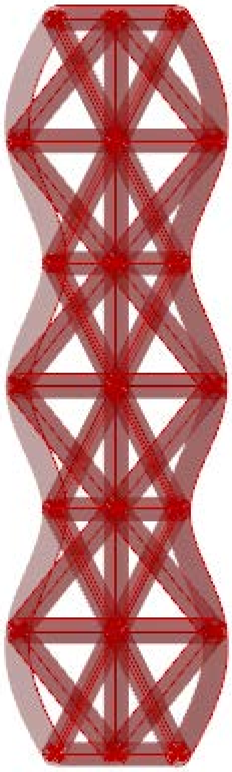
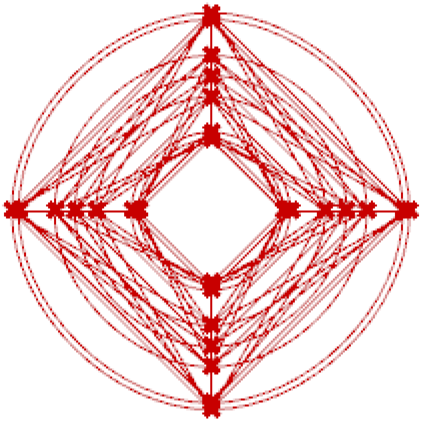
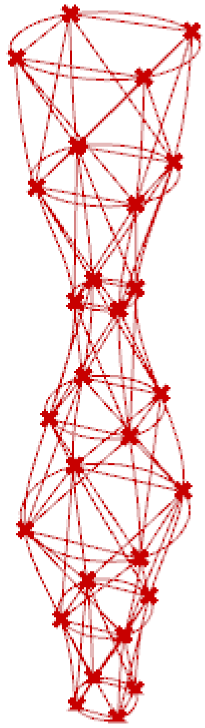
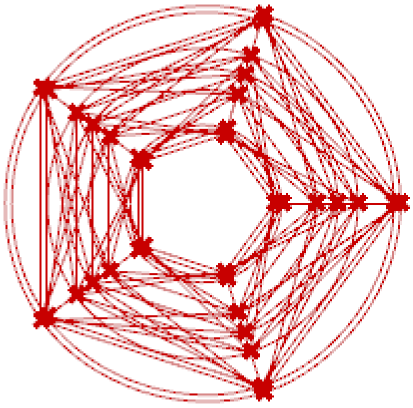
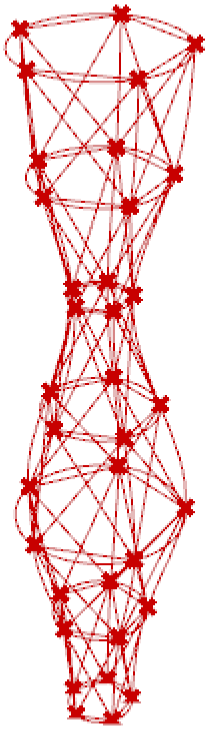
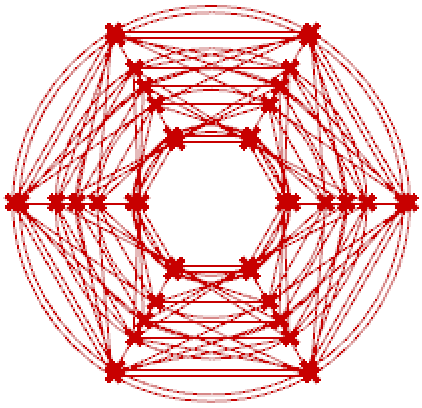
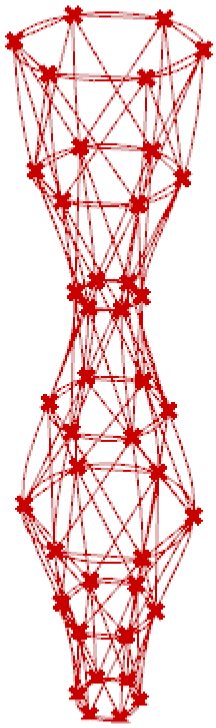
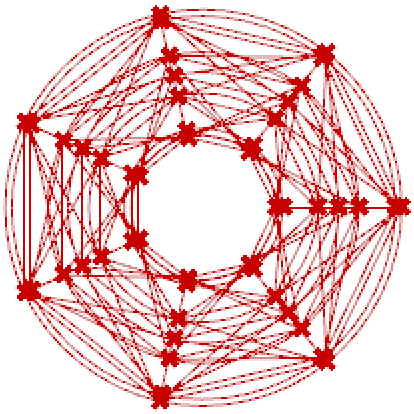
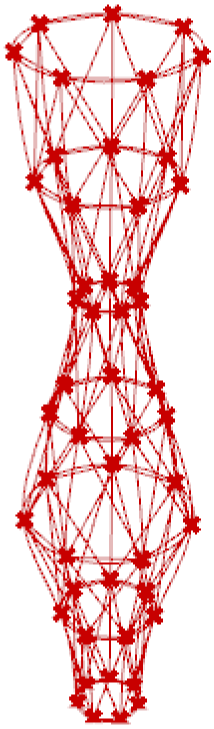
Sine		
Sine Summation		

Table 7-3: *Structural variations Profile segments Upper view and Side view*

Profile segments	Upper view	Side view
4		
5		

6		
7		

The column grid in this construction system is seamlessly integrated with the roof using a data matching algorithm. This algorithm enables a component to generate a list of relevant data from which to select. With this list, it becomes possible to establish connections between each point and its intended target through the utilization of a line component. Even if the geometry undergoes changes, the connections remain intact without any disruption. Moreover, when the necessary information is provided, it becomes feasible to manipulate multiple columns using just one single component, streamlining the overall construction process and enhancing efficiency. This integration between the column grid and the roof not only ensures structural stability but also offers flexibility and adaptability to accommodate design modifications (**Figure 7-8**).

Figure 7-8. *Column grid flexibility and adaptability to accommodate design modifications. (Source : Author).*

7.5. O.O.P Object Oriented Programing

Object-oriented methodology is a widely adopted approach in software programming that aims to logically divide the software development process into different objects. This comprehensive methodology provides a detailed and thorough framework for designing and constructing software systems. By breaking down complex processes into smaller, manageable entities. It contains both:

- Data
- Methods

Every figure within geometry, whether it is a basic point, a curvaceous line, a perfectly round sphere, or a solid cube, possesses its own set of inherent properties and actions that enable the manipulation and adjustment of its distinctive characteristics.

7.5.1. Python library

A Python library provides the capability to engage with Rhino, a software used for 3D modeling and computer-aided design (**Figure 7-9**), and it consists of:

- Classes (objects: cube, cone…)
- Structures: attributes and methods related to a class
- Functions: example: sort (sorting a list), len (length of a list), and range functions

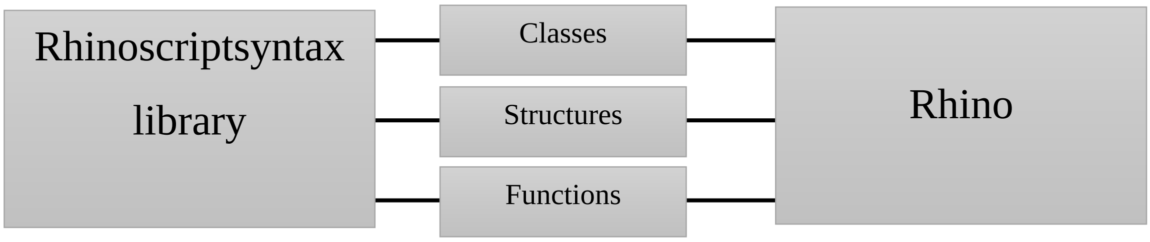


Figure 7-9. *Rhinoscriptsyntax library (Source: Author).*

The following examples are taken from the Rhinoscriptsyntax library[1]:

a) Class

| AddSphere(center_or_plane, radius) | Add a spherical surface to the document

| AddCylinder(base, height, radius, cap=True) | Adds a cylinder-shaped polysurface to the document

Attributes

| Sphere Parameters:
| center_or_plane (point|plane): center point of the sphere. If a plane is input,
| the origin of the plane will be the center of the sphere
| radius (number): radius of the sphere in the current model units

| Cylinder Parameters:
| base (point|plane): The 3D base point of the cylinder or the base plane of the cylinder
| height (point|number): if base is a point, then height is a 3D height point of the
| cylinder. The height point defines the height and direction of the
| cylinder. If base is a plane, then height is the numeric height value
| of the cylinder

[1] Open to access via https://developer.rhino3d.com/api/RhinoScriptSyntax/

| radius (number): radius of the cylinder

| cap (bool, optional): cap the cylinder

b) Methods

| MoveObject(object_id, translation) | Moves a single object

| Parameters:

| object_id (guid): The identifier of an object to move

| translation (vector): list of 3 numbers or Vector3d

| RotateObject(object_id, center_point, rotation_angle, axis=None, copy=False) | Rotates a single object

| Parameters:

| object_id (guid): The identifier of an object to rotate

| center_point (point): the center of rotation

| rotation_angle (number): in degrees

| axis (plane, optional): axis of rotation, If omitted, the Z axis of the active

| construction plane is used as the rotation axis

| copy (bool, optional): copy the object

| ScaleObject(object_id, origin, scale, copy=False) | Scales a single object. Can be used to perform a uniform or non-uniform

| scale transformation. Scaling is based on the active construction plane.

| Parameters:

| object_id (guid): The identifier of an object

| origin (point): the origin of the scale transformation

| scale ([number, number, number]): three numbers that identify the X, Y, and Z axis scale factors to apply

7.5.2. The python component "Chaoui Carpet"

The Python-based component (**Figure 7-10**) provides a wide range of options for configuring different styles of carpet weaving, making it easier to manipulate and interact with various parameters and values that influence the generation of carpet designs (**Table 7-4**). This comprehensive tool enables users to have a full control over design parameters.

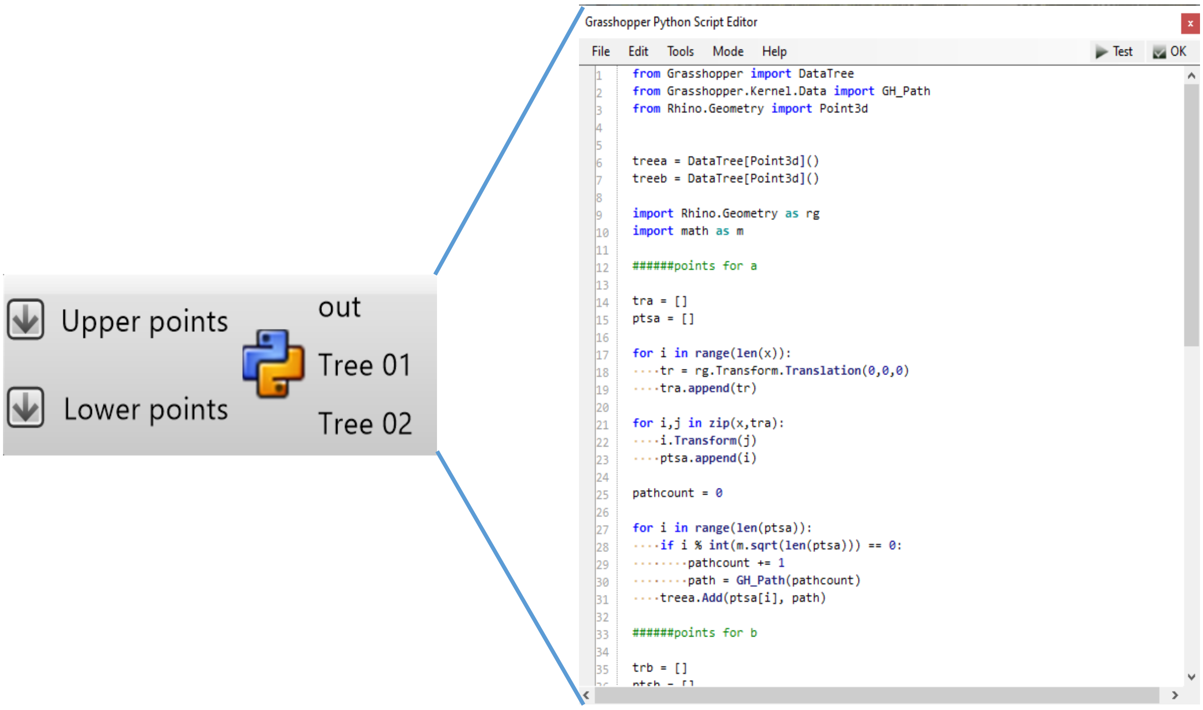
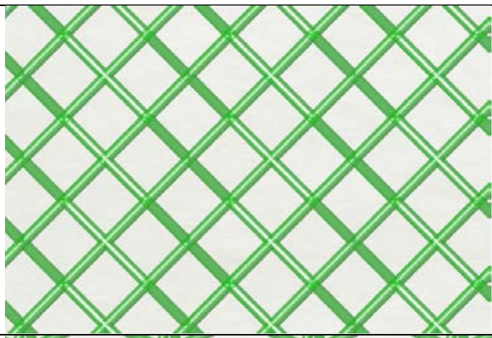
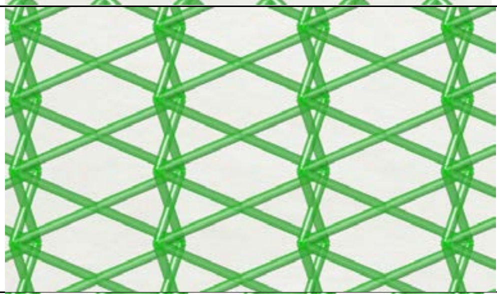
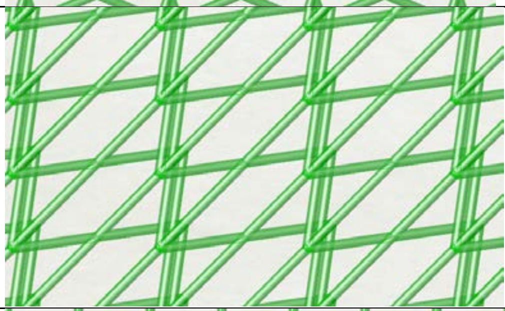
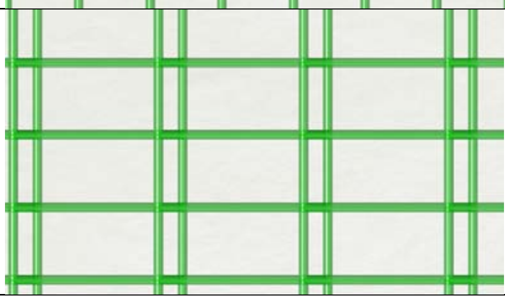
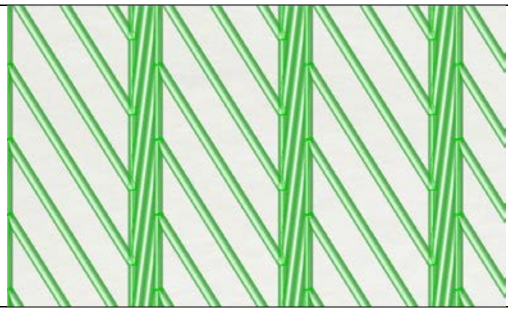


Figure 7-10. *The python component "Chaoui Carpet" (Source: Author).*

Table 7-4: *Some of the many possible variations that could be generated using the python script*

Pattern	Translation	Result
Line 01 = [(x,y)],[(x+1,y+1)] Line 02 = [(x,y+1)],[(x+1,y)]	(0,0,0)	
	(1,0,0)	
	(1,1,0)	
Line 01 = [(x,y)],[(x+1,y)] Line 02 = [(x,y)],[(x,y+1)]	(0,0,0)	
	(1,0,0)	

	(0.5,2,0)	

7.6. Culling

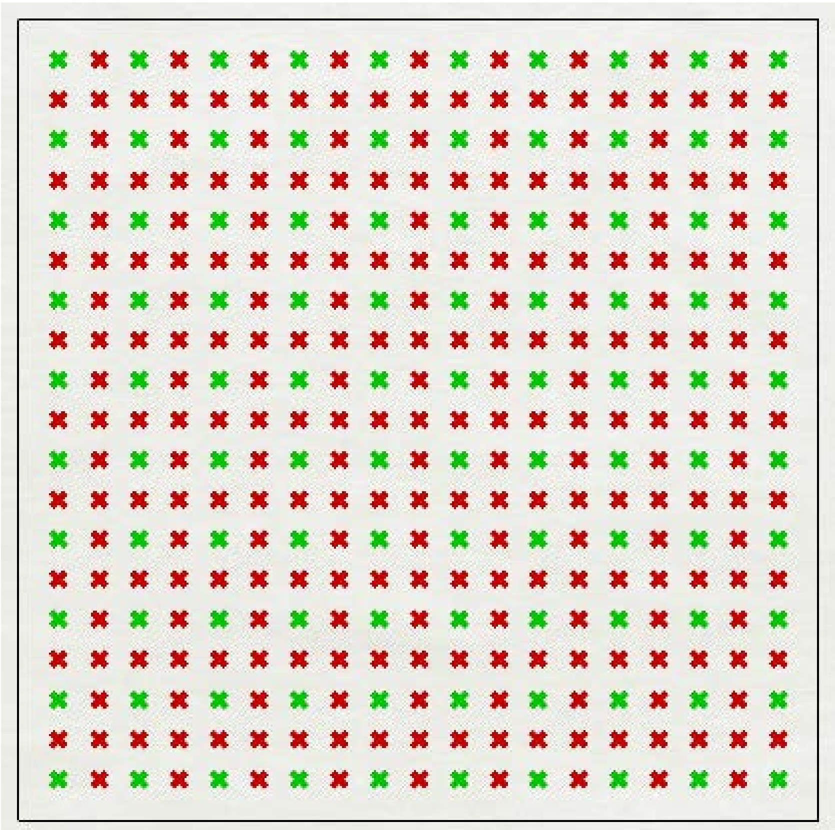


Figure 7-11. *Culling points to produce various configurations (Source: Author).*

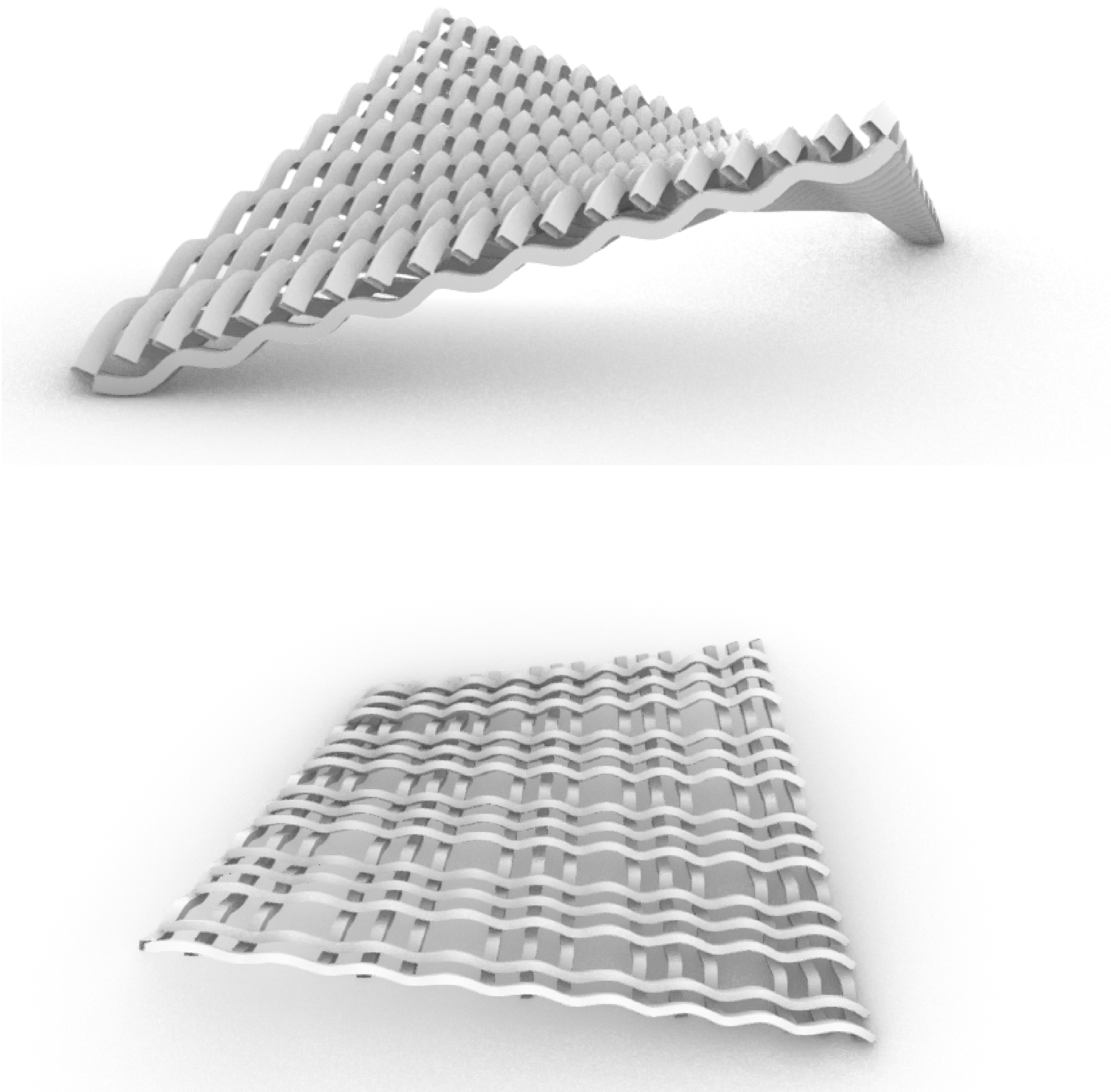


Figure 7-12. *Weaving patterns for constructing structural beams (Source: Author).*

By culling points (selectively extracting specific points) (**Figure 7-11**), one can effectively generate intricate weaving patterns that can be utilized for constructing structural beams (**Figure 7-12**).

By strategically eliminating specific points or segments, it becomes possible to create elaborate intertwining patterns that can be employed in the creation of structural beams and thus result in a wide array of configurations.

This process entails carefully selecting and excluding certain elements to achieve intricate designs that offer versatility and adaptability in their utilization.

The architectural design technique known as the double-crossed weaving pattern, or the utilization of double-faced fabrics, involves the implementation of double weave techniques. These techniques enable the creation of fabrics that possess two distinct sides, each offering a completely unique appearance. This intricate process allows for the development of textiles that exhibit a duality in their visual appeal and can be utilized in various applications (**Figure 7-13**).

Double-faced overshot is a weaving technique that enables the creation of fabric with distinct colors on both the front and back surfaces. This technique involves the use of two pattern yarns, where one is utilized to weave the desired design on the front side while the other is responsible for the back side. To maintain the integrity of the fabric and secure the pattern, a standard tabby thread is woven between the pattern picks .

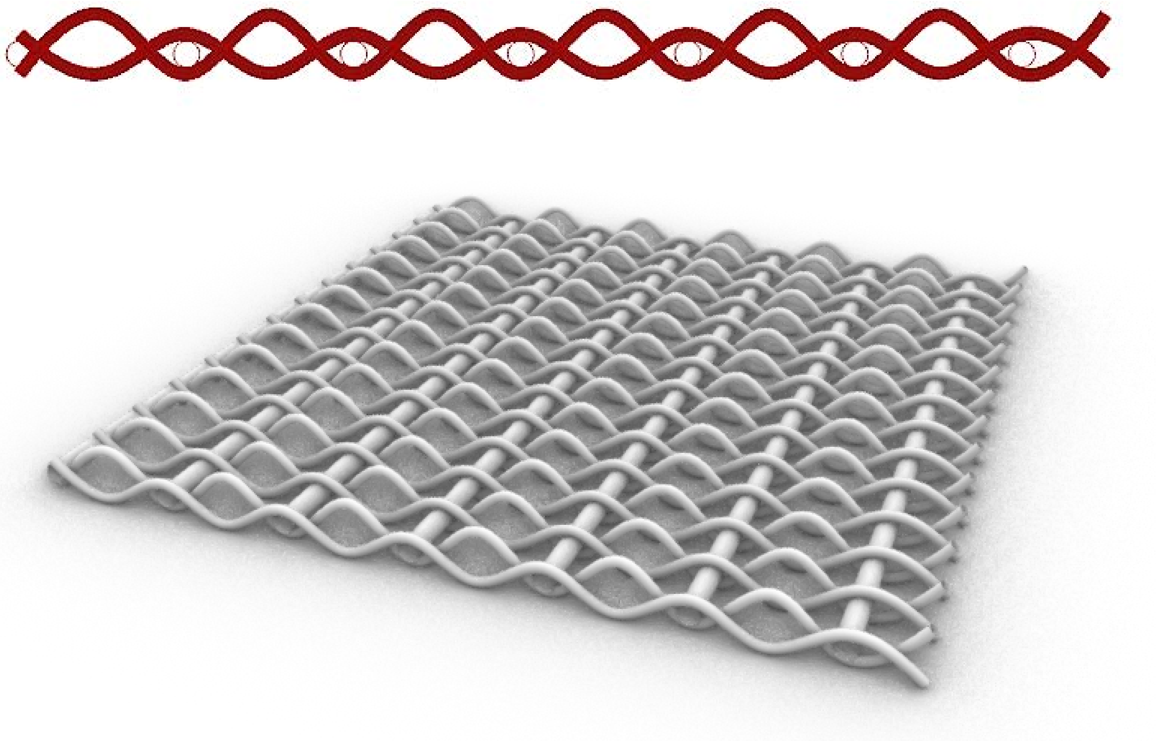
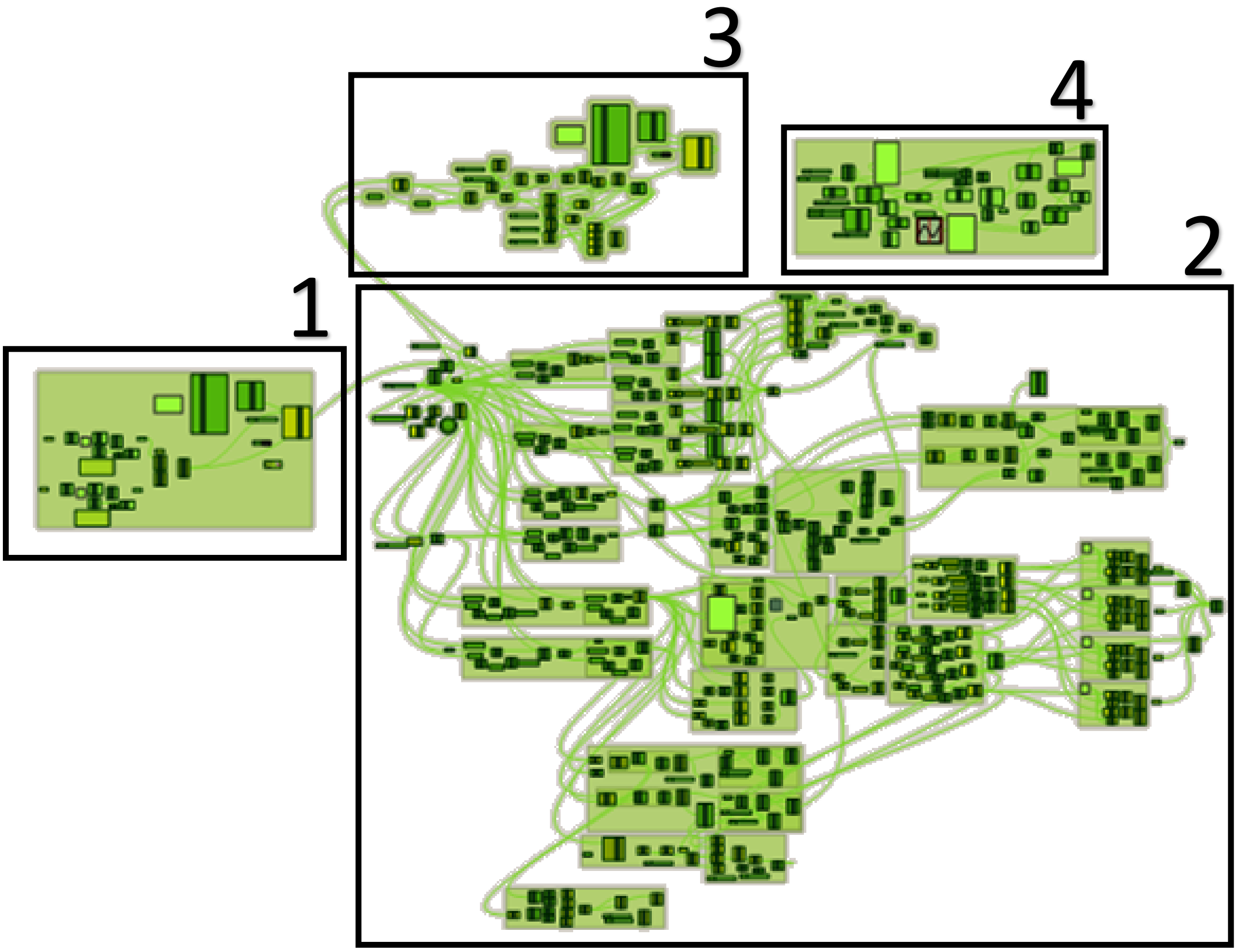


Figure 7-13. *Double-crossed tensor pattern (Source: Author).*

Double-faced tablet weaving is a sophisticated and intricate technique that provides the freedom to manipulate individual cards, resulting in the creation of elaborate designs. This method offers the opportunity to achieve remarkable intricacy through the utilization of the double-faced technique. By employing this technique, architects can skillfully generate a variety of designs and propositions.

7.7. A Parametric system for form generation

7.7.1. Generated geometries from the proposed parametric system



1 Form generation using genetic algorithms

2 Carpet patterns generation

3 Form environmental optimization

4 Vertical bearing system generation

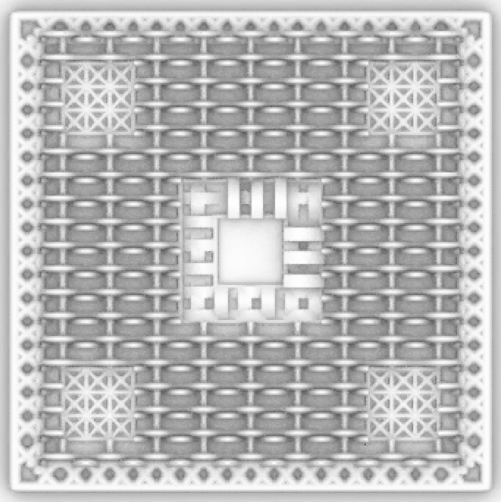
Figure 7-14. *The parametric system responsible for the whole form generation (Source: Author).*

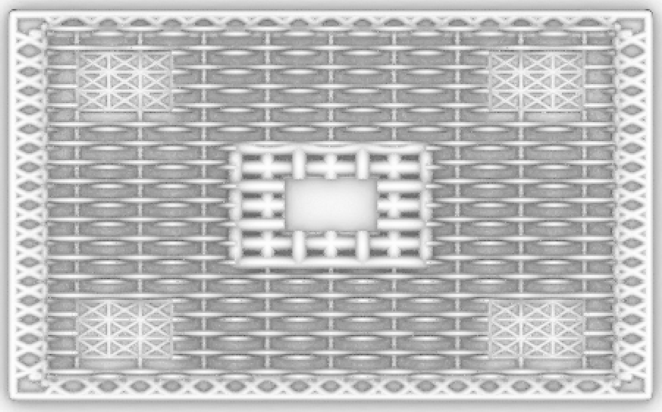
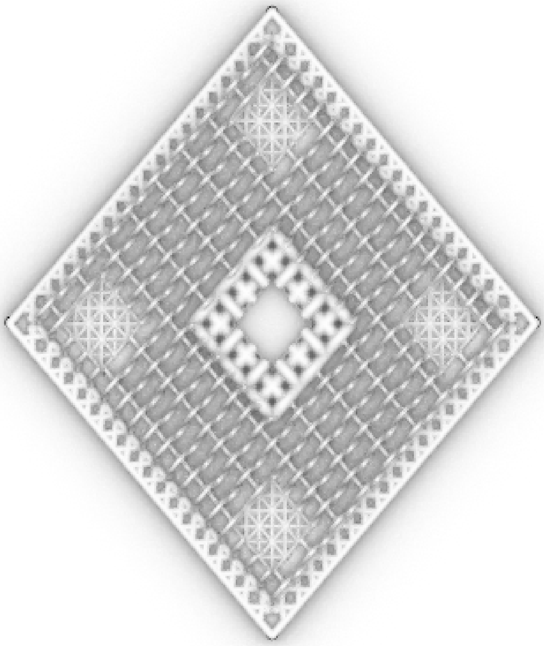
The parametric system that oversees the generation of the entire form comprises four primary subsystems. The first subsystem is responsible for conducting the process of form-finding, exploring and determining the overall shape and arrangement. The second subsystem focuses on commanding the generation of patterns and their various iterations, allowing for variations and customization. The third subsystem aims to optimize the form that has been generated, refining and improving its overall efficiency and performance. Finally, the fourth subsystem is in charge of producing the elements necessary for supporting and maintaining the structural integrity of the form (**Figure 7-14**).

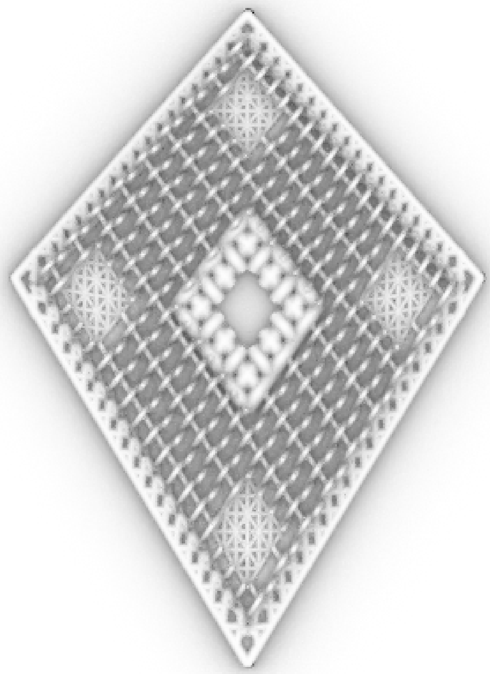
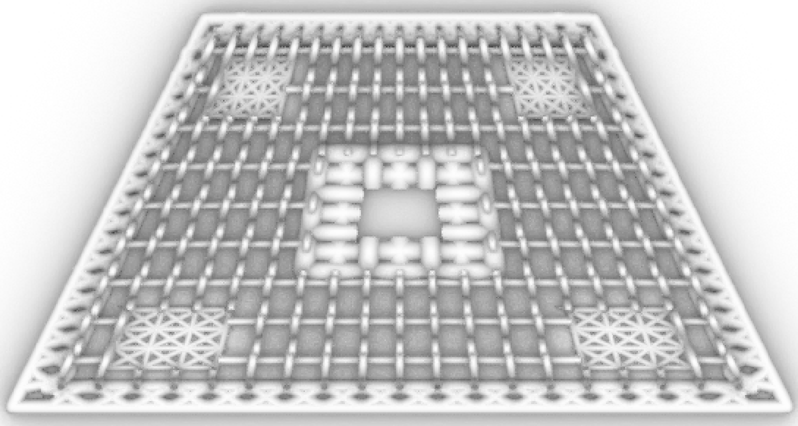
In the context of this project, a parametric system (**Table 7-5**) is utilized to create a model that showcases a highly customizable curved structure adorned with a mechanism designed to effectively respond to the incident radiation.

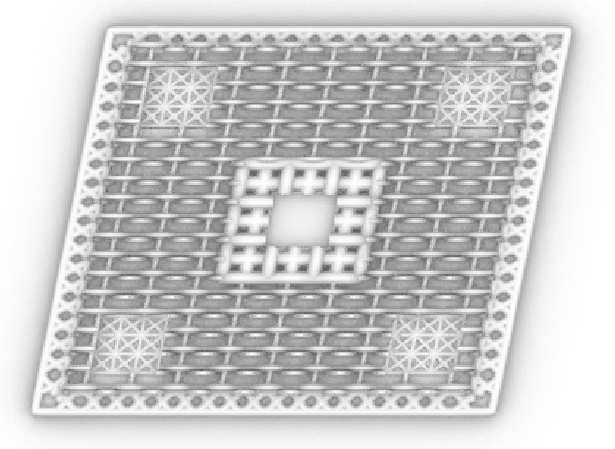
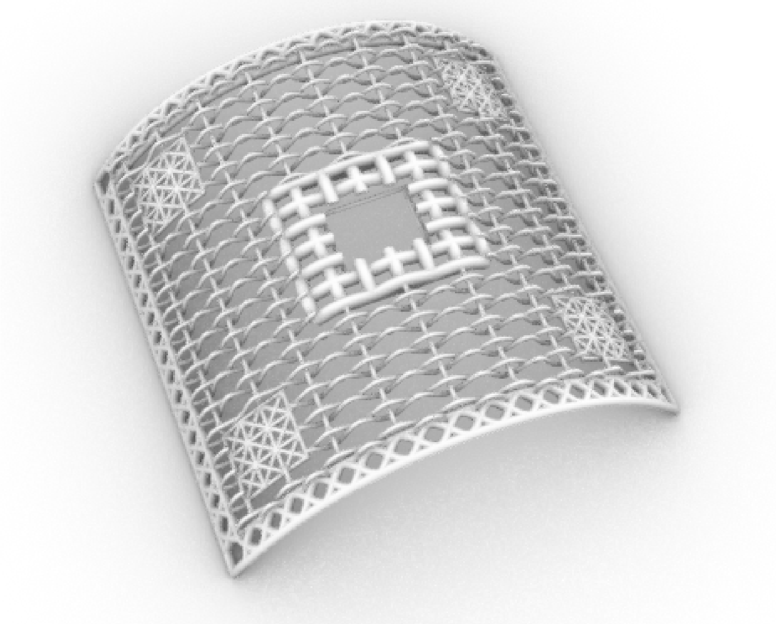
The primary feature of this curved roof is a series of openings, which are equipped with amorphous silicon solar cells, specifically tailored to serve as photovoltaic and thermal hybrid solar collectors. The aim of this system is to generate both electricity and thermal energy. It is worth noting that amorphous silicon cells, also referred to as thin-film silicon solar cells, possess the ability to absorb more light and are suited for application on curved surfaces due to their inherent flexibility. This advanced architectural framework not only accounts for the aesthetic appeal of curved designs but also maximizes the efficiency and functionality of solar energy.

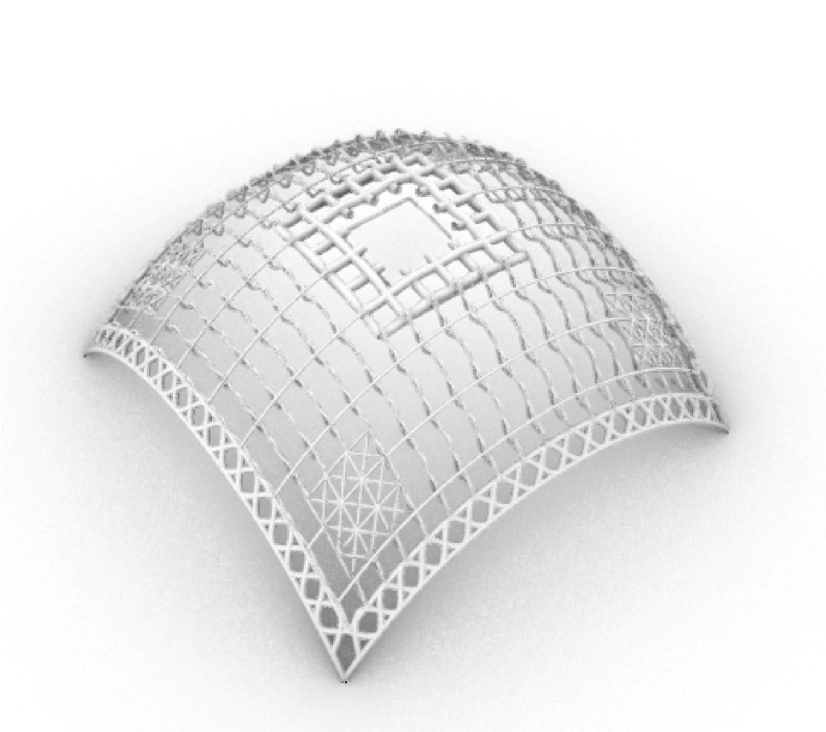
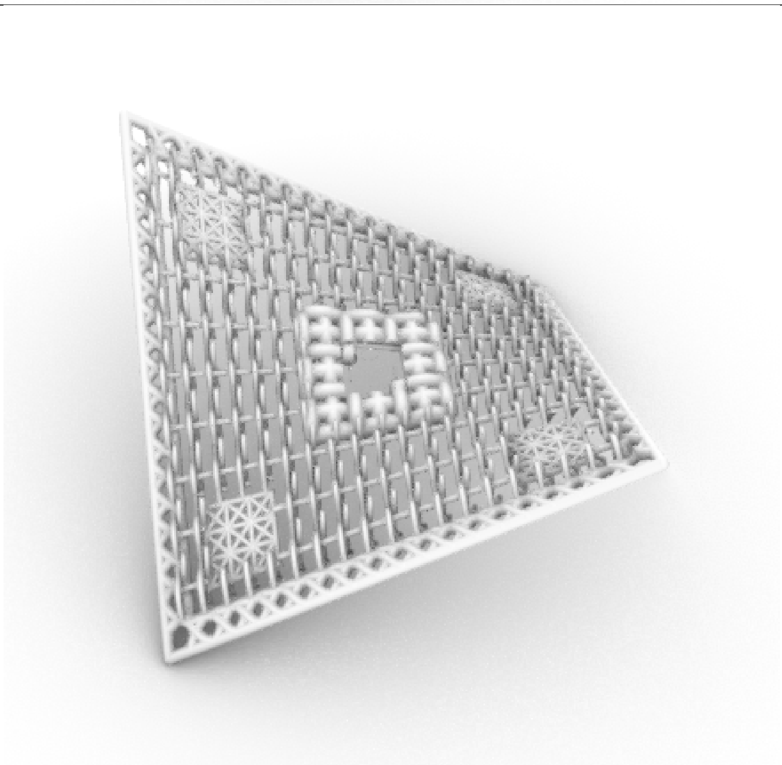
Table 7-5: *Customizable structure for different surface types*

Surface type	Generated geometry
Square	

Rectangular	
Rhombus	

Kite	
Trapezoid	

Parallelogram	
Translational surface	

Hyperbolic paraboloid	
Saddle surface	

7.8. Parametric optimization

7.8.1. Ladybug and meteorological information

Simulation-Based Engineering Science is an emerging and innovative field that utilizes advanced mathematical techniques and intricate algorithms to generate precise simulations of intricate physical behaviors in various domains, such as engineering, multiscale modeling, optimization, big data, and data-driven simulations.

By employing such simulations, the field enables engineers and scientists to effectively develop and test prototypes, identify the most optimal designs, and streamline the production process, all within a significantly reduced timeframe compared to conventional methods. Bryan Crutchfield eloquently highlights the transformative power of simulation-based engineering when he stated that Additive manufacturing allows for the rapid prototyping, testing, selection of the best design, and seamless transition into production, all in a fraction of the time required by traditional methods (Waterman,2017).

Simulation software and 3D CAD modeling tools have brought about a transformative shift in the design and engineering field. The advent of sophisticated tools, including nTopology, ANSYS, and Autodesk Within, has offered professionals an extensive array of features and capabilities. By leveraging these software applications, engineers are empowered to undertake a diverse range of operations, such as finite element analysis and thermal simulations. These functionalities enable them to not only refine and enhance their designs but also achieve substantial advancements in terms of optimization and performance.

Through the utilization of simulation software and 3D CAD modeling tools, the engineering industry has witnessed remarkable progress, as professionals are now equipped with comprehensive resources to thoroughly analyze, simulate, and optimize their designs.

7.8.1.1. Meteonorm 8 epw file description

In order to optimize the design and improve the performance of the system, the parametric system is integrated with a specific weather data file, namely the EPW file for the city of Khenchela, which is generated using Meteonorm 8. This weather data file, illustrated in **Figure 7-15 to 7-18**, is selected for the explicit purpose of conducting a simulation to analyze the optimal orientation of openings in relation to the sun's position. This integration allows for a more wide-ranging analysis, enriching the evaluation of the system's effectiveness in different weather conditions.

The primary purpose of inserting data into the system is to accurately determine the sun's path, as well as the location, latitude, temperature, and humidity for each day throughout the year. To achieve this, an algorithm is employed that calculates and analyzes the position and distance between the central point of attraction, which represents the sun, and the adaptable openings. These openings are designed to respond dynamically by adjusting their size and shape in accordance with the changing conditions.

Some of Meteonorm 8 file details include:

- Name of site = Khenchela
- Latitude [°] = 35,430, Longitude [°] = 7,149, Altitude [m] = 1121
- Climatic zone = IV, 1
- Radiation model = Default (hour); Temperature model = Default (hour)
- Diffuse radiation model = Default (hour) (Perez)
- Radiation: New period = 1996-2015
- Temperature: New period = 2000-2019
- Nearest 3 stations: Ta: Batna (89 km), Thala (139 km), Tebessa (89 km)
- Uncertainty of yearly values: Gh = 6%, Bn = 13 %, Ta = 1.1 °C
- Trend of Gh / decade = -1.9%
- Variability of Gh / year = 3.5%
- P90 and P10 of yearly Gh, referenced to average = 96.5%, 104.5%

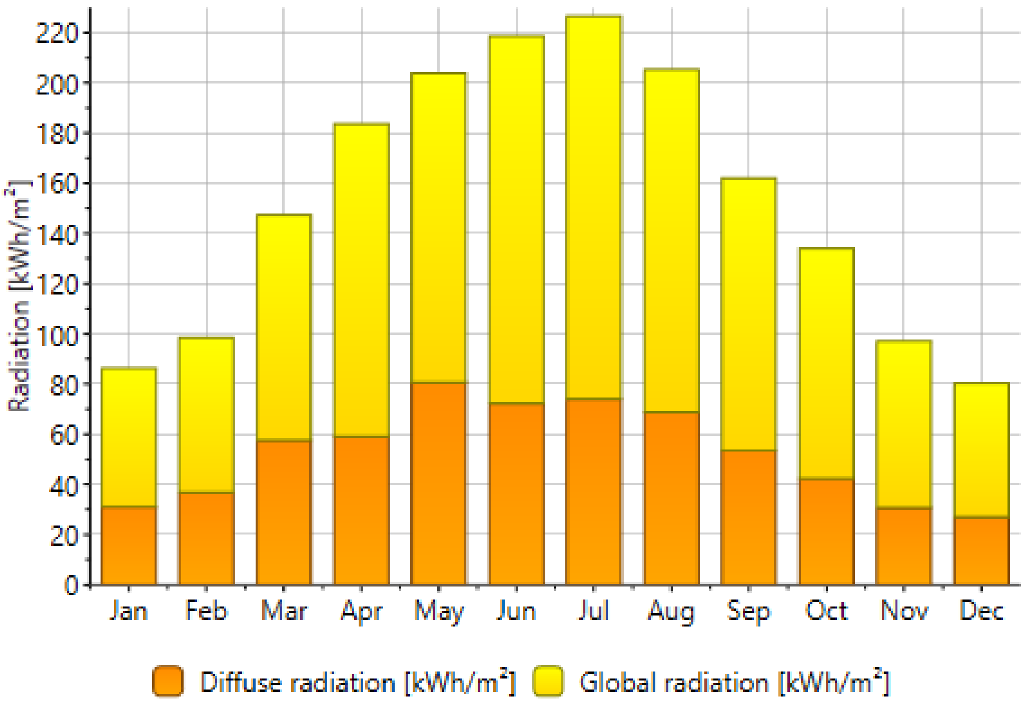


Figure 7-15. *Radiation graph for the city of khenchela (Source: Meteonorm 8).*

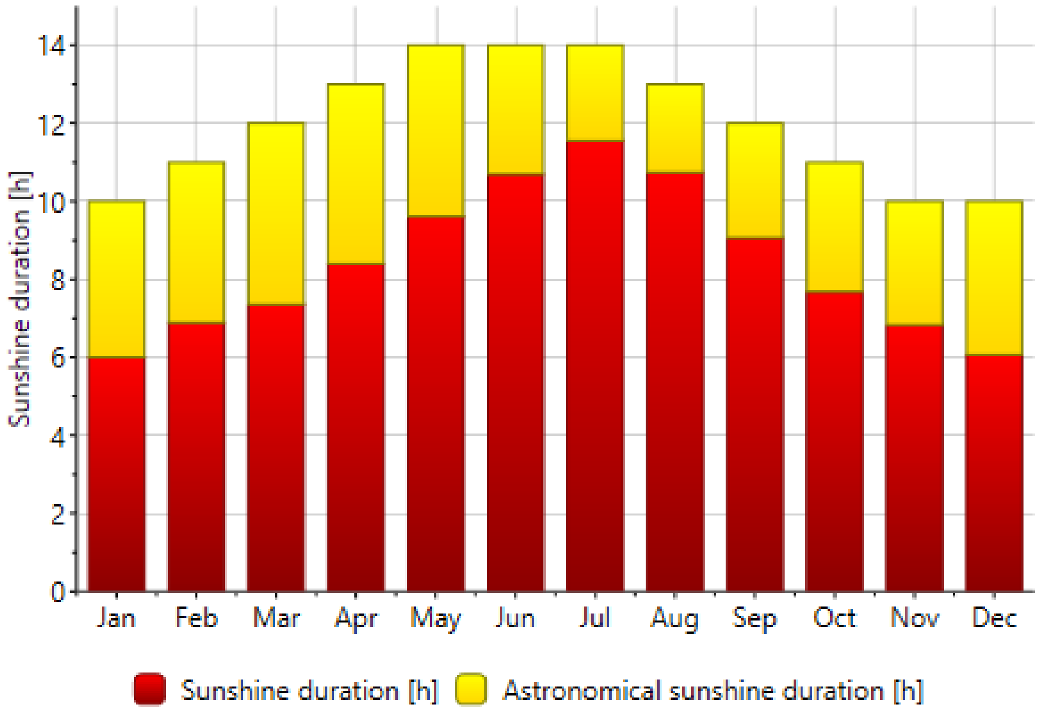


Figure 7-16. *Sunshine duration for the city of khenchela (Source: Meteonorm 8).*

	Gh kWh/m²	Dh kWh/m²	Bn kWh/m²	Ta °C	Td °C	FF m/s
January	86	31	133	6,8	0,6	2,4
February	98	37	126	7,6	0,3	2,9
March	147	58	154	11,2	2,1	3,1
April	184	59	189	14,6	4,7	3
May	204	81	179	18,9	7,6	2,8
June	219	72	207	24,3	9,1	2,8
July	227	74	216	28,2	10,2	2,9
August	205	69	202	27,2	11	2,5
September	162	54	174	22,4	11,3	2,4
October	134	42	174	18	8,3	2,3
November	97	31	153	11,7	4,2	2,5
December	80	27	139	7,9	2,1	2,1
Year	1841	634	2046	16,6	5,9	2,6

Figure 7-17. *Yearly cumulative energy (Source: Meteonorm 8).*

Legend:

H_Gh: Irradiation of global radiation horizontal

H_Bn: Irradiation of beam

H_Dh: Irradiation of diffuse radiation horizontal

N: Cloud cover fraction

Lg: Global luminance

Td: Dewpoint temperature

FF: Wind speed

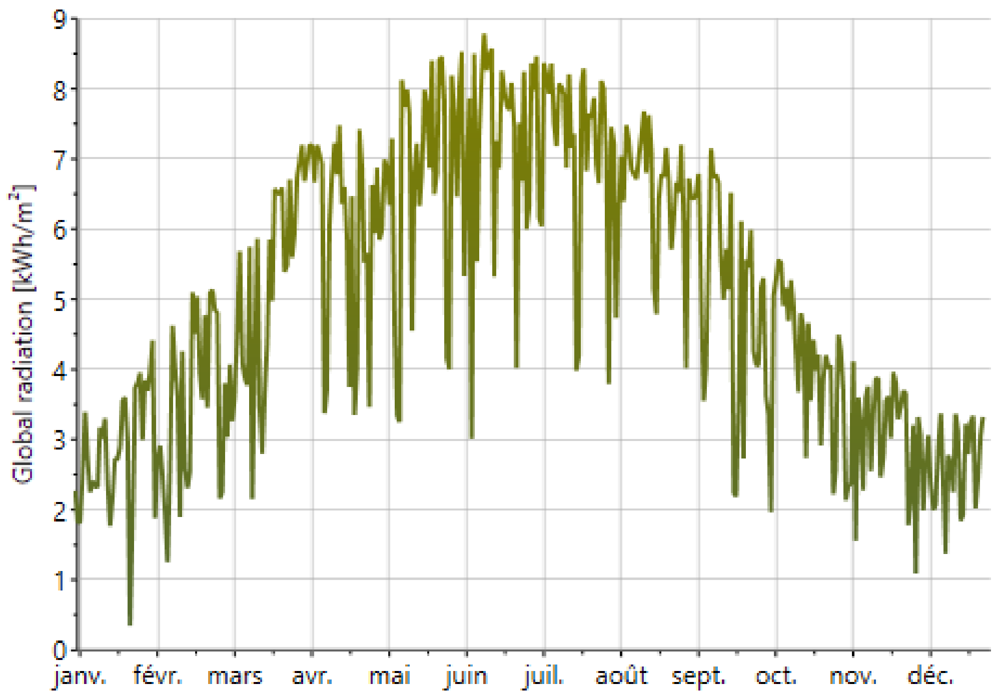


Figure 7-18. *Daily global Radiation (Source: Meteonorm 8).*

7.8.1.2. LADYBUG incident radiation component description

Python is a high-level computer programming language that serves as the foundation for the development of Ladybug, and it is widely recognized as one of the programming languages experiencing rapid growth.

The estimation of incident radiation on a specific geometry is accomplished through the utilization of the "Cumulative Sky Matrix" component. This analysis of incident radiation proves advantageous in approximating the amount of energy collected from photovoltaic or solar panels. Furthermore, it plays a pivotal role in determining how the orientation of a building impacts its overall energy performance.

Evaluating incident radiation is crucial in understanding the potential energy yield and efficiency of a given system or infrastructure. Additionally, it aids in making informed decisions regarding the placement and alignment of solar technology for optimal energy harnessing.

7.8.1.3. Sky matrix component

To gain a comprehensive understanding of the relationship between the test geometry and the sky matrix, one can utilize the "LB Sky Dome" component. This component allows for the exhibition of a detailed and complete sky matrix.

In order to conduct comprehensive studies on the size and cost of cooling systems, it is recommended to utilize a sky matrix obtained from EPW radiation. This sky matrix can provide enriched insights into the cooling system's requirements. A sky matrix derived from the STAT file's clear sky radiation should be used.

7.8.1.4. Geometry:

Geometry refers to the subject of the incident radiation analysis. It covers various representations such as rhino b-reps (Boundary Representation) or meshes. When we have access to the geometry, we can divide the grid into discrete individual points where the analysis will be conducted. This allows for a comprehensive examination of the radiation's impact and facilitates a deeper understanding of the subject.

7.8.1.5. Context:

Similar to the geometry, context in this particular case can manifest itself in the form of either boundary representations (b-reps) or meshes. It encompasses the surrounding geometries or the environment that may obstruct or impede the penetration of solar radiation onto the test geometry.

7.8.1.6. Grid size:

The dimensions of the grid cells play a significant role in dividing the submitted geometry for the purpose of incident radiation analysis. This parameter, expressed as a positive numerical value in Rhino model units, allows for a comprehensive assessment of the analysis. By reducing the size of the grid cells, the precision of the analysis increases, albeit at the cost of longer computational time. Hence, it is recommended to initially set a higher value for the grid size and subsequently make adjustments as needed to achieve optimal results.

This approach ensures that the analysis is conducted with an enriched level of accuracy and attention to detail, albeit with a more time-consuming computational process due to the increased complexity in calculations.

Ladybug undertakes a comprehensive evaluation process, meticulously examining different approaches and taking into account various perspectives for the design. The primary goal is to pinpoint the most suitable option that allows the roof to efficiently capture the highest possible quantity of solar energy.

Ladybug's computations mainly rely on the meteorological information particular to the city of Khenchela, which is made accessible through the Ladybug extension. The weather data used in the simulation is derived from Meteonorm version 8, ensuring a robust foundation for the calculations.

7.8.1.7. Site analysis

After the completion of the 3D model of the culture house (**Figure 7-19**) (which went through several changes through the years as shown in **Table 7-6**), several thorough analyses were carried out to examine the site and its surroundings in great detail. The focus of these analyses primarily revolved around two aspects: the Sky Dome of the building (**Figure 7-20**) and the Incident radiation (**Figure 7-21**).

Table 7-6: *Transformations of the culture house over the years. Source : Google time-lapse*

Year	Arial view
2003	
2007	

2009	
2013	
2016	

2020	
2023	

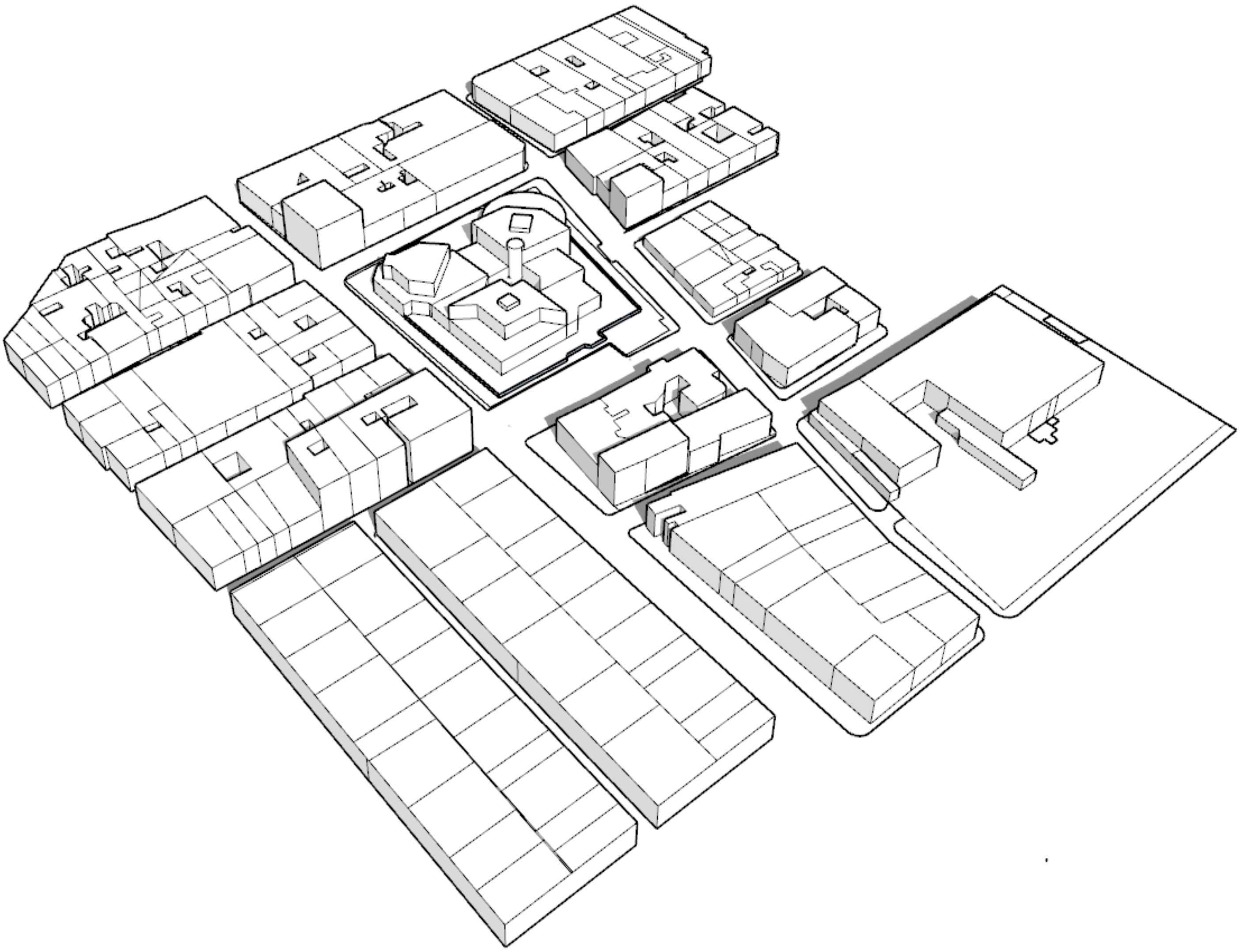


Figure 7-19. *Culture House building and its immediate surroundings (Source: Author).*

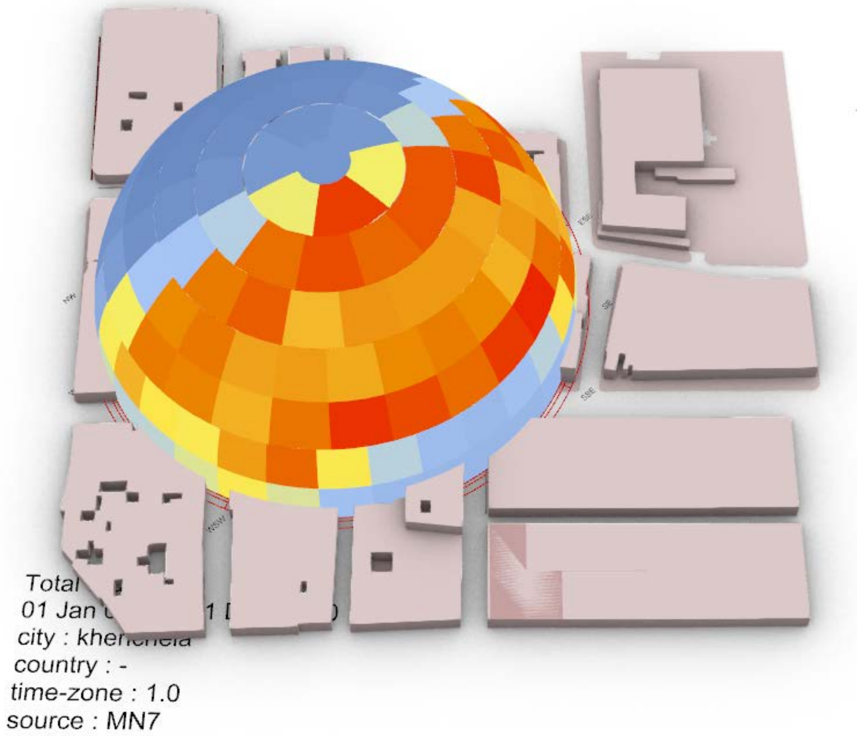


Figure 7-20. *Sky Dome of the site through the entire year (Source: Author).*

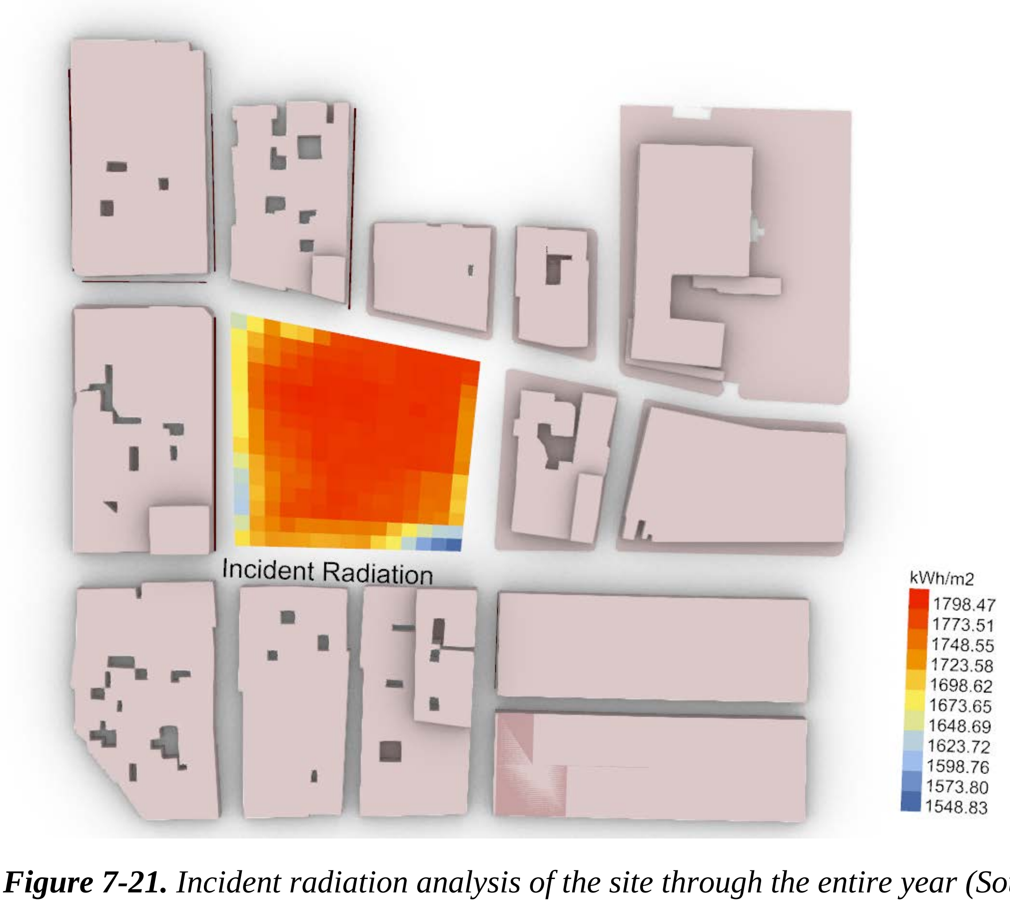


Figure 7-21. *Incident radiation analysis of the site through the entire year (Source: Author).*

7.8.2. Form finding and optimization using Ladybug and Galapagos

In the pursuit of finding the most suitable design for the culture house building, a comprehensive exploration is carried out by taking into account a blend of outcomes derived from the ladybug simulation and the subsequent optimization process suggested by the Galapagos solver, which utilizes genetic algorithms. This meticulous approach aims to ensure that the final shape chosen for the building's envelop is thoroughly examined and refined through a logical and detailed process (**Figure 7-22**). Naidja and Bourbia (2021), similarly, used generative algorithm aided design method (Rhinoceros/Grasshopper/Ladybug) to control solar access.

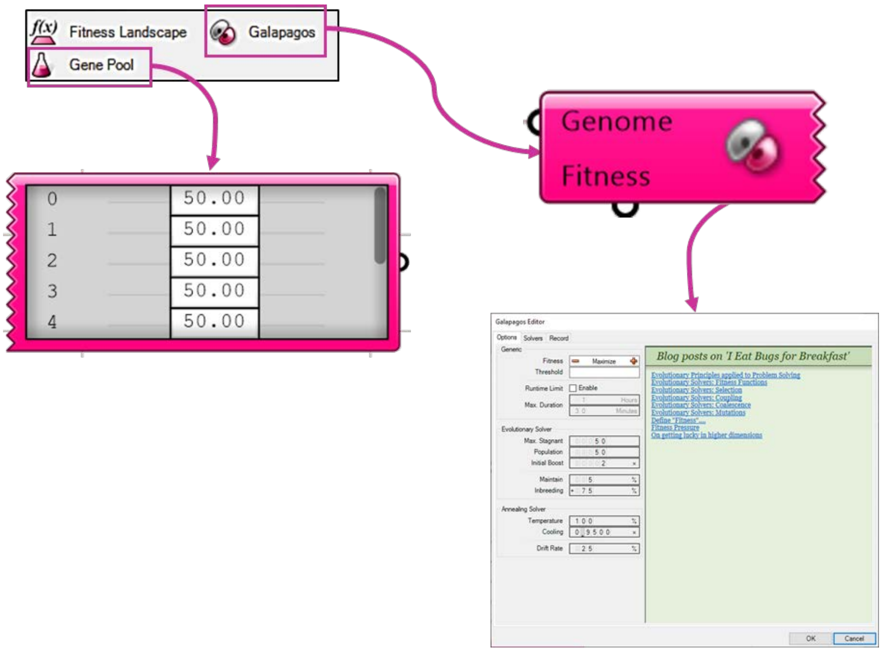


***Figure 7-22.** Galapagos solver and Gene pool (Source: Author).*

In the process of controlling the mesh shape and size in the exterior envelope of a building, control points are strategically placed based on the existing geometry. These control points serve as reference points for creating Nurbs curves. The resulting Nurbs curves are then used to generate the mesh for the building's exterior envelope (**Figure 7-23**). This approach provides a high level of control over various mesh parameters, allowing for precise adjustments to the mesh shape and size. Furthermore, by connecting the Z vector component of the control points to a solver, it becomes possible to manipulate the points in the vertical (Z) direction within a specific domain. This feature enables further control over the height or elevation of the mesh points, aligning them with the desired design intent.

However, it is important to note that the number of control points directly influences the computational load on the Galapagos software, which is responsible for optimizing the mesh.

The more control points there are to manage, the longer it takes for Galapagos to perform the necessary computations. Therefore, a balance needs to be struck between the level of control desired and the computational efficiency required taking account of the results of Ladybug analysis (**Figure 7-24 and 7-25**).

(a)

(b)

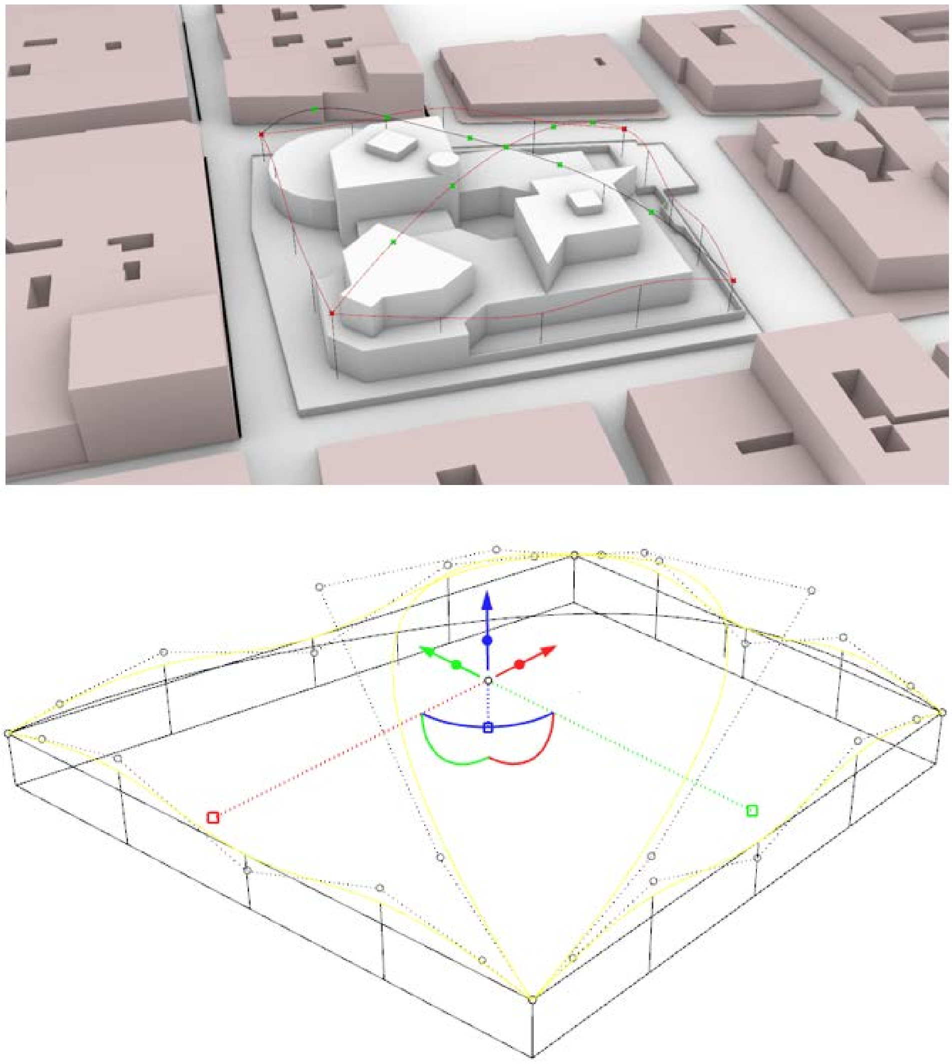


Figure 7-23. *(a) Control points used for creating NURBS curves and thus generating and manipulating the NURBS surface, (b) Isolated NURBS curves with control points (Source: Author).*

Thus, the highlighted objective can be one of the following:

- Maximizing the total incident radiation of the mesh.
- Maximizing the incident radiation of each grid cell.
- Maximizing the result of the equation (WIR-SIR) to achieve a balanced performance. Whereas *WIR* is the winter incident radiation and *SIR* is summer incident radiation.

Any objective to be chosen will alter the mesh differently.

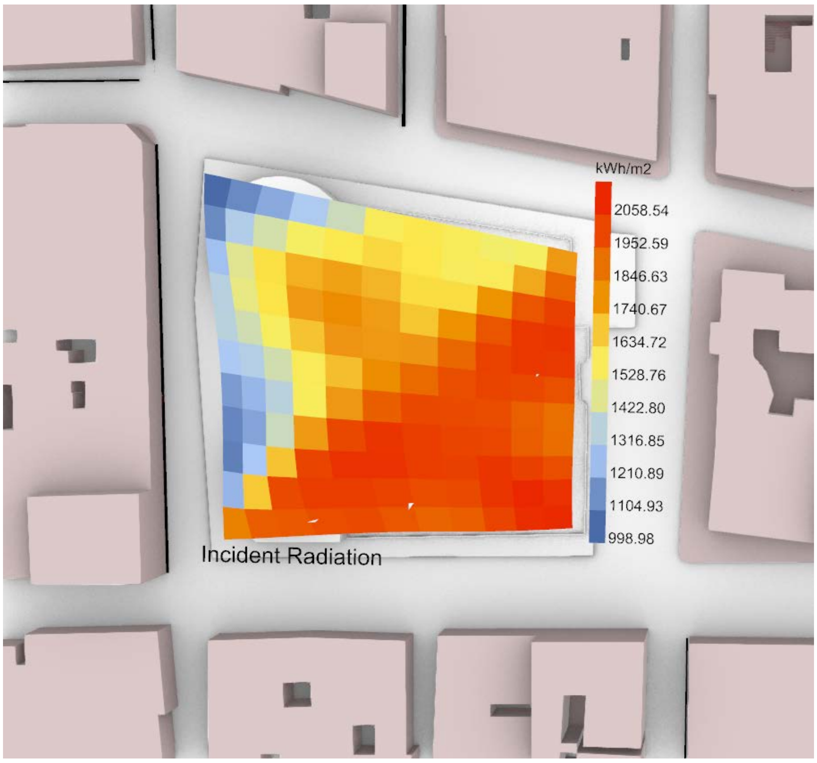


Figure 7-24. *Incident radiation analysis of initial form and before optimization (Source: Author).*

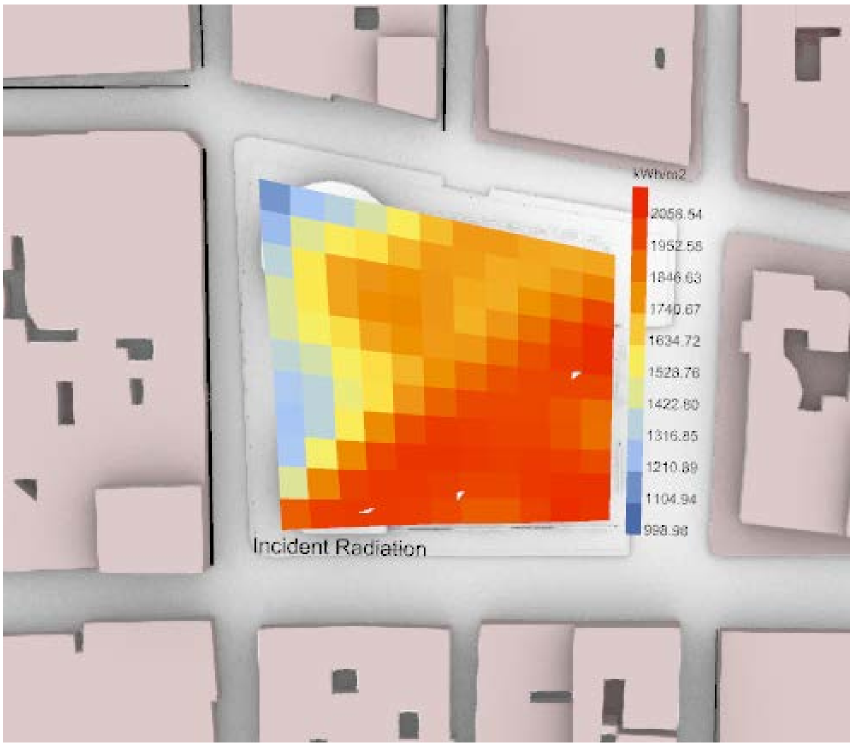


Figure 7-25. *Incident radiation analysis of the optimized form (Source: Author).*

Table 7-7: *Incident radiation analysis comparison between the initial form and the optimized form.*

Test point	Initial form Incident radiation (Kwh/m²)	Initial form Incident radiation (Cell value)	Optimized form Incident radiation (Kwh/m²)	Optimized form Incident radiation (Cell value)	Difference	Optimization percentage %
1	1715,284618	84048,94628	1690,986773	82858,35188	-1190,594405	/
2	1875,971311	91922,59424	1799,098198	88155,8117	-3766,782537	/
3	1975,194398	96784,5255	1954,379792	95764,60981	-1019,915694	/
4	2011,66763	98571,71387	2036,624916	99794,62088	1222,907014	1,23
5	1990,349318	97527,11658	2031,183568	99527,99483	2000,87825	2,01
6	1925,621983	94355,47717	1958,120447	95947,9019	1592,424736	1,66
7	1850,825594	90690,45411	1861,50282	91213,63818	523,184074	0,57
8	1853,204263	90807,00889	1855,168083	90903,23607	96,22718	0,11
9	1929,886728	94564,44967	1942,196861	95167,64619	603,196517	0,63
10	2016,318647	98799,6137	2020,118383	98985,80077	186,187064	0,19
11	2040,003128	99960,15327	2013,337157	98653,52069	-1306,632579	/
12	1489,479596	72984,5002	1681,787833	82407,60382	9423,103613	11,43
13	1686,434414	82635,28629	1723,267229	84440,09422	1804,807935	2,14
14	1912,328082	93704,07602	1845,437065	90426,41619	-3277,659833	/
15	2001,72789	98084,66661	1956,879794	95887,10991	-2197,556704	/
16	1995,079305	97758,88595	1989,754887	97497,98946	-260,896482	/
17	1942,922282	95203,19182	1960,86426	96082,34874	879,156922	0,92
18	1886,630505	92444,89475	1919,167215	94039,19354	1594,29879	1,70
19	1893,102609	92762,02784	1924,156752	94283,68085	1521,653007	1,61
20	1978,10879	96927,33071	1981,743669	97105,43978	178,109071	0,18
21	2058,544343	100868,6728	2022,998249	99126,9142	-1741,758606	/
22	2029,594411	99450,12614	2024,577388	99204,29201	-245,834127	/
23	1464,868112	71778,53749	1690,290229	82824,22122	11045,68373	13,34
24	1531,96164	75066,12036	1684,560476	82543,46332	7477,342964	9,06
25	1737,389089	85132,06536	1745,226484	85516,09772	384,032355	0,45
26	1914,595383	93815,17377	1850,808983	90689,64017	-3125,5336	/
27	1970,494486	96554,22981	1927,094442	94427,62766	-2126,602156	/
28	1959,093788	95995,59561	1951,152502	95606,4726	-389,123014	/
29	1934,756308	94803,05909	1952,959021	95694,99203	891,932937	0,93
30	1949,452343	95523,16481	1968,556389	96459,26306	936,098254	0,97
31	2005,91058	98289,61842	1994,059539	97708,91741	-580,701009	/
32	2007,683664	98376,49954	1995,475533	97778,30112	-598,198419	/
33	1955,981256	95843,08154	1970,356453	96547,4662	704,384653	0,73
34	1524,351797	74693,23805	1714,434439	84007,28751	9314,049458	11,09
35	1515,95855	74281,96895	1680,899471	82364,07408	8082,105129	9,81
36	1602,373477	78516,30037	1678,5144	82247,2056	3730,905227	4,54
37	1743,626169	85437,68228	1733,844392	84958,37521	-479,307073	/
38	1872,177759	91736,71019	1844,807223	90395,55393	-1341,156264	/

39	1931,286612	94633,04399	1927,420804	94443,6194	-189,424592	/
40	1938,903431	95006,26812	1952,161008	95655,88939	649,621273	0,68
41	1958,459865	95964,53339	1971,071751	96582,5158	617,982414	0,64
42	1976,36766	96842,01534	1986,707694	97348,67701	506,661666	0,52
43	1939,557893	95038,33676	1959,093582	95995,58552	957,248761	1,00
44	1893,013054	92757,63965	1908,258879	93504,68507	747,045425	0,80
45	1565,455496	76707,3193	1716,164974	84092,08373	7384,764422	8,78
46	1582,074937	77521,67191	1702,596496	83427,2283	5905,556391	7,08
47	1602,572433	78526,04922	1682,342727	82434,79362	3908,744406	4,74
48	1638,143225	80269,01803	1672,360979	81945,68797	1676,669946	2,05
49	1729,62003	84751,38147	1727,941116	84669,11468	-82,266786	/
50	1864,622697	91366,51215	1861,843334	91230,32337	-136,188787	/
51	1943,772092	95244,83251	1948,598264	95481,31494	236,482428	0,25
52	1987,019619	97363,96133	1987,347473	97380,02618	16,064846	0,02
53	1988,035953	97413,7617	1997,899305	97897,06595	483,304248	0,49
54	1934,067486	94769,30681	1958,5472	95968,8128	1199,505986	1,25
55	1877,489526	91996,98677	1901,790443	93187,73171	1190,744933	1,28
56	1517,77541	74370,99509	1654,82894	81086,61806	6715,62297	8,28
57	1609,972204	78888,638	1710,700205	83824,31005	4935,672049	5,89
58	1667,178524	81691,74768	1727,947191	84669,41236	2977,664683	3,52
59	1705,438258	83566,47464	1725,212256	84535,40054	968,925902	1,15
60	1714,405515	84005,87024	1715,049028	84037,40237	31,532137	0,04
61	1759,45862	86213,47238	1751,672764	85831,96544	-381,506944	/
62	1890,57471	92638,16079	1878,550497	92048,97435	-589,186437	/
63	2009,095707	98445,68964	1993,336708	97673,49869	-772,190951	/
64	2019,268209	98944,14224	2013,782994	98675,36671	-268,775535	/
65	1963,376989	96205,47246	1981,848803	97110,59135	905,118886	0,93
66	1914,92085	93831,12165	1946,068403	95357,35175	1526,230097	1,60
67	1375,976861	67422,86619	1522,784017	74616,41683	7193,550644	9,64
68	1564,38254	76654,74446	1665,145076	81592,10872	4937,364264	6,05
69	1696,666329	83136,65012	1745,279119	85518,67683	2382,02671	2,79
70	1763,855238	86428,90666	1775,435076	86996,31872	567,412062	0,65
71	1733,192996	84926,4568	1741,032886	85310,61141	384,15461	0,45
72	1651,680143	80932,32701	1666,418257	81654,49459	722,167586	0,88
73	1724,245676	84488,03812	1734,927126	85011,42917	523,39105	0,62
74	1945,482779	95328,65617	1929,784795	94559,45496	-769,201216	/
75	2021,926945	99074,42031	2006,311927	98309,28442	-765,135882	/
76	1978,492762	96946,14534	1998,01449	97902,71001	956,564672	0,98
77	1940,835284	95100,92892	1980,346367	97036,97198	1936,043067	2,00
78	1256,945225	61590,31603	1402,284128	68711,92227	7121,606247	10,36
79	1482,705331	72652,56122	1596,660354	78236,35735	5583,796127	7,14
80	1672,967246	81975,39505	1730,530564	84795,99764	2820,602582	3,33
81	1714,808553	84025,6191	1757,122259	86098,99069	2073,371594	2,41
82	1641,0736	80412,6064	1692,128351	82914,2892	2501,682799	3,02
83	1531,801835	75058,28992	1599,676237	78384,13561	3325,845698	4,24

84	1515,189877	74244,30397	1594,803161	78145,35489	3901,050916	4,99
85	1713,60812	83966,79788	1764,48366	86459,69934	2492,90146	2,88
86	1959,129682	95997,35442	1952,420239	95668,59171	-328,762707	/
87	1984,46459	97238,76491	1999,841683	97992,24247	753,477557	0,77
88	1931,685116	94652,57068	1991,301887	97573,79246	2921,221779	2,99
89	1165,228845	57096,21341	1311,522908	64264,62249	7168,409087	11,15
90	1395,214579	68365,51437	1531,277997	75032,62185	6667,107482	8,89
91	1597,921095	78298,13366	1692,827727	82948,55862	4650,424968	5,61
92	1590,8611	77952,1939	1693,331075	82973,22268	5021,028775	6,05
93	1499,375524	73469,40068	1601,741339	78485,32561	5015,924935	6,39
94	1389,319214	68076,64149	1499,925464	73496,34774	5419,70625	7,37
95	1314,847292	64427,51731	1447,846782	70944,49232	6516,97501	9,19
96	1372,975821	67275,81523	1527,895151	74866,8624	7591,04717	10,14
97	1642,143707	80465,04164	1772,487124	86851,86908	6386,827433	7,35
98	1942,316226	95173,49507	1970,524596	96555,7052	1382,21013	1,43
99	1904,840013	93337,16064	1990,261998	97522,8379	4185,677265	4,29
100	1091,231726	53470,35457	1228,845782	60213,44332	6743,088744	11,20
101	1276,189943	62533,30721	1418,968016	69529,43278	6996,125577	10,06
102	1422,08256	69682,04544	1559,571284	76418,99292	6736,947476	8,82
103	1440,139518	70566,83638	1562,116204	76543,694	5976,857614	7,81
104	1386,577349	67942,2901	1489,137658	72967,74524	5025,455141	6,89
105	1285,761568	63002,31683	1393,314482	68272,40962	5270,092786	7,72
106	1196,739757	58640,24809	1325,869731	64967,61682	6327,368726	9,74
107	1154,823723	56586,36243	1328,040817	65074,00003	8487,637606	13,04
108	1236,568989	60591,88046	1466,730915	71869,81484	11277,93437	15,69
109	1633,625179	80047,63377	1793,53965	87883,44285	7835,809079	8,92
110	1894,079994	92809,91971	1984,119181	97221,83987	4411,920163	4,54
111	998,975263	48949,78789	1120,869273	54922,59438	5972,80649	10,87
112	1093,506267	53581,80708	1205,228981	59056,22007	5474,412986	9,27
113	1218,104169	59687,10428	1330,338397	65186,58145	5499,477172	8,44
114	1303,526391	63872,79316	1407,413879	68963,28007	5090,486912	7,38
115	1312,696197	64322,11365	1406,334271	68910,37928	4588,265626	6,66
116	1243,116644	60912,71556	1339,702198	65645,4077	4732,692146	7,21
117	1135,347313	55632,01834	1256,483579	61567,69537	5935,677034	9,64
118	1079,78203	52909,31947	1227,612493	60153,01216	7243,692687	12,04
119	1061,374525	52007,35173	1245,444992	61026,80461	9019,452883	14,78
120	1193,017228	58457,84417	1414,570827	69313,97052	10856,12635	15,66
121	1796,357225	88021,50403	1893,093342	92761,57376	4740,069733	5,11
Total	204940,665	10042092,58	211821,2549	10379241,49	337148,9076	3,25

Note: The grid size dimensions used in the test are 7x7m, that means that the surface of a grid cell equals 49m². Thus, to acquire the total incident radiation of the test cell, the incident radiation of the square meter is multiplied by 49.

The optimization test conducted using Ladybug and Galapagos yielded insightful results. The analysis in **Table 7-7 and Figure 7-26** revealed that an impressive 78.51% of the test points showed improvements in the newly generated form compared to the previous version. This optimization allowed for a significant total gain of 3.25%, which translates to an additional 6880.59 Kwh/m^2 of solar energy obtained yearly.

A 10W LED bulb that is used 8 hours per day uses 29200 watts or 29,2 kWh per year (0.01 kWh * 8h * 365d = 29.2 kWh/year), that means additional energy obtained from the optimization alone can supply more than 235 unit of 10W LED bulbs (6880.59/29.2).

Harnessing additional energy through the optimization of the structure will result in an ample supply to meet the artificial lighting requirements of various areas within the culture house. This includes the 17 workshops, the club, a lecture hall with a seating capacity of 512, and an exhibition hall. The optimized design ensures that sufficient energy is produced to cater to the artificial lighting needs and it can be, also harnessed for other uses.

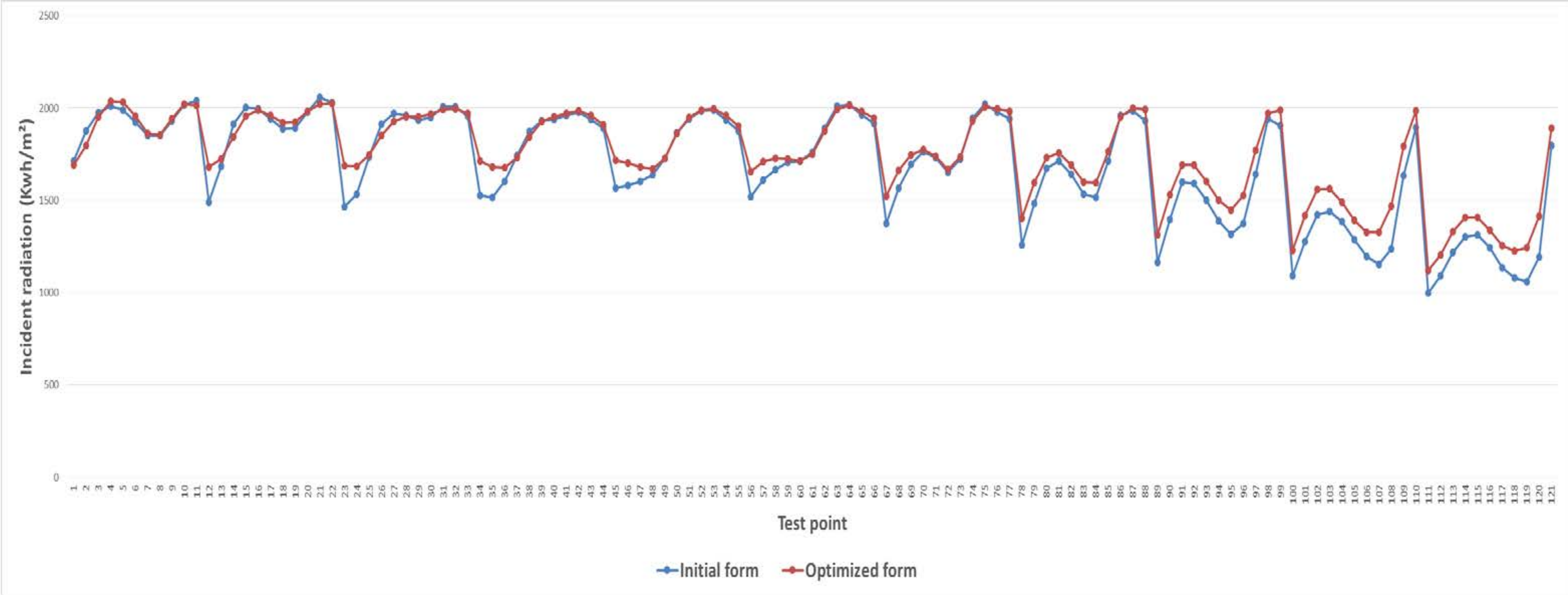
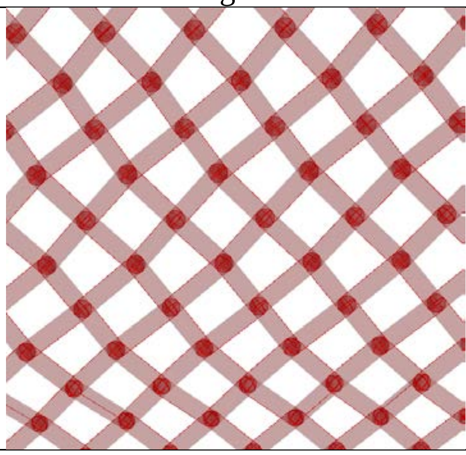


Figure 7-26. *Optimization graph (Source: Author).*

7.8.2.1. Transposed grids method

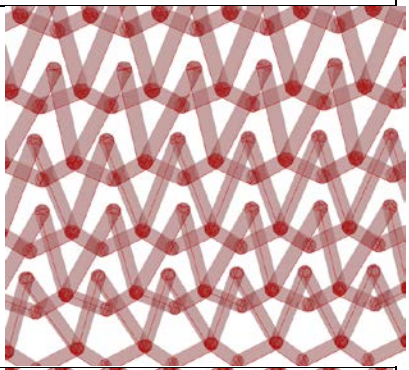
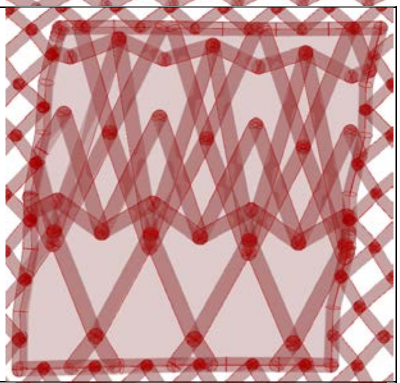
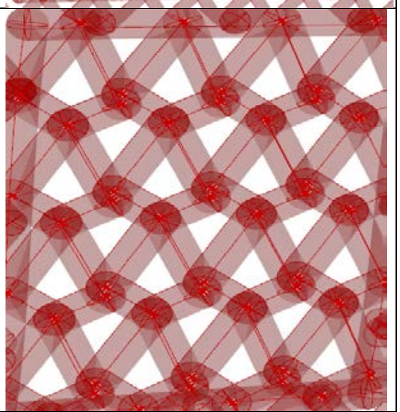
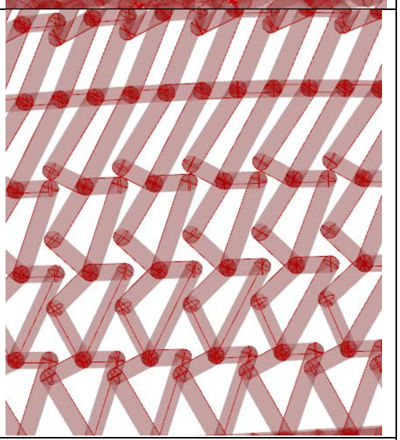
The Transposed grids method offers a versatile approach for creating a wide range of geometries and configurations. To implement this method effectively, four grids featuring distinct domains were utilized to establish the generation grid. Subsequently, the movements of each point in the U and V directions were precisely controlled, guided by the outcomes derived from the fusion of different mathematical formulas. This comprehensive technique explores into the intricacies of the Transposed grids method, providing an understanding of its application and the systematic control of grid points as shown in **Table 7-8** and **Table 7-9**.

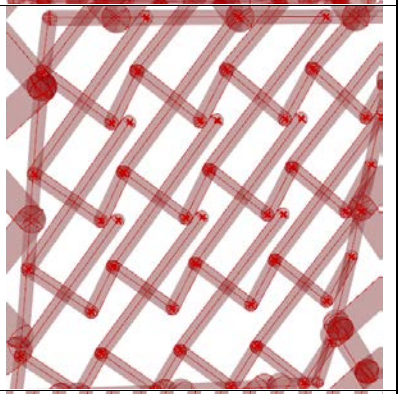
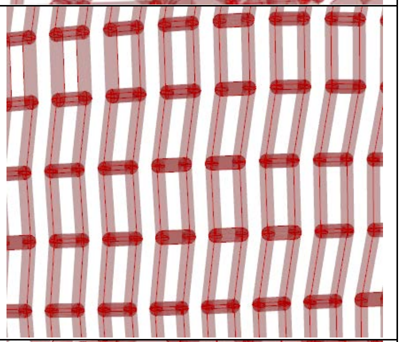
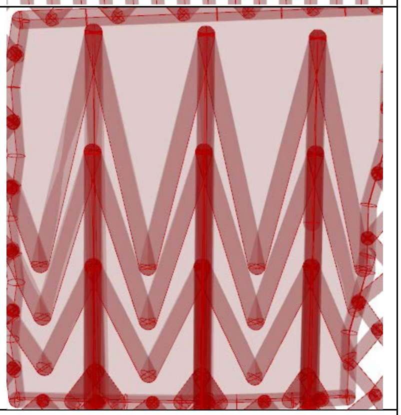
Table 7-8: *The initial transposed grids*

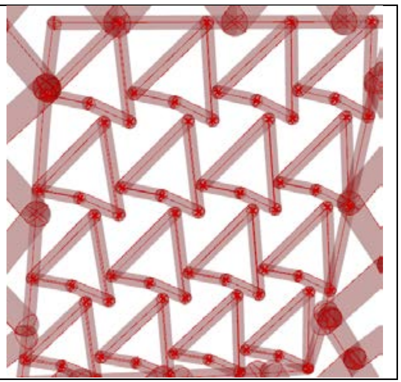
Grid ID	Translation		Configuration
	U	V	
01	X+0.5	Y	
02	X	Y+0.5	
03	X+0.5	Y+1	
04	X+1	Y+0.5	

As mentioned earlier, the precise control over the arrangements of each point in the U and V directions was accomplished by utilizing the results derived from the integration of various mathematical formulas. This fusion of mathematical formulas not only guided the movements but also ensured the accuracy and effectiveness of the control mechanism (**Figure 7-27 to Figure 7-35**).

Table 7-9: *The integration of various mathematical formulas for form generation*

Variant	Component	Grid ID	Translation		Configuration
I	Bedding (alfirash)		U	V	
		01	X+0.5	Y-0.8	
		02	X	Y+0.5	
		03	X+0.5	$\sqrt{Y}$ *0.2	
		04	X+1	Y+0.5	
	The mihrab	01	X+0.5	$\cos Y$*1.5	
		02	X	Y+0.5	
		03	X+0.5	$sinY$ *0.2	
		04	X+1	Y+0.5	
	Almusharaf	01	X+0.2	Y	
		02	X	Y+0.5	
		03	X+0.3	Y+1	
		04	X+1	Y+0.5	
II	Bedding (alfirash)		U	V	
		01	X	Y-1	
		02	X-0.5	Y	
		03	X	Y	
		04	X+0.5	Y-0.2*Y	
	The mihrab	01	X+0.5	Y+Y*1.5	
		02	X	Y+0.5	
		03	X+0.5	Y	

		04	X+1	Y+0.5	
	Almusharaf	01	X+0.5	Y	
		02	X	Y+0.2	
		03	X+0.5	Y+1	
		04	N/A	N/A	
III	Bedding (alfirash)		U	V	
		01	X	Y	
		02	X	Y+1	
		03	X+0.5	Y+1	
		04	X+0.5	Y	
	The mihrab	01	X+0.5	Y-Y*0.5	
		02	X	Y+0.5	
		03	X+0.5	Y*(-0.2)	
		04	X+1	Y+0.5	
	Almusharaf	01	X	Y	
		02	X+0.2	Y+0.5	
		03	X+0.3	Y+1	

		04	X+1	Y+0.3	

Thus, we get the following results:

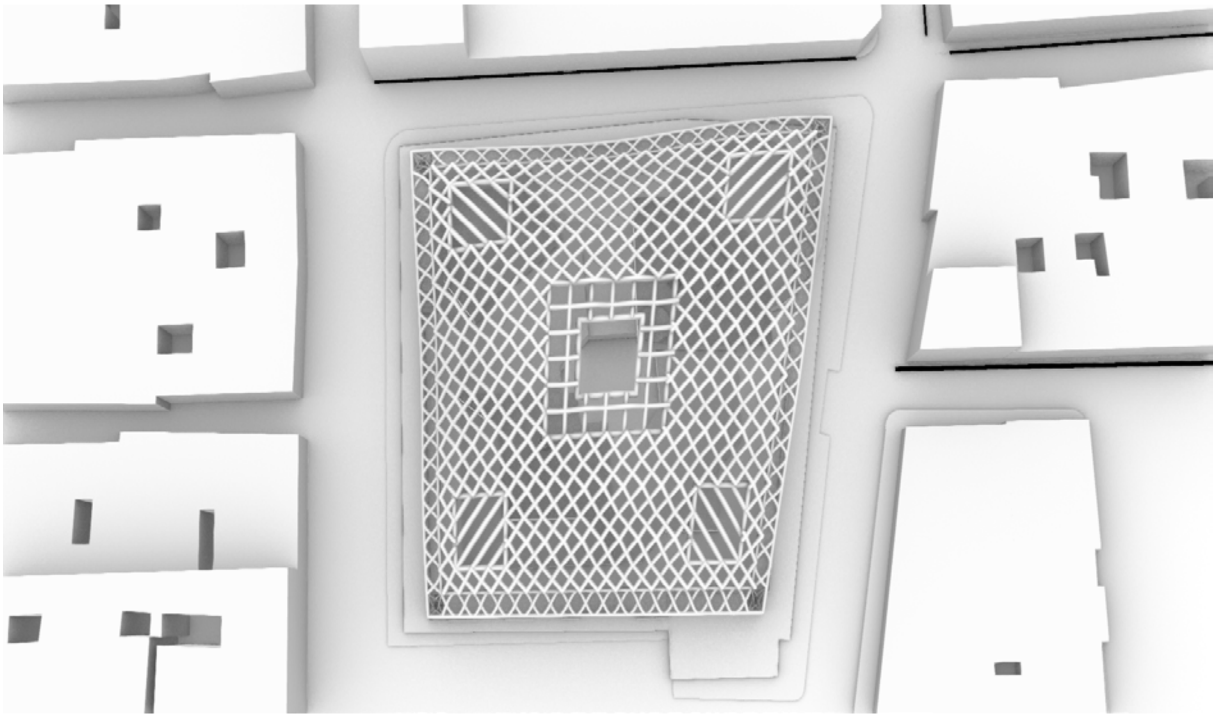


Figure 7-27. *Upper view (Source: Author).*

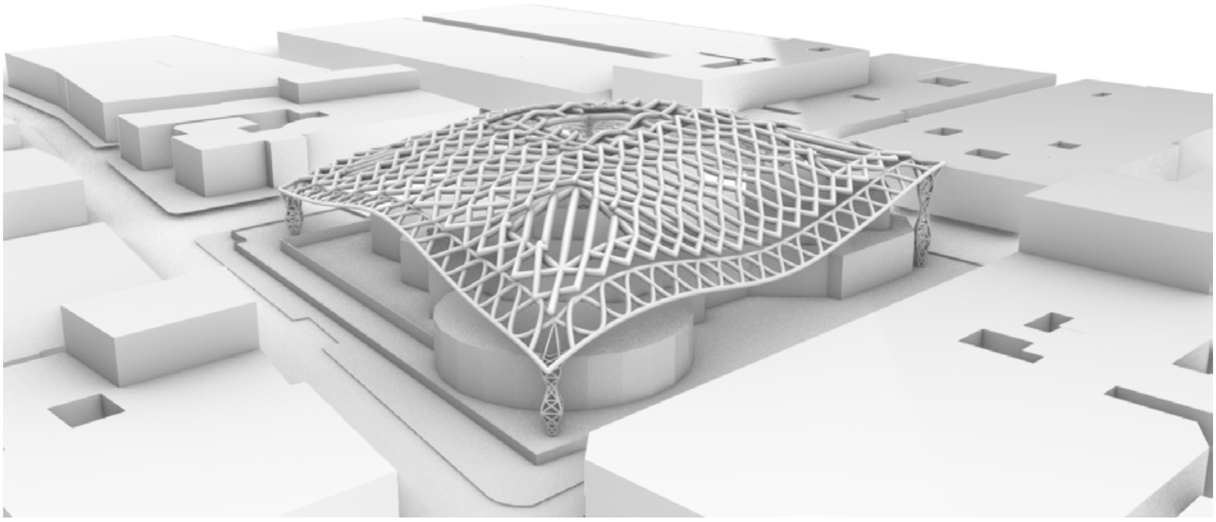


Figure 7-28. *Perspective view 01 (Source: Author).*

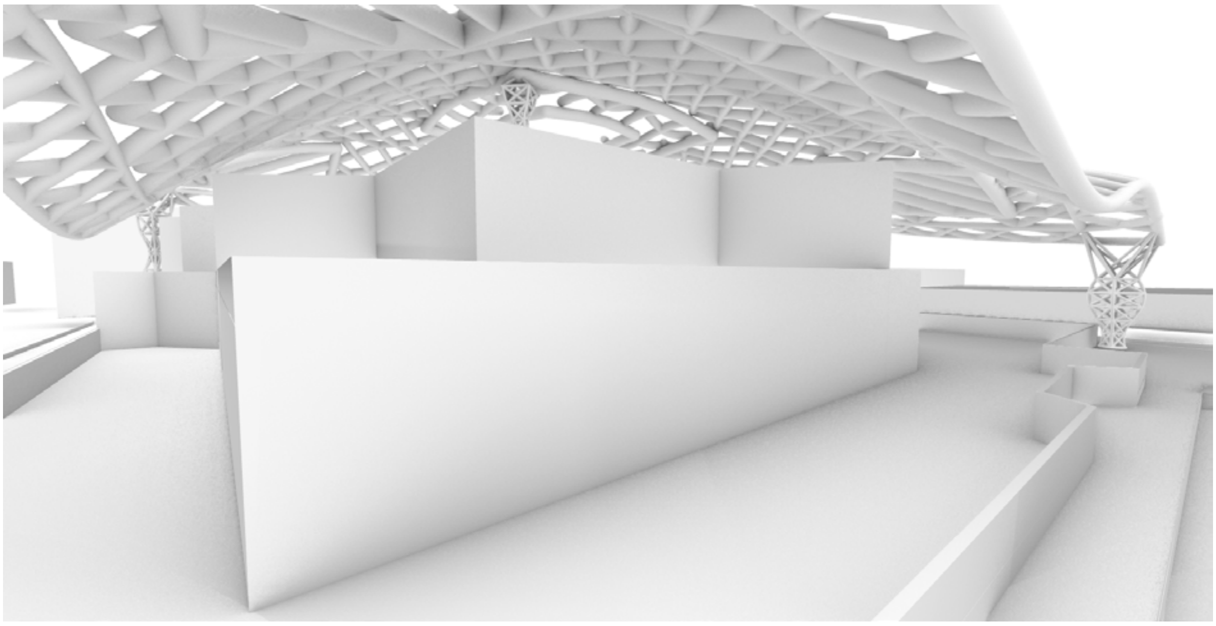


Figure 7-29. *Perspective view 02 (Source: Author).*

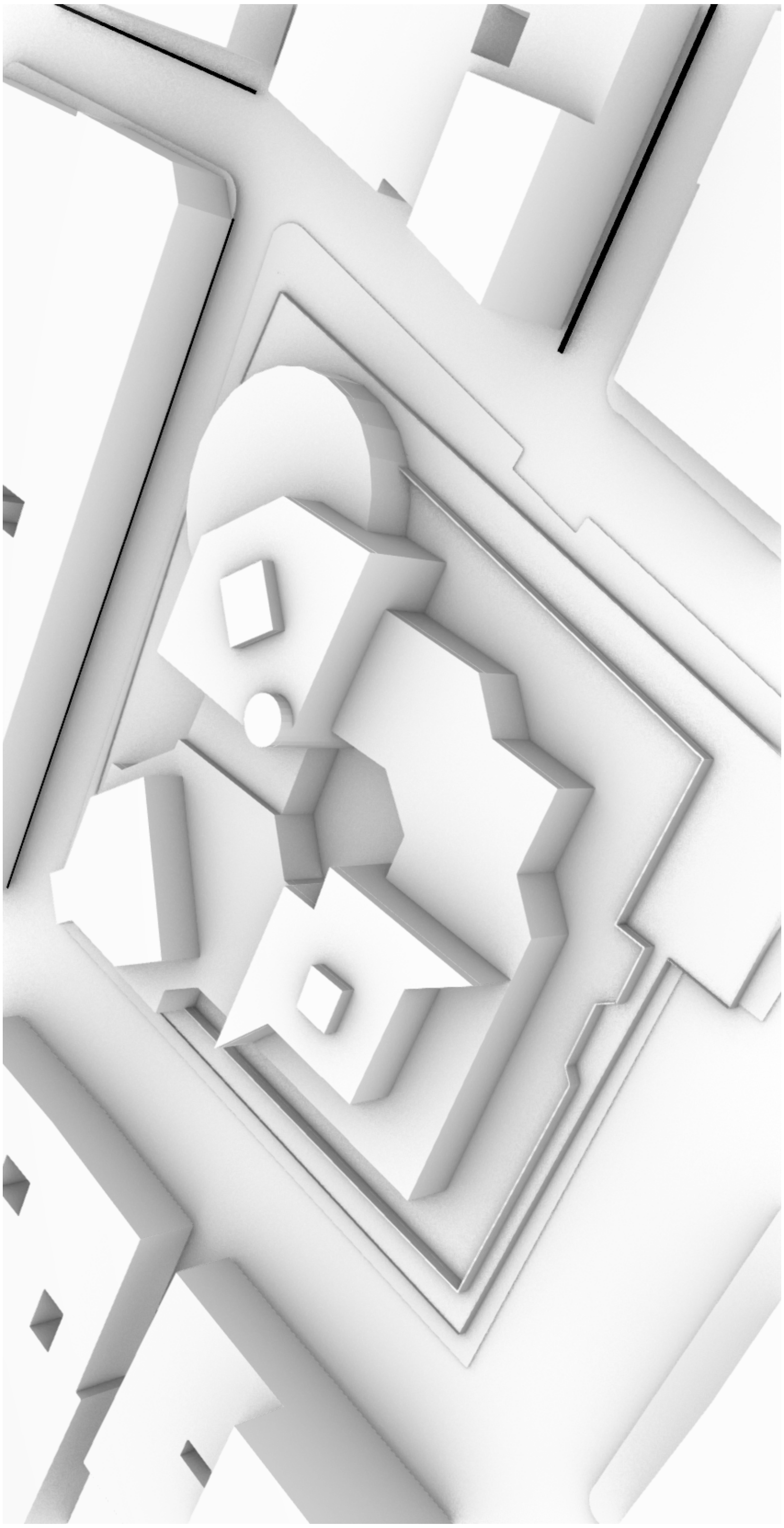


Figure 7-30. *Culture house 3D model (Source: Author).*

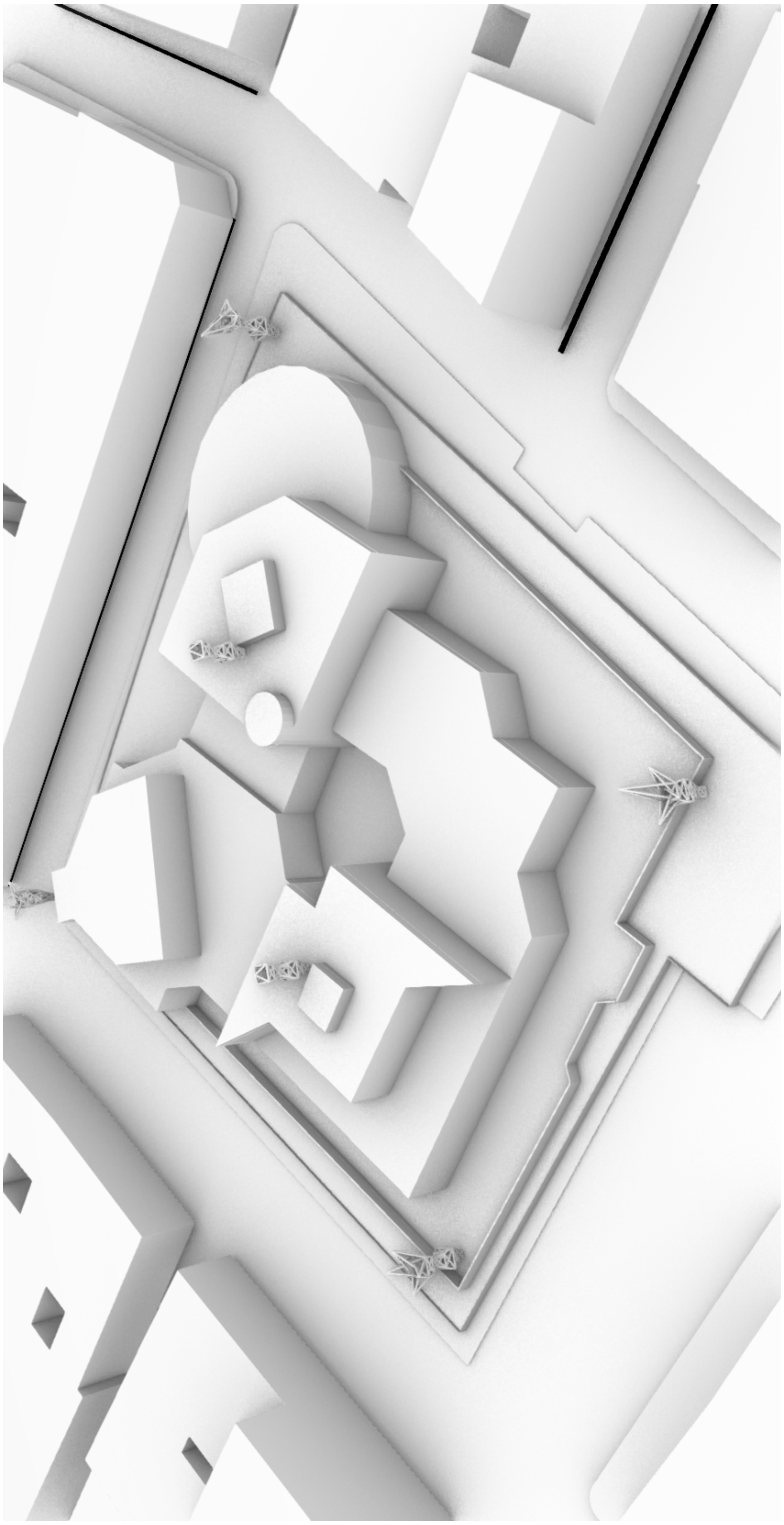


Figure 7-31. *Parametric structural bearing system (Source: Author).*

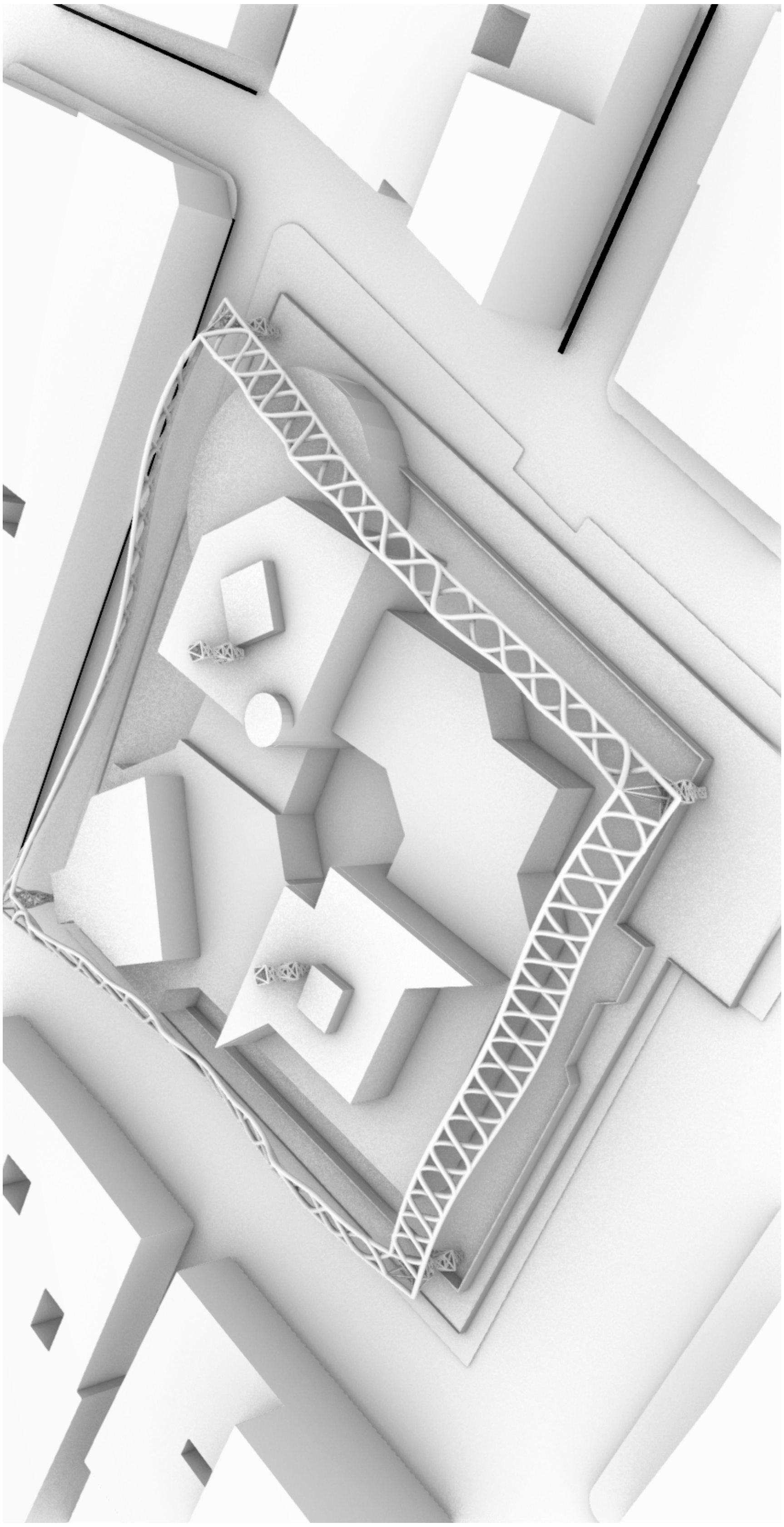


Figure 7-32. *The border (Source: Author).*

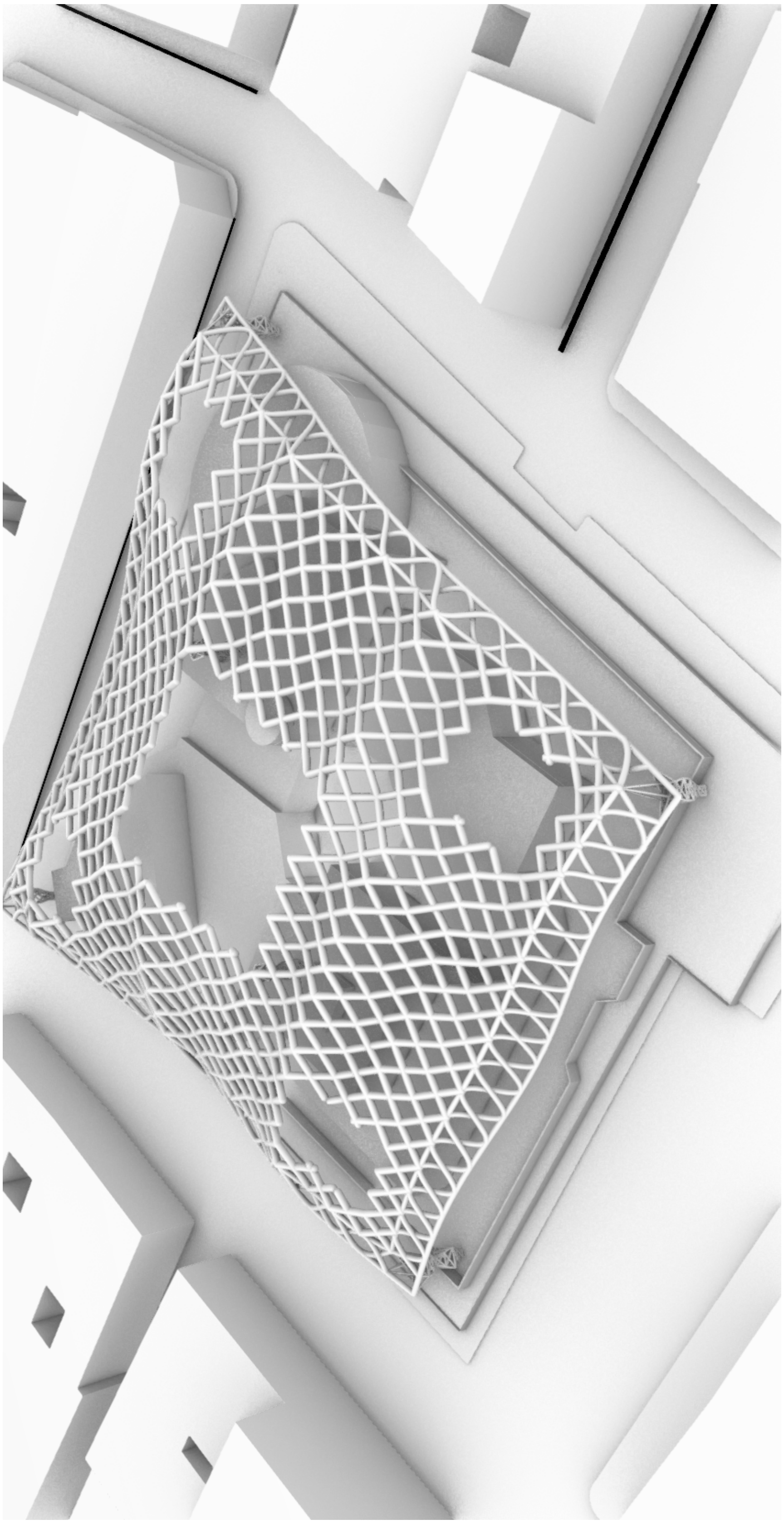


Figure 7-33. *Bedding (alfirash) (Source: Author).*

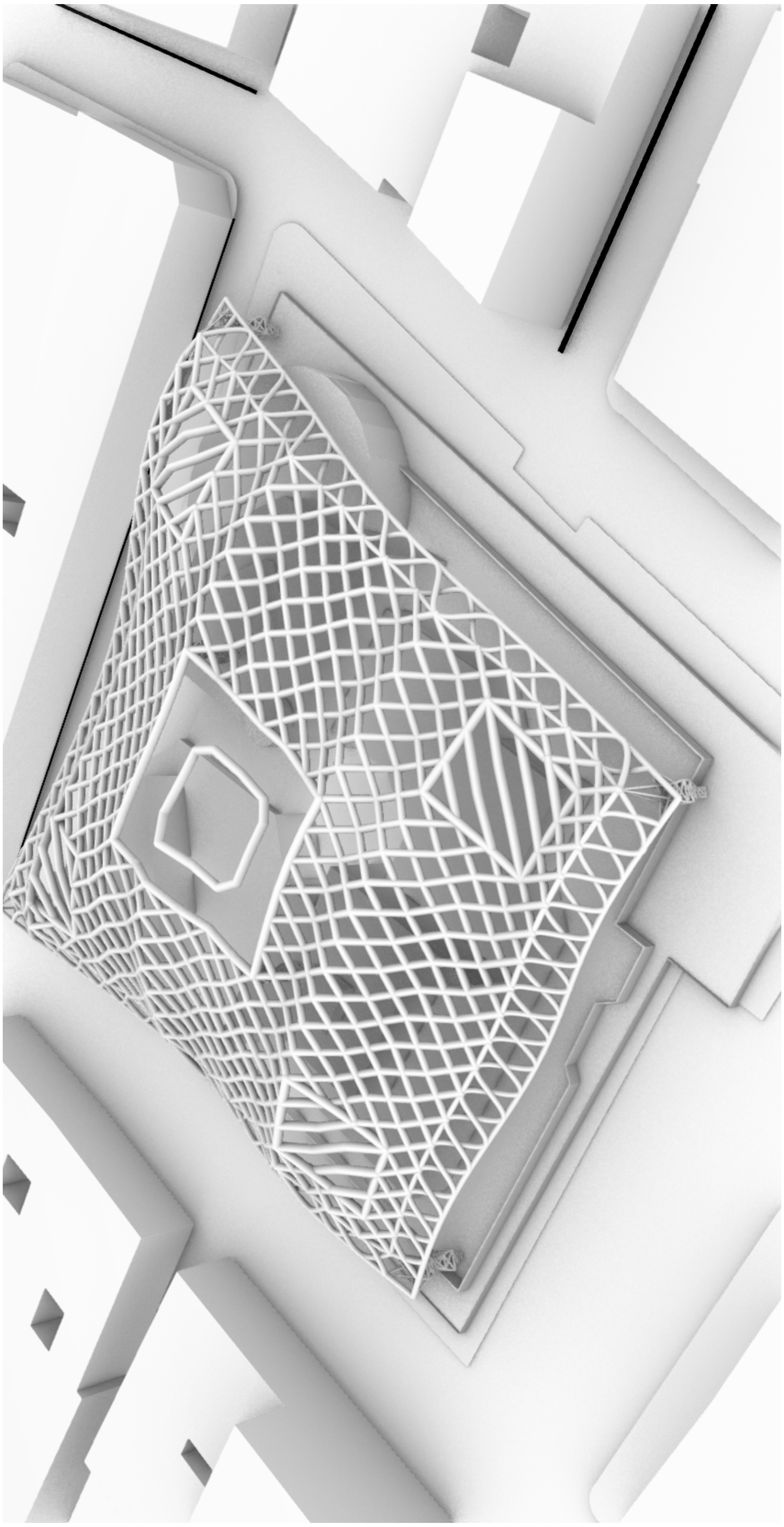


Figure 7-34. *Bedding including Almusharaf (Source: Author).*

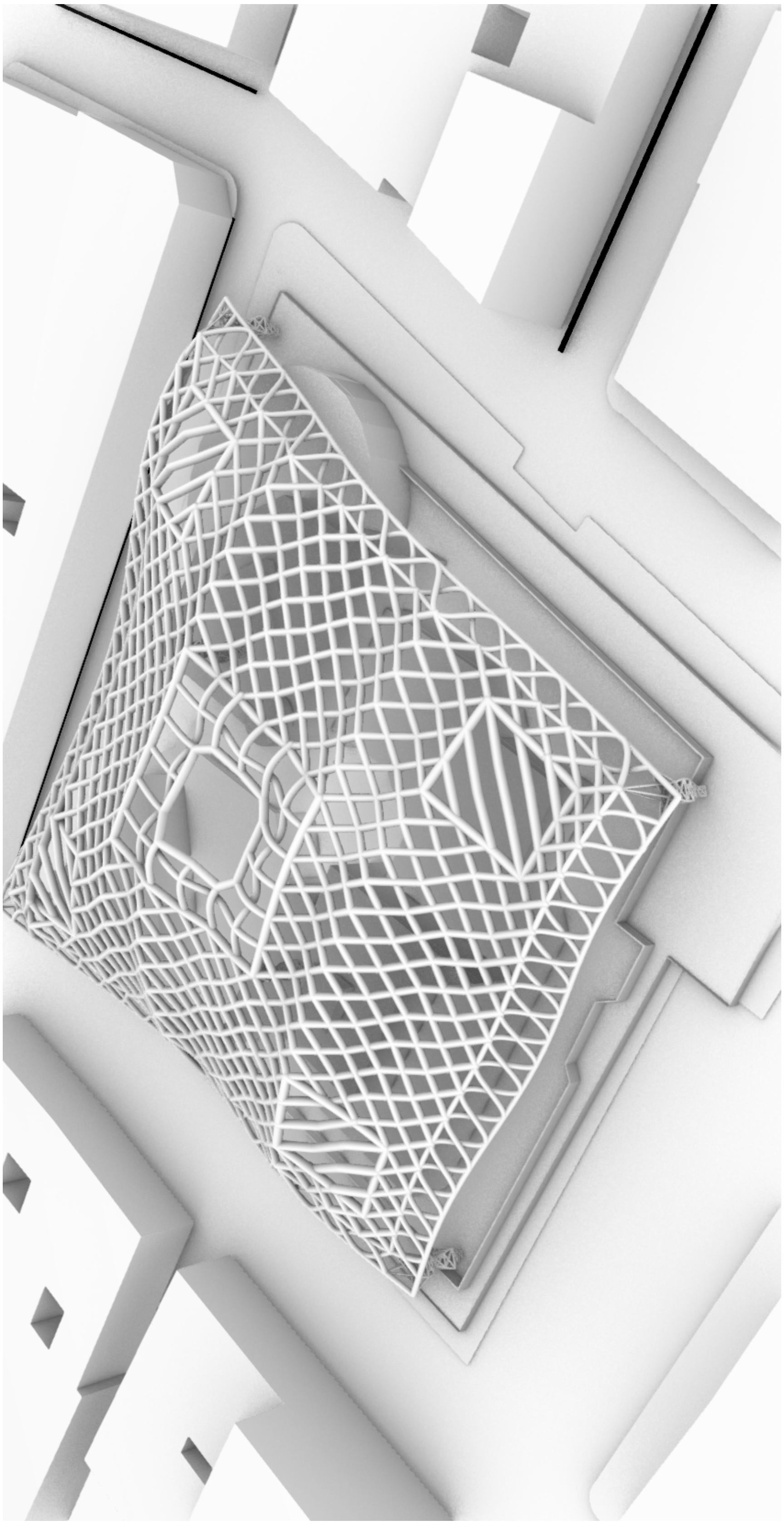


Figure 7-35. *Bedding including Almusharaf and the Mihrab (Source: Author).*

7.8.2.2. Component details

In **Table 7-10**, a comprehensive overview is provided of the number of segments covered and the surface area addressed by each component. This data delves into the intricate details, offering a thorough understanding of the final model (**Figure 7-36 and 7-37**).

Table 7-10: *Number of segments and covered surface of each component*

Component	Covered Surface (m²)	Number of segments
الحاشية ***Border***	1132,70	296
الفراش ***Bedding***	4500.80	538
المشرف الصغير1 ***Almusharaf1***	116.94	21
المشرف الصغير2 ***Almusharaf2***	103.57	21
المشرف الصغير3 ***Almusharaf3***	133.47	21
المشرف الصغير4 ***Almusharaf4***	123.05	21
المحراب ***Mihrab***	486.30	72
Total	6596,83	990

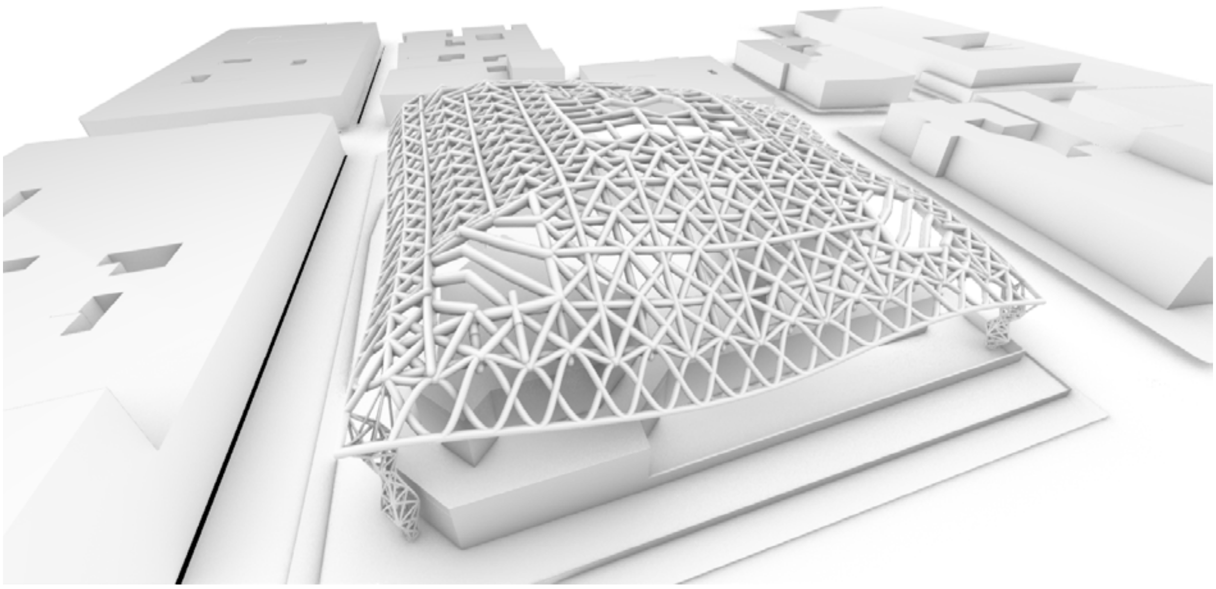


Figure 7-36. *Perspective view 03 (Source: Author).*

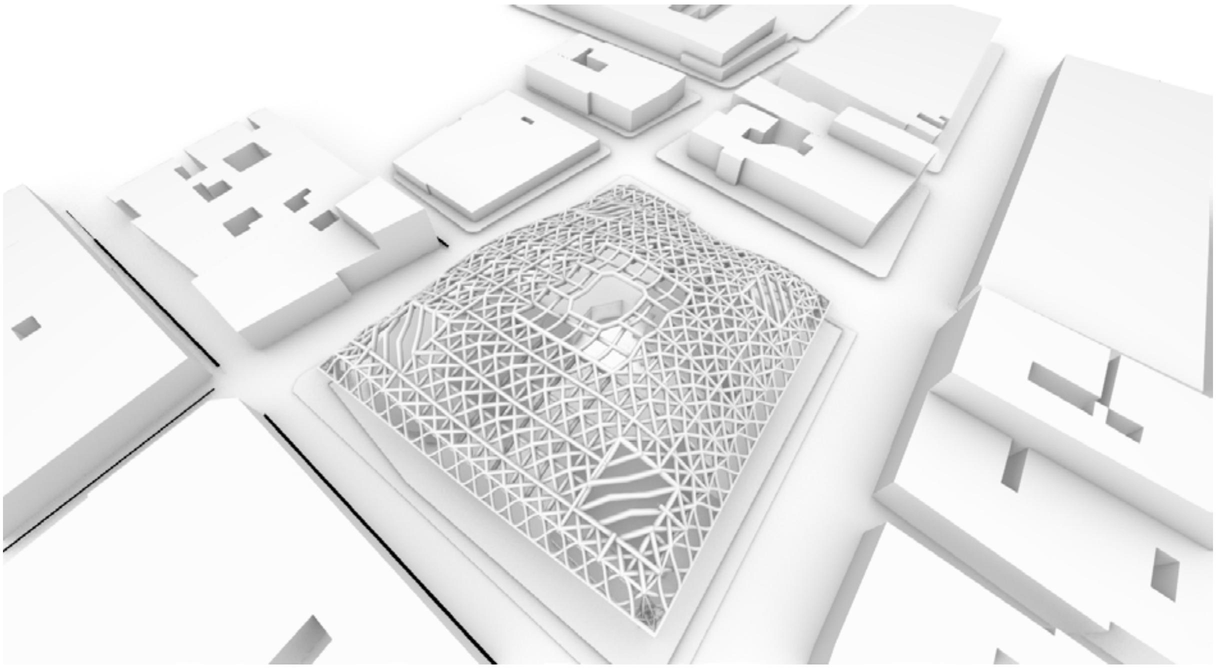


Figure 7-37. *Perspective view 04 (Source: Author).*

7.8.2.3. Adaptive (responsive) Skin Adoption for Form Optimization

Patterns have long served as decorative elements that not only add emphasis to certain aspects but also convey meaning and style. By considering Adaptive Skins as an alternative approach to the design process, it becomes possible to create new configurations of building skins using data sets. This expanded design process goes beyond addressing purely decorative concerns and delves into the realm of incorporating performative elements. It tackles technical issues such as daylight and Incident Radiation simulation, taking into account the functional aspects of the design (**Figure 7-38** and **7-49**). Through the utilization of Adaptive Skins, designers are able to enrich their creations and explore new possibilities in architectural design.

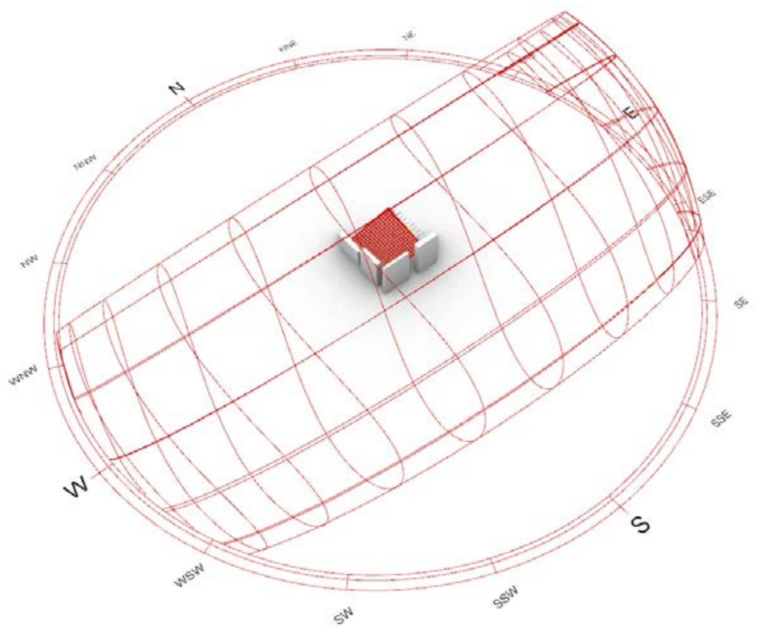


Figure 7-38. *Sun path diagram (Source: Author).*

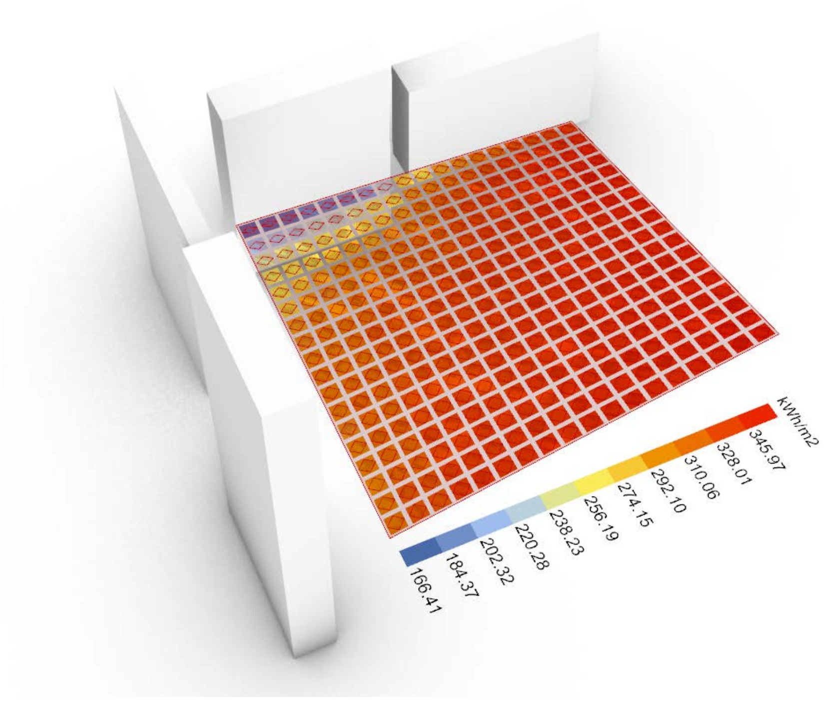


Figure 7-39. *Impact of the context geometry on the result of the test (Source: Author).*

7.8.2.4. Adaptive Envelope generation method

The envelope is designed with diamond-shaped openings, which were inspired by the diamond patterns found in Chaoui carpet making. These apertures can open both upwards and downwards, with a range between 1 and 0 (**Figure 7-40**). The decision on the opening of each diamond aperture is based on the incident radiation analysis, specifically the amount of energy collected by each grid cell. When we analyze the incident radiation, we obtain a list of values that corresponds to the measurement points. These values indicate the cumulative incident radiation, measured in kilowatt-hours per square meter (kWh/m2), received by each grid point from the sky matrix. This information allows us to accurately determine the level of energy received by each point, aiding in the overall assessment of the envelope's performance and efficiency (**Figure 7-41**).

The utilization of this approach enables the integration of both the artistic aspect and the ecological aspect, wherein the design process is guided not only by visual considerations but also by the outcomes derived from simulations, with the objective of achieving a more streamlined and effective form optimization.

This method places equal emphasis on aesthetic appeal and environmental consciousness, fostering a holistic design approach that takes into account both visual appeal and sustainability goals.

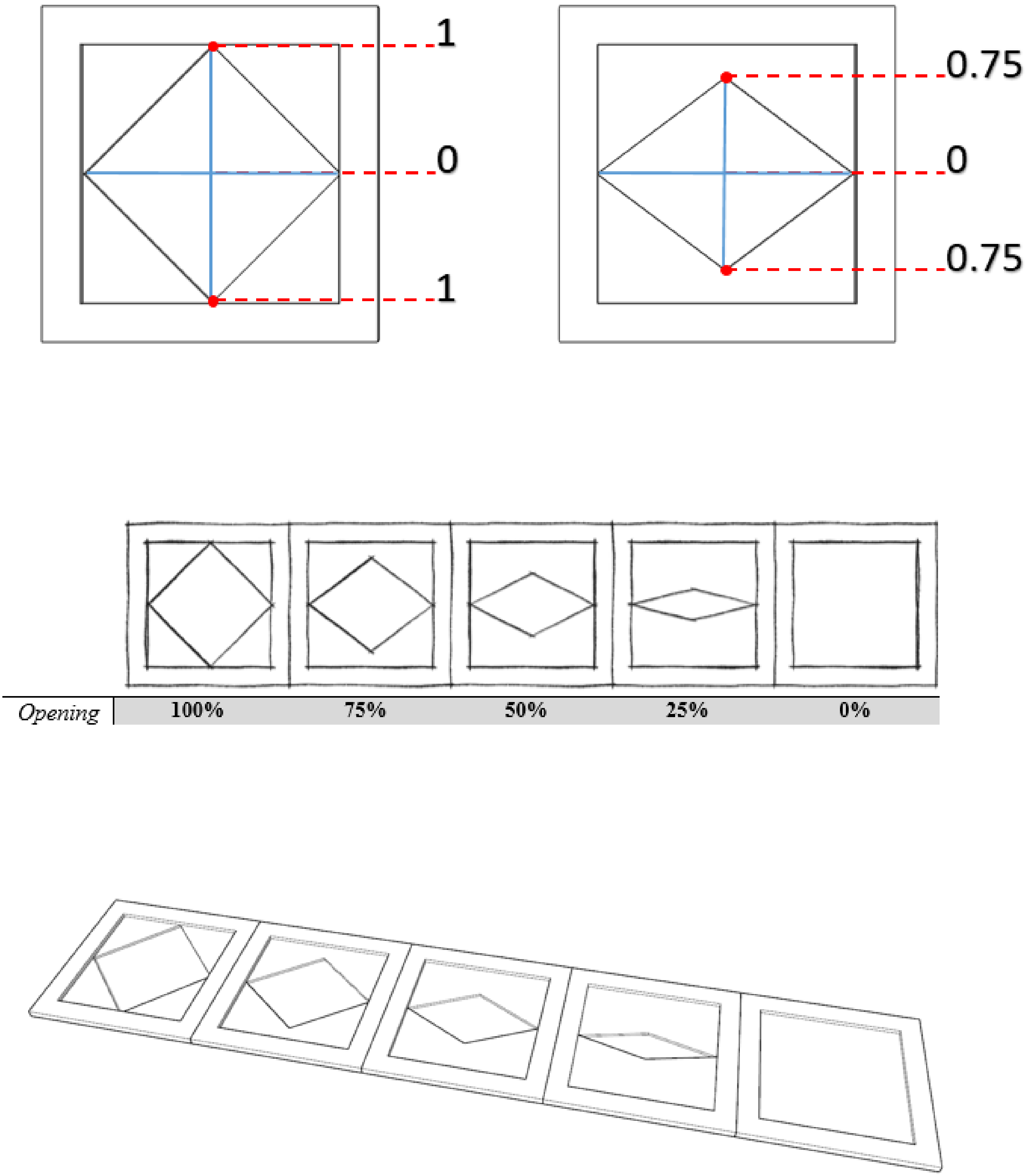


Figure 7-40. *Openings range and work method (Source: Author).*

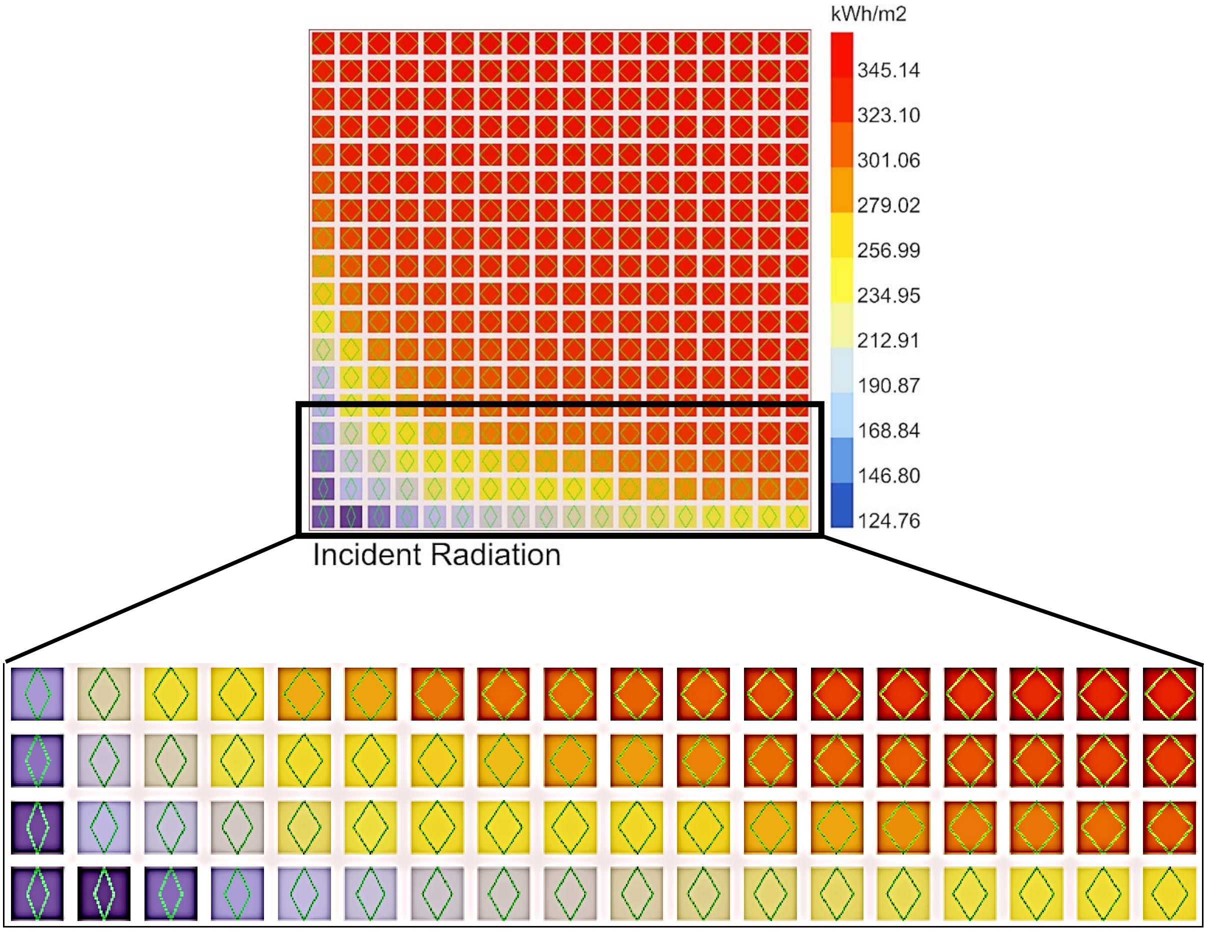


Figure 7-41. *Openings size variations according to incident radiation analysis (Source: Author).*

7.8.2.5. Custom python script for responsive skin

The Python component serves as a crucial tool for manipulating aperture sizes in accordance with the results obtained from the LadyBug component's "Incident Radiation" simulation (**Figure 7-42**). This simulation quantifies the level of incident energy in terms of kilowatt-hours per square meter (kWh/m2), and the area exposed to this energy expands proportionally as the energy levels increase. By leveraging the capabilities of the Python component, users have the ability to exercise meticulous control and make precise modifications to the aperture size, thus maximizing the effectiveness and efficiency of form generation. This comprehensive functionality, coupled with its formal nature, facilitates a thorough exploration of the topic, enriching the overall understanding and utilization of the Python component's capabilities in optimizing aperture size.

The following formula calculates the appropriate opening range:

$$O = \frac{IR\ gr}{IR\ max}$$

Whereas:

O = Opening size

IR gr: The incident radiation of the simulated grid

IR max: The maximum incident radiation

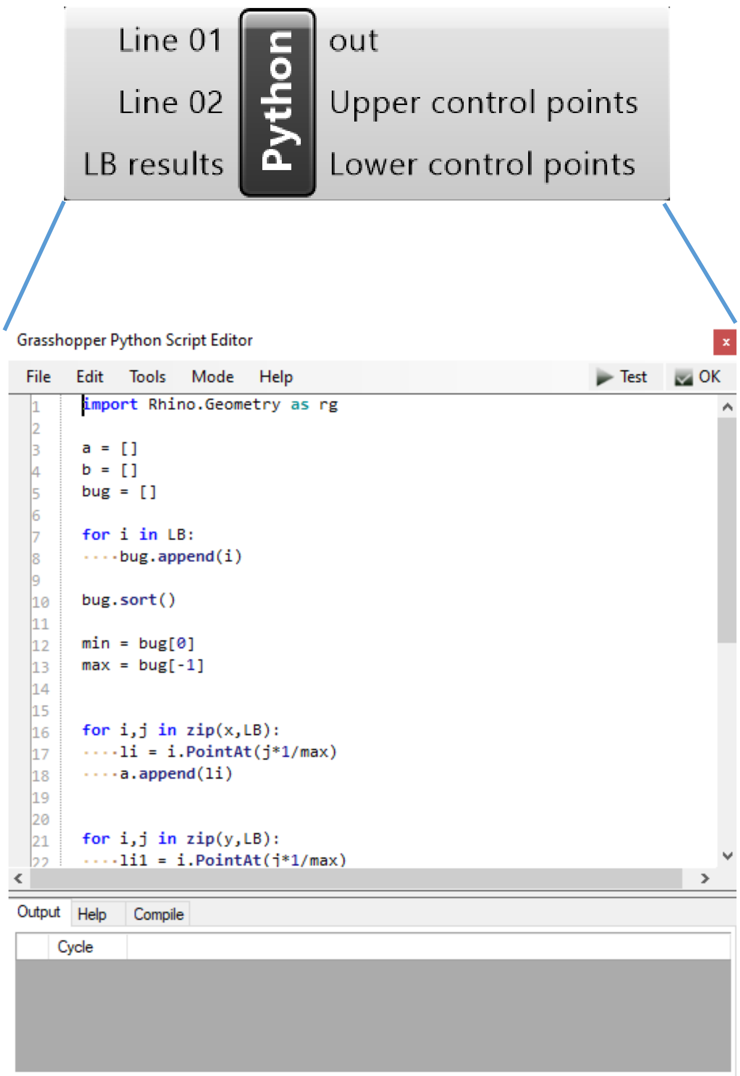


Figure 7-42. *Python component for manipulating aperture size in accordance with the results obtained from the LadyBug analysis (Source: Author).*

7.8.2.6. The parametric system responsible for executing the simulation

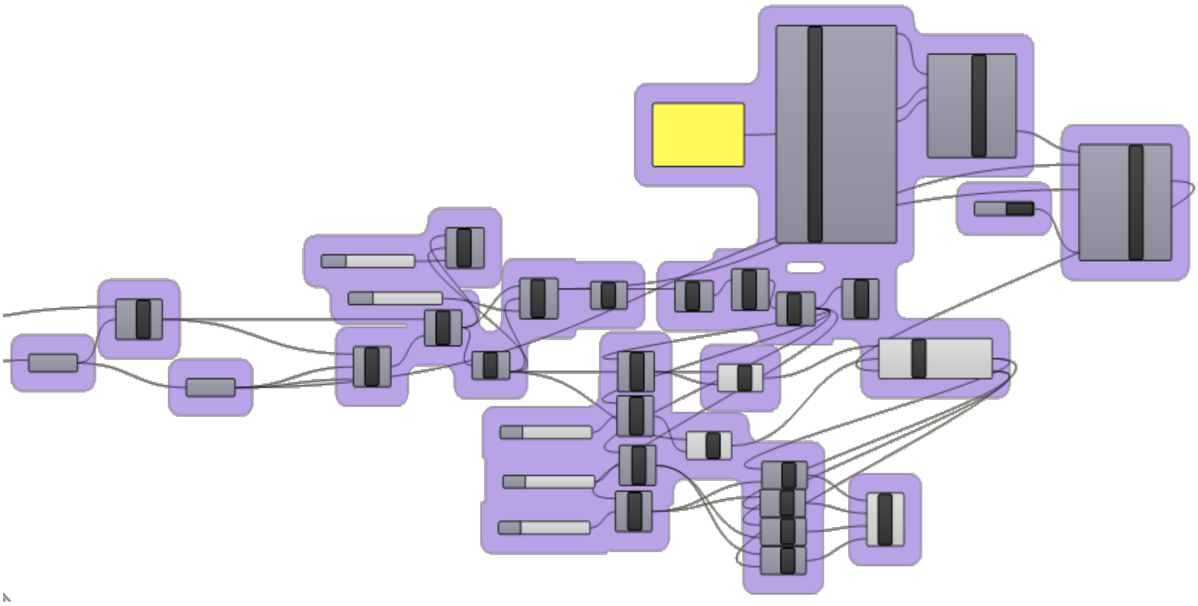


Figure 7-43. *The parametric system responsible for executing the simulation (Source: Author).*

The parametric system, responsible for executing the simulation, is a highly intricate process. It involves a complex series of procedures and calculations that are meticulously designed to accurately replicate real conditions (**Figure 7-43**).

In order to enhance performance and optimize the efficiency of the design, the parametric system incorporates an additional component Ladybug component. This integration serves the purpose of importing a dedicated weather data file that is subsequently used to configure and execute a simulation (**Figure 7-44**).

The primary objective of this simulation is to examine the correlation between the size of openings in the structure and the incident radiation (**Table 7-11**). By incorporating this comprehensive integration and analysis, the aim is to enrich our understanding of how the design responds to various weather conditions, thereby assisting in the overall optimization of the design. This approach ensures a thorough exploration of the design's capabilities and enables a comprehensive assessment of its performance under different climatic scenarios.

The adoption of a photovoltaic (PV) module efficiency of 15% has been made due to the fact that the maximum efficiency of thin-film amorphous silicon solar cells is estimated to be in the range of 14 to 15% (Carlson & Wronski, 1976). Moreover, the typical efficiency of amorphous silicon has a theoretical limit of about 15% (Roy et al., 2021).

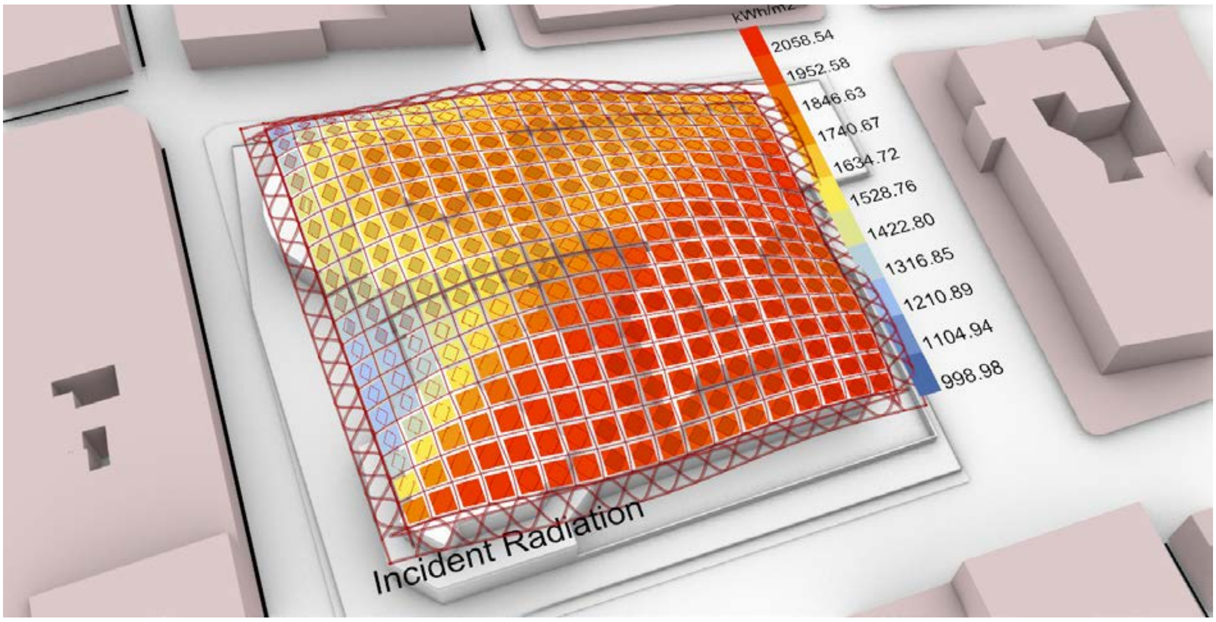


Figure 7-44. *Incident radiation analysis of the cells of each opening (Source: Author).*

Table 7-11: *Detailed description of the incident radiation analysis of the cells*

Opening ID	Opening Size (%)	Opening Surface (m²)	Cell Radiation(Kwh/m²)	Opening Radiation (Kwh)	Flexible solar panel efficiency 15% (Kwh)
1	78	3,015	1687,715	5088,90654	763,34
2	78	3,095	1677,692	5193,15179	778,97
3	79	3,195	1674,497	5349,402115	802,41
4	81	3,307	1679,490	5553,237222	832,99
5	83	3,417	1691,951	5781,961596	867,29
6	85	3,517	1709,837	6013,915949	902,09
7	85	3,572	1722,207	6152,264649	922,84
8	85	3,578	1719,428	6152,341934	922,85
9	83	3,554	1695,215	6025,396313	903,81
10	80	3,500	1641,373	5744,675534	861,70
11	77	3,443	1569,885	5404,360187	810,65
12	73	3,414	1500,319	5122,545105	768,38
13	70	3,427	1443,954	4947,961333	742,19
14	67	3,449	1397,860	4821,729535	723,26
15	64	3,419	1357,687	4642,535641	696,38
16	61	3,274	1320,788	4324,119787	648,62
17	58	3,014	1278,672	3853,9104	578,09
18	55	2,704	1206,659	3262,644492	489,40
19	80	3,170	1731,723	5489,639225	823,45
20	79	3,232	1703,745	5505,836144	825,88
21	79	3,313	1685,121	5583,350893	837,50
22	80	3,407	1676,935	5713,02702	856,95

23	82	3,498	1679,226	5873,720091	881,06
24	83	3,580	1691,941	6056,40496	908,46
25	84	3,636	1708,800	6213,517513	932,03
26	84	3,668	1720,475	6311,108684	946,67
27	84	3,685	1717,857	6329,466496	949,42
28	82	3,673	1690,849	6210,438452	931,57
29	80	3,651	1647,161	6013,779508	902,07
30	77	3,631	1595,577	5793,746296	869,06
31	75	3,643	1556,350	5669,782754	850,47
32	73	3,637	1523,004	5539,62663	830,94
33	70	3,540	1486,667	5263,533481	789,53
34	67	3,335	1443,964	4815,758147	722,36
35	64	3,099	1384,767	4291,475542	643,72
36	61	2,905	1277,914	3712,781117	556,92
37	83	3,337	1804,362	6021,501592	903,23
38	82	3,370	1756,350	5919,311444	887,90
39	81	3,427	1719,362	5892,883111	883,93
40	81	3,495	1693,782	5920,322738	888,05
41	81	3,555	1679,441	5969,884998	895,48
42	82	3,604	1679,639	6053,132304	907,97
43	82	3,650	1694,333	6184,658716	927,70
44	83	3,703	1716,122	6354,58763	953,19
45	84	3,753	1729,450	6490,527354	973,58
46	84	3,785	1725,658	6531,299061	979,69
47	83	3,797	1706,542	6480,131053	972,02
48	81	3,803	1680,724	6391,602842	958,74
49	80	3,801	1655,786	6293,645514	944,05
50	78	3,766	1635,424	6159,685175	923,95
51	75	3,641	1602,837	5835,70529	875,36
52	72	3,459	1549,542	5359,636972	803,95
53	69	3,305	1466,559	4846,403744	726,96
54	66	3,195	1341,981	4286,979754	643,05
55	88	3,511	1890,813	6639,411274	995,91
56	85	3,518	1831,253	6443,0126	966,45
57	84	3,545	1776,501	6297,045746	944,56
58	82	3,578	1730,692	6193,002183	928,95
59	81	3,598	1696,004	6101,909398	915,29
60	81	3,598	1675,114	6027,663564	904,15
61	81	3,623	1680,656	6088,377977	913,26
62	82	3,684	1706,463	6285,915165	942,89
63	83	3,759	1731,420	6507,550265	976,13
64	84	3,828	1746,363	6684,378061	1002,66
65	84	3,872	1747,929	6768,243057	1015,24
66	84	3,896	1741,360	6784,169239	1017,63
67	83	3,899	1733,872	6760,791576	1014,12

68	81	3,867	1725,284	6671,352856	1000,70
69	79	3,778	1693,931	6398,848194	959,83
70	76	3,665	1624,748	5954,986525	893,25
71	72	3,564	1523,067	5427,534151	814,13
72	69	3,453	1397,499	4824,917826	723,74
73	92	3,678	1961,621	7215,070179	1082,26
74	90	3,664	1903,573	6974,392043	1046,16
75	87	3,665	1843,592	6757,043748	1013,56
76	85	3,669	1786,251	6553,180476	982,98
77	83	3,641	1730,804	6301,15142	945,17
78	80	3,589	1686,101	6051,317253	907,70
79	80	3,579	1674,686	5994,503348	899,18
80	81	3,625	1693,584	6139,428711	920,91
81	82	3,719	1727,972	6426,042289	963,91
82	84	3,824	1759,140	6726,738638	1009,01
83	85	3,891	1771,913	6894,104844	1034,12
84	84	3,922	1771,881	6949,640356	1042,45
85	84	3,929	1767,523	6945,018373	1041,75
86	83	3,913	1755,784	6871,125598	1030,67
87	80	3,869	1714,718	6634,481425	995,17
88	77	3,795	1632,905	6196,478591	929,47
89	74	3,727	1542,730	5749,919897	862,49
90	70	3,588	1431,614	5136,531849	770,48
91	96	3,840	2005,801	7703,005395	1155,45
92	94	3,815	1959,499	7474,831601	1121,22
93	91	3,799	1906,505	7243,592627	1086,54
94	89	3,778	1848,587	6984,547684	1047,68
95	85	3,716	1785,034	6633,003504	994,95
96	82	3,619	1721,155	6229,089412	934,36
97	80	3,558	1682,237	5986,108723	897,92
98	79	3,565	1680,554	5990,611053	898,59
99	81	3,667	1718,089	6299,615349	944,94
100	84	3,810	1765,346	6726,55296	1008,98
101	85	3,892	1783,318	6941,4696	1041,22
102	84	3,921	1780,894	6982,342026	1047,35
103	83	3,913	1765,073	6907,059414	1036,06
104	81	3,880	1731,149	6717,241317	1007,59
105	79	3,857	1681,299	6484,495204	972,67
106	76	3,814	1606,990	6129,759763	919,46
107	73	3,752	1528,826	5736,891234	860,53
108	70	3,638	1449,408	5273,057644	790,96
109	99	3,968	2018,556	8009,014085	1201,35
110	97	3,944	1985,598	7830,244863	1174,54
111	95	3,922	1945,933	7632,531841	1144,88
112	92	3,889	1900,498	7391,653727	1108,75

113	88	3,814	1848,464	7050,480129	1057,57
120	83	3,875	1762,153	6829,151114	1024,37
121	81	3,849	1733,146	6671,455807	1000,72
122	80	3,815	1687,980	6440,197474	966,03
123	77	3,784	1626,813	6155,255251	923,29
124	75	3,758	1562,499	5872,310431	880,85
125	72	3,693	1493,695	5516,048155	827,41
126	70	3,609	1441,598	5202,263119	780,34
127	100	4,033	2007,559	8096,303211	1214,45
128	98	4,023	1986,817	7992,288131	1198,84
129	96	4,003	1961,776	7852,295816	1177,84
130	94	3,968	1934,576	7675,709651	1151,36
131	91	3,906	1904,898	7440,266347	1116,04
138	80	3,785	1717,474	6500,179961	975,03
139	79	3,750	1681,429	6305,976091	945,90
140	77	3,716	1629,717	6055,436578	908,32
141	75	3,681	1565,847	5763,454792	864,52
142	73	3,653	1506,927	5505,506773	825,83
143	71	3,587	1448,017	5194,674085	779,20
144	68	3,517	1412,503	4967,423082	745,11
145	99	4,015	1977,442	7939,748444	1190,96
146	98	4,030	1970,835	7941,729912	1191,26
147	97	4,021	1962,774	7893,259	1183,99
148	95	3,992	1952,040	7791,638867	1168,75
149	93	3,960	1941,132	7686,325671	1152,95
156	78	3,682	1666,670	6137,180611	920,58
157	76	3,646	1626,623	5930,931453	889,64
158	75	3,606	1569,278	5658,725323	848,81
159	73	3,570	1507,061	5380,943576	807,14
160	71	3,527	1448,586	5109,733025	766,46
161	68	3,455	1396,042	4823,675655	723,55
162	66	3,383	1368,445	4630,132793	694,52
163	97	3,921	1934,499	7584,451643	1137,67
164	97	3,966	1946,131	7717,405797	1157,61
165	96	3,977	1954,698	7774,060592	1166,11
166	94	3,964	1958,231	7762,87952	1164,43
167	93	3,961	1957,574	7754,078281	1163,11
174	76	3,597	1626,576	5850,015282	877,50
175	74	3,557	1580,548	5621,970748	843,30
176	72	3,504	1516,071	5311,920714	796,79
177	71	3,462	1454,258	5034,046668	755,11
178	69	3,399	1393,924	4737,442439	710,62
179	66	3,315	1343,391	4453,54128	668,03
180	64	3,232	1316,362	4254,348854	638,15
181	93	3,799	1898,279	7211,360926	1081,70

182	94	3,868	1925,620	7447,652451	1117,15
183	94	3,906	1948,016	7609,215707	1141,38
184	93	3,918	1960,572	7682,274481	1152,34
185	92	3,936	1962,854	7726,188063	1158,93
192	76	3,614	1643,921	5940,311222	891,05
193	74	3,540	1572,913	5568,030009	835,20
194	71	3,456	1491,165	5153,182188	772,98
195	69	3,392	1421,350	4821,008006	723,15
196	67	3,312	1357,783	4497,02655	674,55
197	64	3,209	1302,550	4179,258919	626,89
198	61	3,116	1273,894	3969,89615	595,48
199	90	3,673	1880,147	6905,260236	1035,79
200	91	3,759	1917,460	7208,474054	1081,27
201	92	3,824	1946,805	7445,311683	1116,80
202	92	3,869	1964,241	7598,750207	1139,81
203	91	3,904	1965,637	7674,144198	1151,12
210	79	3,754	1730,412	6495,752039	974,36
211	75	3,616	1623,354	5870,251095	880,54
212	72	3,474	1509,456	5243,809785	786,57
213	68	3,365	1416,943	4767,381622	715,11
214	65	3,255	1340,418	4363,017013	654,45
215	62	3,134	1277,934	4004,837068	600,73
216	60	3,030	1244,204	3770,094785	565,51
217	88	3,566	1893,742	6753,83036	1013,07
218	90	3,662	1930,677	7070,778345	1060,62
219	91	3,752	1960,665	7356,666563	1103,50
220	91	3,827	1977,654	7568,713564	1135,31
221	91	3,890	1979,182	7699,278089	1154,89
222	90	3,951	1974,082	7798,9166	1169,84
223	91	4,047	1979,753	8011,212288	1201,68
224	92	4,187	1998,177	8366,008947	1254,90
225	93	4,279	2004,265	8576,230386	1286,43
226	91	4,265	1987,179	8476,266337	1271,44
227	88	4,153	1938,408	8050,057448	1207,51
228	84	3,982	1853,110	7378,566083	1106,78
229	79	3,786	1734,463	6566,624267	984,99
230	74	3,580	1592,990	5702,799446	855,42
231	69	3,392	1459,282	4950,041991	742,51
232	65	3,229	1351,558	4363,651625	654,55
233	61	3,088	1275,147	3937,273096	590,59
234	58	2,966	1231,106	3651,340127	547,70
235	88	3,489	1932,770	6743,453132	1011,52
236	89	3,587	1961,546	7036,111517	1055,42
237	90	3,688	1983,930	7316,234963	1097,44
238	90	3,780	1993,429	7535,514889	1130,33

239	90	3,871	1992,725	7713,587307	1157,04
240	90	3,965	1989,332	7888,328296	1183,25
241	91	4,084	1994,322	8144,403368	1221,66
242	92	4,237	2009,596	8514,125013	1277,12
243	92	4,371	2017,635	8819,228261	1322,88
244	92	4,430	2013,649	8920,4282	1338,06
245	91	4,385	1996,014	8752,622989	1312,89
246	88	4,247	1955,572	8304,732003	1245,71
247	84	4,026	1870,489	7530,887549	1129,63
248	79	3,761	1733,749	6520,111963	978,02
249	72	3,483	1562,735	5443,65627	816,55
250	66	3,247	1408,023	4571,231125	685,68
251	62	3,062	1299,017	3977,175793	596,58
252	58	2,911	1234,836	3594,948545	539,24
253	88	3,434	1979,107	6796,639718	1019,50
254	89	3,525	1995,450	7034,285564	1055,14
255	89	3,619	2004,018	7252,781186	1087,92
256	89	3,713	2002,281	7435,273708	1115,29
257	89	3,817	1994,875	7615,405962	1142,31
258	89	3,934	1987,317	7818,846304	1172,83
259	90	4,077	1989,297	8110,234227	1216,54
260	90	4,245	1999,734	8488,758764	1273,31
261	91	4,412	2008,542	8861,791192	1329,27
262	92	4,534	2013,759	9130,082253	1369,51
263	91	4,556	2010,580	9159,35974	1373,90
264	90	4,475	2000,697	8952,677736	1342,90
265	88	4,281	1966,176	8417,730589	1262,66
266	84	3,999	1882,930	7530,757059	1129,61
267	77	3,674	1732,173	6363,614071	954,54
268	70	3,347	1538,239	5148,327579	772,25
269	64	3,088	1378,812	4257,689997	638,65
270	58	2,860	1261,608	3608,390218	541,26
271	88	3,385	2017,145	6827,899566	1024,18
272	89	3,462	2020,555	6996,053323	1049,41
273	88	3,543	2016,377	7143,897781	1071,58
274	88	3,629	2003,290	7270,133987	1090,52
275	88	3,732	1985,737	7410,277696	1111,54
276	88	3,859	1970,738	7604,510559	1140,68
277	88	4,020	1968,493	7913,012351	1186,95
278	88	4,206	1976,464	8312,319808	1246,85
279	89	4,398	1986,777	8737,712457	1310,66
280	90	4,565	1998,690	9123,337599	1368,50
281	91	4,650	2004,296	9319,327418	1397,90
282	91	4,642	2006,789	9316,27022	1397,44
283	90	4,521	2003,214	9056,841115	1358,53

284	87	4,269	1975,747	8433,865373	1265,08
285	82	3,920	1894,403	7426,724483	1114,01
286	75	3,533	1733,247	6123,024356	918,45
287	68	3,180	1536,858	4887,276895	733,09
288	60	2,869	1353,289	3881,915655	582,29
289	88	3,325	2036,076	6769,059627	1015,36
290	88	3,395	2032,395	6899,031402	1034,85
291	88	3,465	2019,782	6998,002788	1049,70
292	87	3,540	1996,159	7066,750581	1060,01
293	86	3,636	1968,136	7157,033622	1073,56
294	86	3,764	1944,543	7319,12611	1097,87
295	86	3,935	1939,898	7633,733169	1145,06
296	87	4,126	1946,359	8030,26459	1204,54
297	87	4,334	1961,212	8499,026862	1274,85
298	89	4,531	1979,791	8970,324264	1345,55
299	90	4,663	1990,354	9281,669016	1392,25
300	91	4,726	1999,017	9448,238375	1417,24
301	90	4,684	2003,788	9385,25948	1407,79
302	89	4,509	2004,847	9040,14611	1356,02
303	86	4,193	1984,876	8323,403396	1248,51
304	81	3,783	1909,787	7224,878672	1083,73
305	73	3,373	1758,417	5930,387337	889,56
306	64	2,976	1536,940	4574,473696	686,17
307	87	3,222	2028,136	6534,582624	980,19
308	87	3,313	2034,157	6738,357609	1010,75
309	87	3,378	2015,466	6808,35401	1021,25
310	86	3,447	1983,199	6835,683571	1025,35
311	85	3,539	1947,100	6890,26249	1033,54
312	85	3,661	1916,050	7013,741665	1052,06
313	85	3,824	1907,983	7296,791586	1094,52
314	85	4,009	1916,535	7684,153585	1152,62
315	86	4,220	1937,623	8175,859353	1226,38
316	87	4,434	1963,147	8703,659819	1305,55
317	89	4,598	1977,929	9094,991605	1364,25
318	90	4,710	1988,026	9364,265405	1404,64
319	90	4,751	1996,016	9483,324636	1422,50
320	90	4,684	2002,076	9378,432461	1406,76
321	88	4,471	2005,393	8966,749326	1345,01
322	84	4,109	1996,133	8201,248344	1230,19
323	79	3,677	1947,066	7160,242352	1074,04
324	72	3,228	1801,926	5815,997502	872,40

The primary motivation behind the removal of the 36 panels situated above the patio was to improve its visual appeal. This decision was driven by the desire to enhance the overall appearance of the patio, taking into account aesthetic considerations. Moreover, this modification was implemented with the aim of optimizing the functioning of the patio, especially in terms of lighting and ventilation. The details of the panels that were removed can be found in the annexes, specifically in a table. This deliberate alteration was undertaken to enrich and elevate the patio's ambiance and ensure that it serves its intended purpose effectively (**Figure 7-45 to Figure 7-47**).

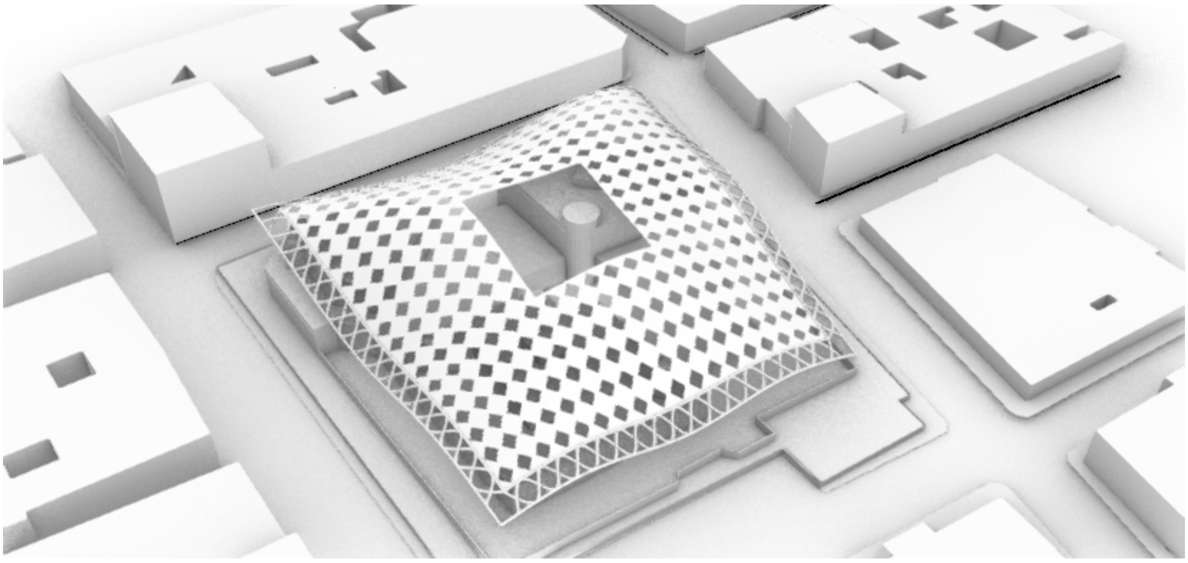


Figure 7-45. *Perspective view 05 (Source: Author).*

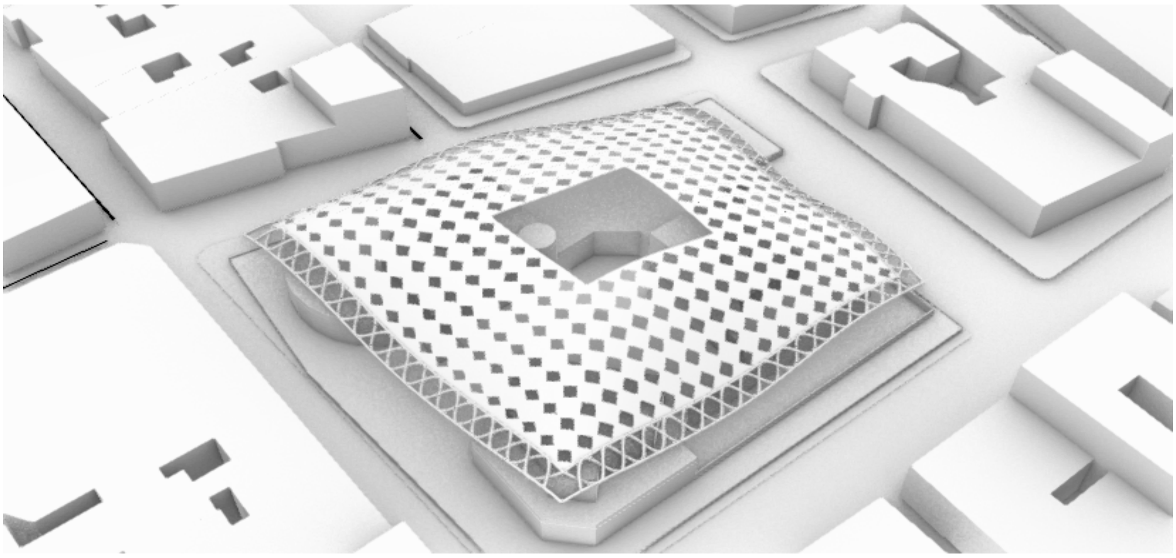


Figure 7-46. *Perspective view 06 (Source: Author).*

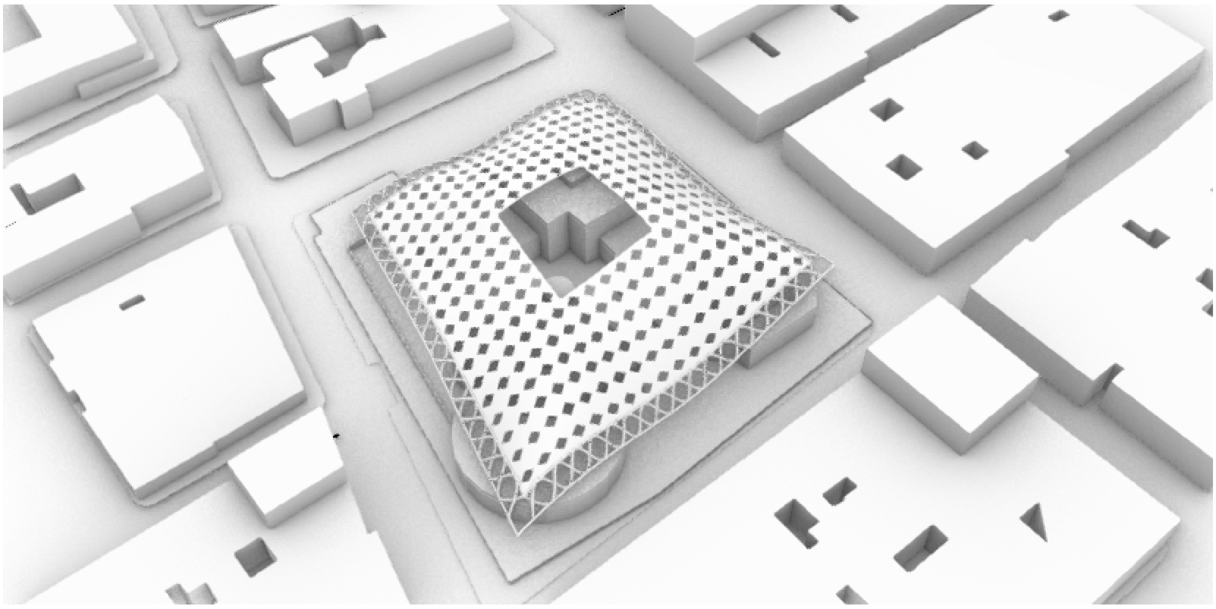


Figure 7-47. *Perspective view 07 (Source: Author).*

7.9. Transparent and Flexible amorphous cells

Flexible amorphous cells belong to the category of solar cells that utilize amorphous silicon. Amorphous silicon refers to a non-crystalline form of silicon, which can be applied as thin films on various flexible substrates, including glass, metal, and plastic.

These cells stand out due to their ability to be cut into unconventional shapes, providing a high degree of design flexibility. This characteristic enables them to be effortlessly installed on curved surfaces, minimizing the risk of damage caused by mechanical friction and vibrations.

The use of amorphous silicon in these cells allows for a versatile application, as it lends itself to coating a wide range of materials commonly found in everyday objects. By utilizing this technology, solar panels can be manufactured with diverse forms and dimensions, going beyond the traditional method (**Figure 7-48**).

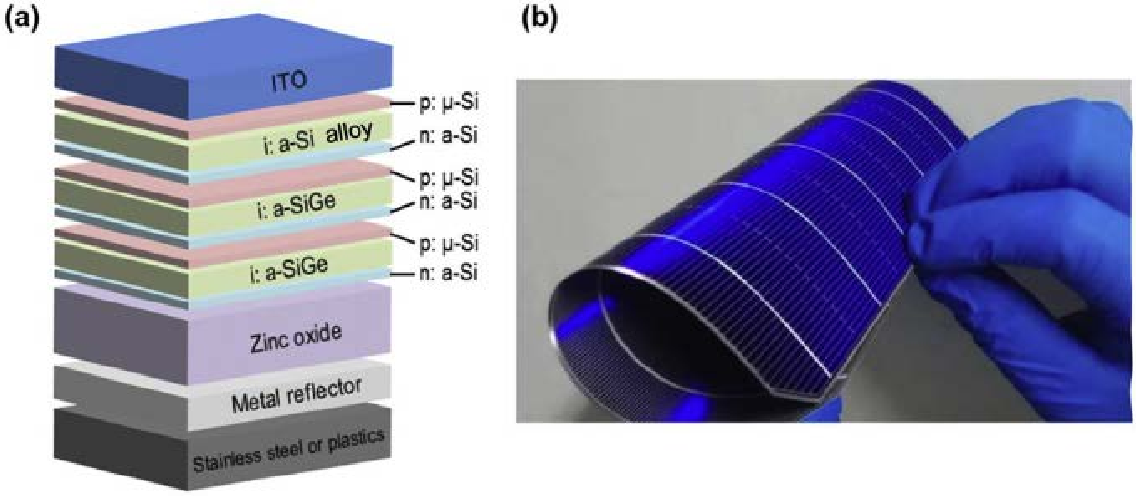


Figure 7-48. *(a) A flexible triple-junction silicon solar cell illustration (Zhao et al., 2018). (b) silicon-heterojunction solar cell photograph outstanding bending aptitude (courtesy of Hanenergy group, China; Li et al., 2021)*

Flexible cells, utilizing the properties of amorphous silicon, possess a multitude of distinct characteristics. According to Louzazni et al (2020) These cells are known for:

7.9.1. Flexibility

Flexibility, in the context of solar cells, pertains to their remarkable capability to flex and mold themselves to conform to diverse surfaces. Unlike conventional cells, these innovative cells possess the unique ability to be seamlessly affixed to objects with curved or irregular contours, completely eliminating any worries about potential harm or structural compromise. This exceptional adaptability not only broadens the scope of possible applications but also bestows an unparalleled level of creative liberty in terms of solar panel integration and design within a myriad of architectural structures. Consequently, this exceptional attribute of flexibility enhances the versatility, durability, and aesthetic integrity of solar power systems, elevating their potential impact on various industries and sectors.

7.9.2. Thin film deposition

Thin film deposition plays a pivotal role in the manufacturing of amorphous silicon cells, which are essential components of solar energy production. The intricate process involves delicately applying a thin layer of amorphous silicon onto flexible substrates, including diverse materials like glass, metal, or plastic. The application of thin film deposition technique offers numerous advantages to these solar cells, including their lightweight nature and ability to adapt to a wide range of scenarios. This advanced method of deposition not only ensures the production of high-quality, efficient solar cells but also contributes to the ongoing advancements in renewable energy technology.

7.9.3. Shape customization

Shape customization is an outstanding attribute exhibited by flexible amorphous cells, enabling them to effortlessly acquire different forms while maintaining their full functionality. This remarkable characteristic grants them exceptional versatility, making them suitable for a diverse range of applications, particularly those involving curved surfaces and wearable devices. By virtue of their capability to be molded into various desired shapes, these cells offer alternative solutions that cater to specific needs and requirements. This feature provides ample room for innovation and opens up new possibilities in the field of flexible amorphous cell technology.

7.9.4. Non-Crystalline Structure:

Amorphous silicon, distinguished by its absence of a crystalline framework, differentiates itself from other forms of silicon that are typically employed in the manufacture of solar cells. This specific structural attribute presents numerous benefits, primarily including heightened flexibility and increased tolerance towards mechanical strain and torsion. The exclusive arrangement of atoms in amorphous silicon allows for these advantageous properties to emerge, rendering it a valuable material in the field of solar energy utilization.

7.9.5. Efficiency

In the field of solar cells, efficiency holds great significance. While flexible amorphous cells offer the advantage of flexibility, their efficiency has often been found to be lower in comparison to other types of solar cells. Nevertheless, continuous research efforts are underway to boost their efficiency and concurrently reduce the costs associated with their production. This endeavor is of utmost importance as it will play a pivotal role in enhancing the competitiveness of flexible amorphous cells in the market. By improving their efficiency and lowering manufacturing costs, these advancements will contribute to the wider adoption and utilization of flexible amorphous cells as a viable alternative in solar energy solutions.

7.10. Conclusion

Parametric computer-aided design (PCAD) is a powerful modeling tool that empowers designers to create adaptable models, allowing for responsive interactions with various elements of the parametric environment. This capability enables designers to engage in flexible exploration of form, reduces the time required for realization, and enhances the overall quality of their designs. By integrating simulation-based processes into the design experience, designers gain invaluable support in optimizing the performance of their creations. This optimization is achieved through the efficient transfer of real data among different components of the system. Ultimately, the utilization of parametric CAD, with its inherent adjustability and interactive features, facilitates an inclusive and detailed approach to design, enriching the entire creative process and yielding superior results.

The intertwined elements of the dynamic parametric CAD/simulation combination enable a wide range of possibilities for generating and evaluating various design propositions in architecture. This comprehensive process takes into account the perceived quality dimensions throughout the different stages of architectural design. Starting from the initial pre-design phase, where the concept model is created, the combination seamlessly progresses to the optimization phase where multiple solutions are tested. Finally, the outcome is presented in the form of a detailed 3D model. This approach enriches the overall understanding of how the iterative design process incorporates advanced CAD and simulation techniques to enhance architectural outcomes.

The integration of digital technologies into the architectural design process brings forth novel approaches to address challenges specific to designing in specific areas. This integration not only enables the exploration of innovative solutions but also facilitates a deeper comprehension of the principles underlying sustainable design in such environments. By harnessing the power of digital tools, architects can holistically analyze and design structures that are in harmony with the site while promoting ecological balance and resource efficiency.

GENERAL CONCLUSIONS

In the realm of building design, it is certainly correct to acknowledge that the architect assumes the crucial role of the designer. However, it is essential to recognize that this notion represents only a fraction of the entire truth. In fact, the final outcome of the design is greatly influenced and shaped not only by the architect, but also by the recipient or client, who holds a significant sway over numerous aspects of the project.

When individuals engage with their surroundings, they must gather various forms of information to develop an understanding of their environment. This process heavily relies on the utilization of the five senses: vision, hearing, smell, taste, and touch. However, in the area of architecture, an additional sense comes into play, proprioception, an ability to perceive and interpret the physical space itself. Understanding that one exists within a physical body, with sensations of pressure and temperature, adds to this sense of spatial perception. Furthermore, different buildings can evoke a distinct chronological sense, known as chronoception, which influences a user's ability to perceive and experience time, triggering a range of emotions and thoughts. This comprehensive understanding of the human sensory experience within architectural spaces enriches our appreciation for the interconnectedness between our senses, emotions, and the physical environment.

The perceiver's direct and interactive experience, both inside and outside the building, plays a crucial role in engaging them in a parallel and multi-sensory encounter. This experience triggers various perceptual and cognitive processes that work simultaneously to create assessments and form opinions. These processes encompass a wide range of sensory inputs and cognitive activities, which require a deep consideration.

According to Skaza (2019), a significant majority of the information perceived by individuals is derived from the sense of sight, accounting for approximately 83% of the total. The sense of hearing contributes to about 11% of the information received, while the remaining portion stems from the other senses, such as smell, touch and taste.

Pallasmaa as cited by Skaza (2019) points out: "*The live encounter with Frank Lloyd Wright's Eallingwater weaves the surrounding forest, the volumes, surfaces, textures and colors of the house, and even the smells of the forest and the sounds of the river, into a uniquely full experience. An architectural work is not experienced as a collection of isolated visual pictures, but in its fully embodied material and spiritual presence*"(p.6).

I. Contributions of the thesis

1. Defining the notion of perceived architectural quality

Architecture is an art form that is primarily based on visual and mental perception, encompassing all the senses to create a complete architectural experience. Therefore, the concept of perceived architectural quality was defined from an interdisciplinary point of view and broken down into several dimensions which are combined in the architectural model based on their relation with parametric design applications and their significance in the field.

2. Establishing the relationship between parametric design and perceived architectural quality

This study focused specifically on the relationship between architectural quality and parametric design applications, and how they contribute to the overall quality of the architecture. The selected dimensions include elements such as functionality, aesthetics, spatial organization, and sustainability, among others. These various dimensions are taken into consideration when designing a building, with the aim of creating an all-inclusive experience for the users.

3. Assessment of the perceived architectural quality of the Khenchela culture house and the users' cognitive response

This work showed that the user's cognitive response can be evaluated and analysed to have an outlook on perceived architectural quality of buildings. This is significant in the architectural field and the subjective quality research because it contributes to our understanding of the user's cognitive response and the building's perceived quality. This work evaluated the cognitive response and assessed how people perceive different aspects of the architectural building and investigate the complex relationships between the factors that make up the response based on a multidisciplinary approach that inspects the psychological literature on perception and cognition with respect to the architectural building to improve the overall perceived architectural quality and the revisit intention.

4. Development of a customized Grasshopper component

This work entailed the creation of a specialized component, which utilizes a programming language with the ability to interpret various paradigms. The main objective was to develop a module that would generate a multidimensional grid, employing the principles and techniques of object-oriented programming (OOP). By incorporating both data attributes and programming methods, the module was able to achieve a cohesive and logical structure, ensuring its effectiveness in the intended context. Furthermore, the module was designed to encompass the complexities associated with multiple dimensions, offering comprehensive solutions.

5. Corrective action procedure for optimizing perceived architectural quality

An architectural competition involves a process where individuals or firms compete for the opportunity to be awarded a contract for providing architectural services or to secure an architectural order. This competition is organized to evaluate and select the most competent and qualified participant to undertake the architectural project (**Figure A)**

Architecture competitions serve as platforms for democratic and humanistic discussions surrounding the development of public spaces. These competitions provide an opportunity for diverse perspectives to be taken into account and foster a comprehensive debate. The competition jury serves as a platform where experts assess and compare projects. This forum provides an analysis and evaluation of the projects, ensuring thorough examination and comparison.

Architectural competitions serve as a method for clients to not only select an architectural project but also the project management team responsible for executing it. This process involves a comprehensive evaluation of various architectural proposals, allowing clients to choose the most suitable project.

The assessment standards utilized in architectural competitions can differ based on factors such as the nature of the competition and the specific goals of each project. That being said, there are several common criteria that are commonly employed to evaluate architecture projects.

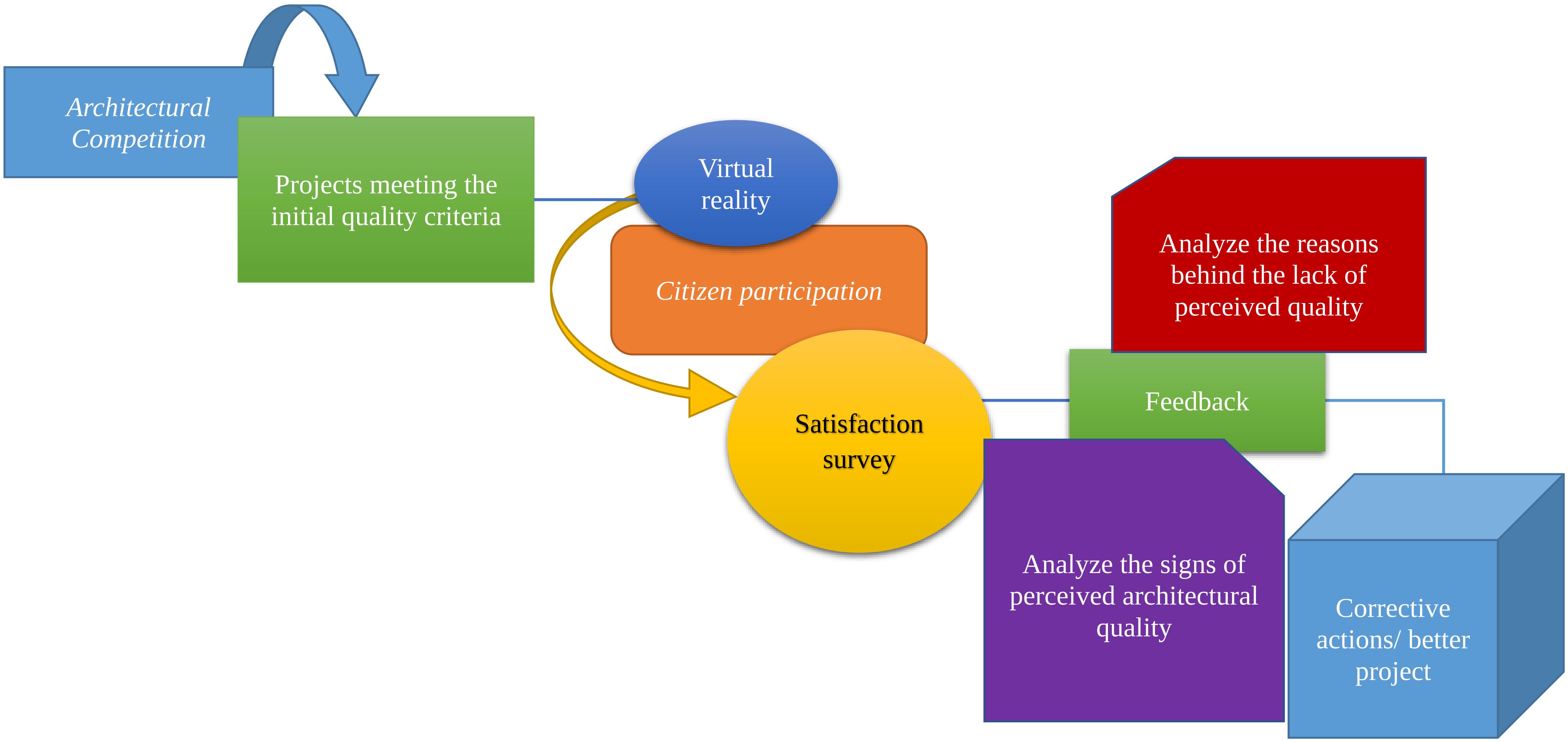


Figure E. *Corrective action procedure in order to optimize the perceived architectural quality of buildings in Algeria (Source: Author).*

II. Further conclusions and recommendations

6. *Criteria playing a crucial role in the assessment of projects' quality and effectiveness*

6.1. Architectural quality

Architectural quality refers to the visual appeal, uniqueness, and inventive nature of an architectural project. When assessing a design, the jury takes into account the level of creativity and the extent to which the project addresses both functional and aesthetic requirements. This comprehensive evaluation encompasses the originality and innovation embedded in the design, ensuring that it captures the essence of artistic expression while also fulfilling practical needs.

6.2. Functionality

Architecture projects should undergo a thorough evaluation of their functionality, specifically in terms of how well they meet the program's needs and requirements. This assessment encompasses various aspects, such as circulation, space organization, ergonomics, and user-friendliness.

6.3. Sustainability

Sustainability and the consideration for the environment have gained significant importance in architectural competitions. Evaluations of projects now include a comprehensive assessment of their environmental impact, energy efficiency, utilization of sustainable materials, and their integration into the surrounding environmental context. This evaluation ensures that architectural designs not only meet their functional requirements but also contribute positively to the overall sustainability goals.

6.4. Context and integration

In order to assess the success of a project, it is crucial to consider its seamless integration within its surroundings. This entails taking into account various factors, including the urban landscape, architectural aesthetics, historical significance, and cultural context. By thoroughly evaluating these aspects, it can be ensured that the project fits harmoniously into its environment.

6.5. Technical and economic feasibility

Evaluation of Technical and Economic Viability: When considering projects, it is crucial to thoroughly evaluate their technical and economic viability. This comprehensive assessment encompasses various aspects such as construction feasibility, effective cost management, optimal construction duration, and sustainable long-term maintenance strategies.

6.6. Social impact

In addition to evaluating the architectural aspects, certain architectural competitions also give consideration to the potential social impact of the projects. This entails assessing factors such as the project's accessibility, its contribution to social inclusion, the creation of public spaces, and the promotion of social cohesion. Judges and evaluators take into account these criteria to determine the broader societal implications and benefits that the architectural project may offer.

6.7. Citizen participation

In the country of Algeria, the well-being and concerns of its citizens have frequently been disregarded, whether justified or not. It is noteworthy to acknowledge that for over three decades, the government's efforts to construct housing units have largely overlooked the actual needs and requirements of the intended beneficiaries (Adad, 2004).

It is of utmost importance for the constructor to prioritize listening to the client's needs and requirements, as this plays a significant role in satisfying their demands. This process of active involvement not only ensures that their individuality is acknowledged but also gives them a sense of ownership over the project. The constructor diligently understands and incorporates the client's input.

In order to achieve community acceptance and effectively address current challenges, it is widely acknowledged that sharing and collecting information from a significant number of individuals is crucial.

This process allows for the development of a comprehensive understanding of sociocultural and demographic factors, as well as the intricate relationship between humans and their immediate physical environments.

By acquiring such insights, uncertainty can be eliminated, and the reliance on random decision-making can be minimized. Taking an all-inclusive and detailed approach to information sharing and collection not only facilitates the identification of potential solutions but also plays a vital role in enriching community decision-making processes.

6.8. Design concepts and cutting-edge tools

It is of utmost importance to enhance the architectural competitions by incorporating a wider range of technological considerations into the selection process. This encompasses various aspects such as:

1) To enhance one's abilities in the field of architecture, it is crucial to focus on the development of technical skills. This involves dedicating time and effort towards improving proficiency in various areas such as:

- Drawing
- 3D modeling
- Rendering
- Architectural design software
- AI
- VR

By regularly practicing these skills, individuals can refine their expertise and effectively communicate their ideas.

2) Architecture competitions offer a platform for architects to delve into uncharted territories and challenge conventional design norms by experimenting with fresh design concepts and cutting-edge tools. Engaging in these competitions allows architects to explore innovative ideas, adopt environmentally sustainable approaches, and harness advanced design tools to develop extraordinary and distinctive projects. By participating in such competitions, architects are given the opportunity to expand their horizons and diversify their creative palette.

7. The interplay between perception and the physical building

When encountering an architectural building, it is not merely the physical structure that is experience, but rather an intricate compilation of artistry. The amalgamation of tangible and intangible elements contributes to the overall presence that we perceive. By immersing ourselves in the space, we are able to fully appreciate the collective experience.

The properties and characteristics of the architectural elements that form the architectural space come together to create a sense of wholeness and coherence that can be perceived as a complete entity.

Perception encompasses the interplay between the physical structure of a building, the spatial environment it creates, and the individual perceiving it. This dynamic relationship between all three elements is symbiotic, with each influencing and shaping the others. Through this intricate interplay, ideas and evaluations are formed, resulting from the multitude of interactions and diverse interpretations that take place. These perceptions and evaluations can vary greatly.

Architectural building is an intricate and multifaceted entity that encompasses various elements and aspects. It involves the dynamic interplay between open spaces and physical components, such as materials, colors, and shapes. Additionally, the interplay of light and shadow further contributes to the overall experience.

An architectural experience refers to an immersive encounter that can be interpreted and unraveled by the individual based on their unique blend of knowledge, expertise, emotions, and thought processes. It represents a subjective aspect of quality that warrants continuous consideration and analysis.

The architectural experience stands out from other experiences, such as admiring a painting, by encompassing a multitude of emotions and engaging multiple senses. Unlike a purely visual encounter, architecture involves a personal and sensorial immersion where users intimately perceive the ambiance, detect the atmosphere's nuances, gauge the scale, sense the temperature, observe the lighting, and perceive the flow of air. Additionally, this profound architectural experience encompasses a fusion of various visual and architectural elements, resulting in a rich and layered encounter. Collectively, these acquired perceptions and sensations shape a more meaningful and lasting architectural experience that goes beyond mere observation.

Architecture and perception are closely intertwined, as different architectural styles elicit a range of emotions and reactions. The contemporary architectural designs provoke a sense of complexity, newness, and innovation, encouraging exploration and discovery. On the other hand, classical architecture, with its emphasis on order and rhythm, evokes nostalgic sentiments and offers glimpses into past eras and their respective cultures. In both cases, individuals experience distinct emotions and engage in thought processes, but ultimately, the perception and cognition of the viewer determine their preferences and overall interpretation of the architectural experience. This interplay between architecture and perception highlights the profound impact that built environments can have on individuals, shaping their emotions, memories, and cultural associations. An exploration of these connections provides a deeper understanding of how architecture influences our senses and enhances our overall experience of the physical world.

8. Balance between functionality and aesthetics in architectural design

In his work, Howes (1910) argued that there is a dual need for an understandable structure that conveys its purpose and function, while also being aesthetically appealing. He emphasized that a structure should be intelligible, providing clear indications of its intended use, without compromising its decorative aspect. Furthermore, Howes (1910) contended that a structure must possess beauty, but without misleading observers about its true nature or underlying framework. This highlights the intricate balance between functionality and aesthetics in architectural design. By satisfying both these demands, a structure can effectively fulfill its intended purpose while also having an aesthetically pleasing aspect.

In his depiction, he characterized beauty as a composite of unity, perfection, inner harmony, self-completeness, and alignment of intentions. These qualities prompt numerous inquiries that necessitate the application of psychological and physiological approaches to obtain comprehensive explanations and insights.

In addition, he posits that the initial understanding and interpretation of a piece of artwork rely heavily on the evaluation of psychological factors and the explanation of physiological processes that are at play.

The author further explains that the aesthetic mechanism can be understood as a fusion of perception and association. According to his analysis, as soon as we perceive an object, the association is already in motion. This implies that the process of perceiving and associating with the object happens simultaneously and instantaneously.

The examination of perception is deemed significant in relation to the perceiver's attention, response, and reaction as they pertain to the behavior of objects. Furthermore, Howes (1910) defines architecture as «the art of behavior of things» (p.510). As a result, the presence of architectural forms enhances the response and reaction experienced. This comprehensive exploration digs into the intricate interplay between perception, attention, response, and the behavior exhibited by objects.

The inclusion of structured elements in an image can evoke a sense of distance and stability, which are regarded as influential factors in shaping the perception of the viewer. These elements provide an organized framework that creates a perception of spatial separation and gives the image a tangible and solid quality.

In his inquiry, Howes (1910) also poses significant questions regarding the influence of objects on our perception. He delves into the nuanced aspects of perception, exploring the differing ways in which we perceive size, textures, and materials. Furthermore, he scrutinizes the impact that these various forces have on the individual experiencing them.

9. Perception, subjectivity, memory, and the symbolic message

Explicit spatial forms leave a lasting impact on our memory and are more readily recalled. The sensory experiences derived from these specific spatial configurations have undoubtedly a noticeable influence.

The emotional state plays a significant role in shaping our perception of images. When we experience strong emotions, the elements we perceive alongside these emotions are considered more noteworthy and are better ingrained in our memory. This phenomenon suggests that emotions greatly influence our ability to prioritize and retain information.

According to Trebacz (2019), J. Żórawski describes spatial perception as a subjective experience, highlighting the unique interpretation that each individual has when perceiving information from their surroundings. This implies that people have their own distinct way of understanding and making sense of the environment they are exposed to. The perception of space can vary greatly from person to another.

Symbols and signs play a crucial role in human communication, serving as effective tools to convey meaning and facilitate understanding between individuals (Trebacz, 2019).

In order for an architect to effectively communicate with users, they must utilize the building itself as a tool for conveying signs and messages. This means incorporating elements within the design that act as vehicles for communication, allowing the building to effectively transmit its intended message to those interacting with it.

Human beings possess an inherent inclination to perceive and comprehend geometric objects such as lines, figures, and shapes. Our understanding of the surrounding environment is greatly influenced by the perception and interpretation of these fundamental forms. As perceivers, we rely on the basic features of these forms, identifying both their similarities and differences, in order to gain a deeper understanding of our surroundings.

An architectural structure can be interpreted in two ways: as a unified entity or as a collection of distinct elements. When viewed as a unified entity, it is essential for the constituting elements of the building to be harmonious and cohesive in order to reinforce the perception of a cohesive whole. On the other hand, when perceived as separate components, these elements need to stand out, each possessing its own significance and unique attributes. The key objective in this scenario is to achieve a delicate balance between these two perspectives.

Trebacz (2019) proposed that the cognitive system has the ability to adapt to the input of spatial information, allowing individuals who are acquainted with a spatial layout to process and comprehend such information more effortlessly on repeated occasions. This adaptation is believed to enhance the perceiver's capacity to assimilate

J. Żórawski observed that in order for human perception to enhance the clarity and unity of the perceived form, it is essential to distinguish it from the background. Additionally, elements that exhibit characteristics such as order, rhythm, and repetition are more easily grasped and contribute to a sense of cohesiveness. This observation made by Żórawski aligns with the principles of Gestalt psychology, highlighting the similarity between the two perspectives on visual perception (Trebacz, 2019).

The process of perception, as described previously, involves the perceiver's perceptual apparatus actively analyzing and paying attention to the significant aspects that make up a structure. These important points are then interconnected to form a grid-like pattern, which plays a crucial role in defining the spatial form.

An architect has multiple objectives, one of which is to highlight and make easily noticeable and comprehensible the various elements of a structure to an observer. Additionally, apart from focusing on the aesthetics of the building, it is crucial for the architect to ensure that the design is well-suited and appropriate for the human environment in which it will be situated. This entails considering factors such as functionality, and comfort.

According to J. Żórawski, perception refers to the recollection of sensations associated with a specific spatial arrangement. This recollection is based on the alignment of points from previously encountered spatial configurations that were similar. In architecture, J. Żórawski played a significant role in implementing the principles of the psychology of form, which emphasized the importance of continuity, closeness, and good form. He believed that these elements were crucial for the creation of aesthetic aspects (Trebacz, 2019).

10. Culture and architecture

Culture and architecture share a deep connection, as architecture serves as a reflection of a society's history and culture. Monuments and historic buildings stand as tangible witnesses of our past and signify our growth as a community. The architectural styles prevalent within a community are often influenced by its unique culture. The intricate relationship between culture and architecture is so convolutedly intertwined that attempting to comprehend one without the context of the other proves to be futile. This interdependence highlights the profound impact that culture has on shaping architectural styles and designs, while also showcasing architecture's ability to embody and preserve the essence of a society's cultural heritage.

11. Significance of architectural design

In his study on the perceived value of artificially built attractions, Rattanaprichavej (2019) highlighted the significance of architectural design. He classified this value into three distinct components. This comprehensive research delves deep into the various aspects related to the perceived value of architectural design in artificially built attractions.

Functional value encompasses various aspects of a product's performance, including its efficiency, usefulness, durability, and reliability. It refers to how well a product meets its intended purpose and delivers on its promises.

Emotional value encompasses a wide range of emotions that users may encounter while interacting with a product or service. These emotions can shape their overall perception, either positively or negatively. It goes beyond the surface level of just having fun or feeling happy; it involves a deeper, more profound experience that captures the essence of beauty and aesthetic

Social value encompasses the set of societal norms, customs, and ethical standards that shape an individual's beliefs and actions. It plays a significant role in influencing how users perceive and behave. These values are not fixed and can evolve over time, varying across different regions and cultures. They form a fundamental part of our social fabric, guiding our interactions and influencing our moral compass.

III. Future directions

12. Virtual Reality (VR)

Future works may include the reassessment of the perceived architectural quality of the Khenchela culture house after the finalization of the design of the new envelope using Virtual Reality (VR) and following the proposed corrective action procedure in order to optimize the perceived architectural quality of buildings.

13. Artificial intelligence (AI)

Artificial intelligence (AI) is a multidisciplinary field that combines various scientific and technological disciplines, including Computer Science, Biology, Psychology, Linguistics, Mathematics, and Engineering. According to John McCarthy, a prominent figure in the field, AI can be defined as "*the science and engineering behind the development of intelligent machines*" (Joshi & Mishra, 2010: p.1). In essence, AI aims to create computers, computer-controlled machines, or software that can exhibit intelligent behavior, much like human intelligence.

Achieving AI involves an exploration and analysis of how the human brain thinks, learns, makes decisions, and solves problems. Researchers study these cognitive processes to understand how they can be replicated or emulated in intelligent systems. By leveraging the insights gained from this investigation, the development of intelligent solutions and systems capable of overcoming various challenges becomes possible.

The interdisciplinary nature of AI allows experts from different fields to contribute their knowledge and expertise, fostering collaboration and innovation. Computer scientists, biologists, psychologists, linguists, mathematicians, and engineers all play a crucial role in advancing AI technologies. Their collective efforts contribute to the continuous development and improvement of intelligent machines and software that can perform complex tasks effectively and efficiently.

In conclusion, AI represents a significant scientific and technological endeavor that seeks to develop intelligent machines through a comprehensive understanding of human intelligence. The pursuit of AI involves studying the intricacies of human cognition and using these insights to create intelligent solutions.

BIBLIOGRAPHICAL REFERENCES

1TOD. AEWORLDMAP.COM (3,000+ posts). (2010, August 31). Retrieved April 13, 2023, from https://aeworldmap.com/2010/08/30/tod%e2%80%99s-omotesando-tokyo-japan/1tod/

Aaker, D. A. (1991). Managing brand equity : capitalizing on the value of a brand name. Free Press ; Toronto.

Aaker, D. A., & Jacobson, R. (1994). The financial information content of perceived quality. *Journal of Marketing Research*, *31*(2), 191. https://doi.org/10.2307/3152193

Abu-Obeid, N. (1998). Abstract and scenographic imagery: the effect of environmental form on wayfinding. Journal of Environmental Psychology, 18, 159-173.

Adad, M. C. (2004). Les effets du rapport architecte et usager sur l'habitat. *Sciences Humaines,* 21, 39-51.

Adad, M. C. (2008). Participation de la population dans son habitat : cas d'un nouveau ksar au M'zab. *Science et technologie,* D28 , 67-76.

Akalin, A., Yildirim, K., Wilson, C., & Kilicoglu, O. (2009). Architecture and engineering students' evaluations of house façades: Preference, complexity and impressiveness. Journal of Environmental Psychology, 29(1), 124–132. DOI: https://doi.org/10.1016/j.jenvp.2008.05.005

Akin, Ö. (2001). Variants in design cognition. *Design Knowing and Learning: Cognition in Design Education*, 105–124. https://doi.org/10.1016/b978-008043868-9/50006-1

Alberti, L. B. (1991). *On the art of building in ten books*. MIT Press

Anderson, J. R. (1983). *The architecture of cognition*. Harvard University Press.

Anderson, J. R., Kline, P., & Lewis, C. (1977). A production system model for language processing. In P. Carpenter & M. Just (Eds.) *Cognitive Processes in Comprehension*, Hillsdale, NJ: Lawrence Erlbaum Associates.

Anderson, L. M., Mulligan, B. E., Goodman, L. S., & Rezen, H. Z. (1983). Effects of sounds on preferences for outdoor settings. *Environment and Behavior,* 15, 539-566.

Appleyard, D. (1981). Livable streets. Berkely: University of California Press.

Appleyard, D. (1969). Why buildings are known. Environment and Behavior 1: 131-156.

Appleyard, D. (1976). Planing a pluralistic city. Cambridge: MIT Press.

Appleyard, D. (1979). The environment as a social symbol. Journal of the American Planning Association 45: 143-153.

Ariffin, S., Yusof, J. M., Putit, L., & Shah, M. I. (2016). Factors influencing perceived quality and repurchase intention towards green products. *Procedia Economics and Finance*, 37, 391–396. https://doi.org/10.1016/s2212-5671(16)30142-3

Arnheim, R. (1985). The other Gustav Theodor Fechner. *A Century of Psychology as Science.* 856–865. https://doi.org/10.1037/10117-052

Asch, S. E. (1946). Forming impressions of personality. The Journal of Abnormal and Social Psychology, 41(3), 258–290. https://doi.org/10.1037/h0055756

Asshidin, N. H., Abidin, N., & Borhan, H. B. (2016). Perceived quality and emotional value that influence consumer's purchase intention towards American and local products.

Procedia Economics and Finance, 35, 639–643. https://doi.org/10.1016/s2212-5671(16)00078-2
Autodesk, (2003), "*Building Information Modeling in Practice*" White Paper, Autodesk Building Solutions
Baan, I., (2013). Heydar Aliyev Center. www.archdaily.com. Retrieved August 21, 2023, from https://www.archdaily.com/448774/heydar-aliyev-center-zaha-hadid-architects.
Balaban, C. Z., Karimpur, H., R¨oser, F., & Hamburger, K. (2017). Turn left where you felt unhappy: How affect influences landmark-based wayfinding. *Cognitive Processing, 18* (2), 135–144. https://doi.org/10.1007/s10339-017-0790-0
Balaban, C. Z., Roser, F., & Hamburger, K. (2014). The effect of emotions and emotionally laden landmarks on wayfinding. In, Vol. 36. Proceedings of the annual meeting of the cognitive science society. No. 36 https://escholarship.org/uc/item /4p60r568.
Barrett, L. F., Lewis, M., & Haviland-Jones, J. M. (2018). *Handbook of emotions*. The Guilford Press.
Başkaya, A., Wilson, C. & Özcan, Y. Z. (2004). Wayfinding in an unfamiliar environment: different spatial settings of two polyclinics. Environment and Behavior, 36, 839.
Baxter, M. (1995). *Product design: Practical methods for the systematic development of new products*. Stanley Thornes.
Berkowitz, M., Gerber, A., Thurn, C. M., Emo, B., Hoelscher, C., & Stern, E. (2021). Spatial abilities for architecture: Cross sectional and longitudinal assessment with novel and existing Spatial Ability Tests. *Frontiers in Psychology*, 11. https://doi.org/10.3389/fpsyg.2020.609363
Berlyne, D. E. (1960). Conflict, arousal and curiosity. New York: McGraw Hill Book.
Bianconi, F., Filippucci, M., Buffi, A., & Vitali, L. (2019). Morphological and visual optimization in Stadium Design: A digital reinterpretation of Luigi Moretti's stadiums. *Architectural Science Review*, *63*(2), 194–209. https://doi.org/10.1080/00038628.2019.1686341
Bittencourt, M. C., Pereira, V. L., & Júnior, W. P. (2015). The usability of architectural spaces: Objective and subjective qualities of built environment as multidisciplinary construction. Procedia Manufacturing, 3, 6429–6436. https://doi.org/10.1016/j.promfg.2015.07.919
Blijlevens, J., Carbon, C.-C., Mugge, R., & Schoormans, J. P. (2011). Aesthetic appraisal of product designs: Independent effects of typicality and arousal. British Journal of Psychology, 103(1), 44–57. https://doi.org/10.1111/j.2044-8295.2011.02038.x
Bloch, P. H., Brunel, F. F., & Arnold, T. J. (2003). Individual differences in the centrality of visual product aesthetics: Concept and measurement. *Journal of Consumer Research*, *29*(4), 551–565. https://doi.org/10.1086/346250
Blondel Jacques François. (1777). *Cours d'architecture, ou traité de la décoration, distribution et construction des bâtiments*. Desaint.
Böckenhoff Ewald, & Hamm, U. (1983). *Perspektiven des Marktes Für Alternativ Erzeugte Nahrungsmittel*. Univ. Hohenheim, Inst. für Agrarpolitik und Landw. Marktlehre.
Bosia, D. (2011). Long Form and Algorithm. *ARCHITECTURAL DESIGN MATHEMATICS OF SPACE*, *81*(4), 58–65.
Box, J.M.F. (1983), "Product Quality Assessment by Consumers — the Role of Product Information", *Industrial Management & Data Systems*, Vol. 83 No. 3/4. 25-31. https://doi.org/10.1108/eb057308
Bruner, J. S., & Goodman, C. C. (1947). Value and need as organizing factors in perception. The Journal of Abnormal and Social Psychology, 42(1), 33–44. https://doi.org/10.1037/h0058484

Brunyé, T. T., & Taylor, H. A. (2008). Working memory in developing and applying mental models from spatial descriptions. *Journal of Memory and Language*, 58(3), 701–729. https://doi.org/10.1016/j.jml.2007.08.003

Burry, M. (2011). Geometry Working Beyond Effect. *ARCHITECTURAL DESIGN MATHEMATICS OF SPACE*, *81*(4), 80–89.

Burry, M., 1999. Paramorph, Stephen Perella (ed.), AD Profile 141: Hypersurface Architecture II. London: Academic Editions.

Canadian Centre for Architecture. (n.d.). Retrieved April 13, 2023, from https://www.cca.qc.ca/en/search/details/collection/object/408962

Canter, D. (1969). An intergroup comparison of connotative dimensions in architecture. Environment and Behavior, 1(1), 37–48. DOI: https://doi. org/10.1177/001391656900100103

Canter, D., & Wools, R. (1970). A technique for the subjective appraisal of buildings. Building Science, 5, 187–198. DOI: https://doi. org/10.1016/0007-3628(70)90009-5

Carlson, David & Wronski, C.R.. (1976). Amorphous silicon solar cell. *Applied Physics Letters*. 28. 671 - 673. 10.1063/1.88617.

Chalup, S.K., Hong, K., & Ostwald, M.J. (2010). Simulating Pareidolia of Faces for Architectural Image Analysis. 2. 262-278.

Chan, L. K. (1998). Less is more or a bore? Detail and formal complexity in architecture. *Hong Kong Papers in Design and Development*, 1, 59–68.

Chatterjee, A., & Vartanian, O. (2014). Neuroaesthetics. *Trends in Cognitive Sciences*, *18*(7), 370–375. https://doi.org/10.1016/j.tics.2014.03.003

Chaudhuri, A. (2002). How brand reputation affects the advertising-brand equity link. *Journal of Advertising Research*, 42(3), 33–43. https://doi.org/10.2501/jar-42-3-33-43

Ching, F. D. K. (2015). *Architecture: Form, space, & order* (4th ed.). John Wiley & Sons.

Choi, S., Guerin, D., Kim, H., Brigham, J., & Bauer, T. (2014). Indoor environmental quality of classrooms and student outcomes:A path analysis approach. *Journal of Learning Spaces*, 2(2).

Chun, M. M., & Turk-Browne, N. B. (2007). Interactions between attention and memory. *Current Opinion in Neurobiology*, *17*(2), 177–184. https://doi.org/10.1016/j.conb.2007.03.005

Coburn, A., Vartanian, O., & Chatterjee, A. (2017). Buildings, beauty, and the brain: A neuroscience of architectural experience. Journal of Cognitive Neuroscience, 29(9), 1521–1531. https://doi.org/10.1162/jocn_a_01146

Cowen-Elstner, C. (2018). Impacting the Sensory Experience of Products : Experimental Studies on Perceived Quality. Springer Fachmedien Wiesbaden : Imprint : Springer Gabler.

Craik, K. H. (1983). The psychology of the large scale environment. In N. R. Feimer & E. S. Geller (Eds.), *Environment psychology: Directions and perspectives* (pp. 67-105). New York: Praeger.

Crilly, N., Moultrie, J., & Clarkson, P. J. (2004). Seeing things: Consumer response to the Visual Domain in product design. *Design Studies*, *25*(6), 547–577. https://doi.org/10.1016/j.destud.2004.03.001

Cross, N. (2011). *Design Thinking: Understanding how Designers Think and Work*. Oxford: Berg. https://doi.org/10.5040/9781474293884

Crozier, W. (1994). *Manufactured pleasures: Psychological responses to design*. Manchester University Press.

Cupchik, G C. (1999). Emotion and industrial design: Reconciling meanings and feelings. First International Conference on Design & Emotion, Delft, Netherlands. 75–82.

Curtis, W. J. R. (1987). *Modern Architecture since 1900*. Prentice-Hall.

Damasio, A. (1994). *Descartes' Error: Emotion, Reason, and the Human Brain*. Avon Books.
Daucé, B., & Rieunier, S. (2002). Le Marketing Sensoriel du point de Vente. *Recherche Et Applications En Marketing (French Edition), 17*(4), 45–65. https://doi.org/10.1177/076737010201700408
De Beni, R., Pazzaglia, F., Gyselinck, V., & Meneghetti, C. (2005). Visuospatial working memory and mental representation of spatial descriptions. *European Journal of Cognitive Psychology*, 17(1), 77–95. https://doi.org/10.1080/09541440340000529
Derradji, M., & Aiche, M. (2014). Modeling the soil surface temperature for natural cooling of buildings in hot climates. *Procedia Computer Science*, *32*, 615–621. https://doi.org/10.1016/j.procs.2014.05.468
de Tommaso, M., Pecoraro, C., Sardaro, M., Serpino, C., Lancioni, G., & Livrea, P. (2008). Influence of aesthetic perception on visual event-related potentials. *Consciousness and Cognition*, 17(3), 933–945. https://doi.org/10.1016/j.concog.2007.09.003
Deutscher, R. (2013). flickr. photograph. Retrieved June 6, 2023, from https://www.flickr.com/photos/bobarc/11448525635/in/photostream/.
Devlin, K., & Nasar, J. L. (1989). The beauty and the beast: Some preliminary comparisons of 'high' versus 'popular' residential architecture and public versus architect judgments of same. *Journal of Environmental Psychology*, *9*(4), 333–344. https://doi.org/10.1016/s0272-4944(89)80013-1
Dewey, J. (1980). Art as experience. New York: Perigee.
Esposito, C V. (1984). Methodological issues in the assessment of environmental sound perception: A strategy for empirical research. In D. Duerk & D. Campbell (Eds.), *EDRA 15: The challenge of diversity* (pp. 179-184). Washington, DC: Environmental Design Research Association.
Eugenio, E., & Parachini, M. (2011). *Restaurante Los Manantiales / Félix Candela*. www.archdaily.mx. Retrieved August 23, 2023, from https://www.archdaily.mx/mx/02-95859/clasicos-de-arquitectura-restaurante-los-manantiales-felix-candela.
Evans, G., Marrero, D., & Butler, P. (1981). Environmental learning and cognitive mapping. *Environment and Behavior,* 13, 83-104.
Evans, G., Smith, C, & Pezdek, K. (1982). Cognitive maps and urban form. Journal of the American Planning Association, 48, 232-244.
Evans, G., Smith, C, & Pezdek, K. (1982). Cognitive maps and urban form. *Journal of the American Planning Association,* 48, 232-244.
Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, Behavioral, and Biomedical Sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/bf03193146
Fiederer, L. (n.d.). *Palazzo dei Congressi / Louis Kahn*. www.archdaily.com. Retrieved August 21, 2023, from https://www.archdaily.com/789021/ad-classics-palazzo-dei-congressi-louis-kahn.
Forbes, L. H., & Ahmed, S. M. (2011). *Modern Construction: Lean Project Delivery and integrated practices*. CRC.
Gallery of 15 details of metal structures and facades for residential projects - 1. ArchDaily. (n.d.). Retrieved April 27, 2023, from https://www.archdaily.com/799868/15-details-of-metal-structures-and-facades-for-residential-projects/580a7b13e58ece844400003e-15-details-of-metal-structures-and-facades-for-residential-projects-image
Garden, S., Cornoldi, C., & Logie, R. H. (2002). Visuo-spatial working memory in Navigation. *Applied Cognitive Psychology*, *16*(1), 35–50. https://doi.org/10.1002/acp.746
Garofalo, V. (2017). Visual perception and graphic analysis. the pattern of inlays in the cathedral of palermo. *Proceedings of the International and Interdisciplinary Conference*

IMMAGINI? Brixen, Italy, 27–28 November 2017. https://doi.org/10.3390/proceedings1091085
Garvin, D. A. (1984). What does “product quality really mean? *Sloan Management Review*, 26: 25-43.
Garvin, D. A. (1988). *Managing quality the strategic and competitive edge*. Free Pr.
Gifford, R., Hine, D. W., Muller-Clemm, W., Reynolds, D. J., & Shaw, K. T. (2000). Decoding modern architecture: A lens model approach for understanding the aesthetic differences of architects and layperson. Environment and Behavior, 32(2), 163–187. DOI: https://doi.org/10.1177/00139160021972487
Gifford, R., Hine, D. W., Muller-Clemn, W., & Shaw, K. T. (2002). Why architects and laypersons judge buildings differently: cognitive properties and physical bases. *Journal of Architectural and Planning Research*, 19, 131–148.
Gimblett, H. R., Itami, R. M., & Fitzgibbon, J. E. (1985). Mystery in an information processing model of landscape preference. *Landscape Journal*, *4*(2), 87–95. https://doi.org/10.3368/lj.4.2.87
GIORDANO, J. L. (2006). *L’approche qualité perçue* (Éditions d’Organisation). Groupe Eyrolles.
Golledge, R.G. (1991). Cognition of Physical and Built Environments. In: Gärling, T. and Evans, G.W., Eds., Environment, Cognition, and Action: An Integrated Approach, Oxford University Press, New York, 35-62.
Gomez-Tone, H. C., Martin-Gutierrez, J., Bustamante-Escapa, J., Bustamante-Escapa, P., & Valencia-Anci, B. K. (2021). Perceived sensations in architectural spaces through immersive virtual reality. *VITRUVIO - International Journal of Architectural Technology and Sustainability*, 6(2), 70–81. https://doi.org/10.4995/vitruvio-ijats.2021.16253
Gonzalez, M. (1960). Convent of La Tourette / Le Corbuiser. www.archdaily.com. Retrieved August 21, 2023, from https://www.archdaily.com/96824/ad-classics-convent-of-la-tourette-le-corbuiser.
Gregorians, L., Velasco, P. F., Zisch, F., & Spiers, H. J. (2022). Architectural experience: Clarifying its central components and their relation to core affect with a set of first-person-view videos. *Journal of Environmental Psychology*, 82, 101841. https://doi.org/10.1016/j.jenvp.2022.101841
Groat, L. (1982). Meaning in post-modem architecture: An examination using the multiple sorting task. Journal of Environmental Psychology, 2, 3-22.
Groat, L. N. (1988). Contextual compatibility in architecture: An issue of personal taste? *Environmental Aesthetics*, 228–254. https://doi.org/10.1017/cbo9780511571213.023
Groat, L., & Despres, C. (1990). The significance of architectural theory for environmental design research. In E. H. Zube & G. T. Moore (Eds.), Advances in environment, behavior, and design: Vol. 4 (pp. 3-53). New York: Plenum.
Grönroos, C. (1984). A service quality model and its marketing implications. *European Journal of Marketing*, *18*(4), 36–44. https://doi.org/10.1108/eum0000000004784
Grütter, J. K. (2020). Basics of Perception in Architecture (1st ed. 2020 ed.). Springer Vieweg.
Hamdaoui, A.E.D., Adad, M.C. (2020). Enhancing Perceived Quality and Comfort Optimization Through a Parametric CAD/Simulation-Based Process. In: Hatti, M. (eds) Smart Energy Empowerment in Smart and Resilient Cities. ICAIRES 2019. Lecture Notes in Networks and Systems, vol 102. Springer, Cham. https://doi.org/10.1007/978-3-030-37207-1_30
Hamdaoui, A., Adad, M. C., Haridi, I., & Ansar, A. M. (2022). Evaluation of perceived architectural quality - case of Culture House of the city of Khenchela, Algeria. *International Journal of Innovative Studies in Sociology and Humanities*, *7*(9), 138–146. https://doi.org/10.20431/2456-4931.070914

Harputlugil T., Gültekin A. T., Topcu Y. İ. (2009, October 09). Architectural Design Quality The Practitioners Perspective An AHP based Approach for Assessment International Conference on Chancing Roles: New Roles, New Challenges, Noordwijk aan Zee, Netherlands, 259-268

Harries, K. (2000). *The ethical function of Architecture*. MIT Press.

Harrison, J. D., & Howard, W. A. (1972). The role of meaning in the urban image. *Environment and Behavior*, 4, 398-411.

Heft, H. (1979). The role of environmental features in route-learning: Two exploratory studies of way-finding. *Environmental Psychology and Nonverbal Behavior*, 3, 172-185.

Hekkert, P. (2006). Design aesthetics: principles of pleasure in design. *Psychology Science, 48*(2), 157.

Hellofs, L. L., & Jacobson, R. (1999). Market share and customers' perceptions of quality: When can firms grow their way to higher versus lower quality? *Journal of Marketing, 63*(1), 16. https://doi.org/10.2307/1251998

Helmholtz, H. V., Wade, N., & Southall, J. P. C. (2000). *Helmholtz's Treatise on Physiological Optics (Facsimile)*. Thoemmes Continuum.

Hensel, M., & Menges, A. (2006). Material and Digital Design Synthesis. *ARCHITECTURAL DESIGN Techniques and Technologies in Morphogenetic Design*, *76*(2), 88–95.

Herford MART. (n.d.). wikimedia. Retrieved May 29, 2023, from https://commons.wikimedia.org/wiki/File:Herford_MARTa_88.jpg.

Hershberger, R G., & Cass, R (1988). Predicting user responses to buildings. In J. L. Nasar (Ed.), Environmental aesthetics: Theory, research and application (pp. 195-211). New York: Cambridge University Press. (Original work published 1974)

Hershberger, R. G. (1972). Towards a set of semantic scales to measure the meaning of architectural environments. In W. Mitchell (Ed.) EDRA III, Proceedings of the Third Annual Conference. Los Angeles: University of California.

Hervé , L. (n.d.). *Urbanisme, projets A,B,C,H, Algiers*. http://www.fondationlecorbusier.fr. Retrieved August 21, 2023, from http://www.fondationlecorbusier.fr/corbuweb/morpheus.aspx?sysId=13&IrisObjectId=6259&sysLanguage=en-en&itemPos=6&itemCount=215&sysParentName=&sysParentId=6.

Herzog, T. R. & Leverich, O. L. (2003). Searching for legibility. Environment and Behavior, 35, 459.

Herzog, T. R., & Gale, T. A. (1996). Preference for urban buildings as a function of age and nature context. Environment and Behavior, 28(1), 44–72. DOI: https://doi.org/10.1177/0013916596281003

Herzog, T. R., & Leverich, O. L. (2003). Searching for legibility. *Environment and Behavior,* 35(4), 459–477. https://doi.org/10.1177/0013916503035004001

Herzog, T. R., & Shier, R. L. (2000). Complexity, age, and building preferences. Environment and Behavior, 32(4), 557–575. DOI: https://doi. org/10.1177/00139160021972667

Herzog, T. R., Kaplan, S., & Kaplan, R. (1976). The prediction of preference for familiar urban places. Environment and Behavior, 8(4), 627–645. DOI: https://doi.org/10.1177/001391657684008

Higuera-Trujillo, J. L., Llinares, C., & Macagno, E. (2021). The cognitive-emotional design and study of architectural space: A scoping review of neuroarchitecture and its precursor approaches. *Sensors*, *21*(6), 2193. https://doi.org/10.3390/s21062193

Hjorth-Andersen, C. (1984). The concept of quality and the efficiency of markets for consumer products. *Journal of Consumer Research*, *11*(2), 708–718. https://doi.org/10.1086/209007

Holzer, D., & Downing, S. (2010). Optioneering: A New Basis for Engagement Between Architects and their Collaborators. *ARCHITECTURAL DESIGN THE NEW STRUCTURALISM DESIGN, ENGINEERING AND ARCHITECTURAL TECHNOLOGIES*, *80*(4), 60–63.

Home. GradAustralia. (n.d.). Retrieved April 13, 2023, from https://gradaustralia.com.au/interviews/macquarie-shelley-street-sydney-office-tour

Homolja, M., Maghool, S. A. H., Schnabel, M. A. (2020). The Impact of Moving through the Built Environment on Emotional and Neurophysiological State-A Systematic Literature Review. In *Proceedings of the 25th International Conference of the Association for Computer-Aided Architectural Design Research in Asia (CAADRIA) 2020, Hong Kong*.

Horayangkura, V. (1978). Semantic dimensional structure: a methodological approach. Environment and Behavior, 110(4), 555–584. DOI: https://doi.org/10.1177/001391657801000405

Howes, E. P. (1910). The study of perception and the architectural idea. *The Philosophical Review*, *19*(5), 505. https://doi.org/10.2307/2177313

Huang, L. V. (2011). Sequential Processing. *Encyclopedia of Clinical Neuropsychology,* 2261–2262. https://doi.org/10.1007/978-0-387-79948-3_1491

Hunt, M. (1984). Environmental learning without being there. Environment and Behavior, 16:3, 307.

Hunt, M. E. (1991). The design of supportive environments for older people. *Journal of Housing for the Elderly*, 9(1-2), 127–140. https://doi.org/10.1300/j081v09n01_09

Hutmacher, F. (2019). Why is there so much more research on vision than on any other sensory modality? *Frontiers in Psychology*, 10, 2246. https://doi.org/10.3389/fpsyg.2019.02246.

IBM Research Center, *La Gaude*, *France*. Works.io. (n.d.). Retrieved April 13, 2023, from https://www.works.io/101887/ibm-research-center-la-gaude-france

Ikemi, M. (2005). The effects of mystery on preference for residential facades. Journal of Environmental Psychology, 25(2), 167–173. DOI: https://doi.org/10.1016/j.jenvp.2005.04.001

Jabi, W. (2013). *Parametric design for architecture*. Laurence King.

Jang, S. C. (S., & Namkung, Y. (2009). Perceived quality, emotions, and behavioral intentions: Application of an extended Mehrabian–russell model to restaurants. *Journal of Business Research*, 62(4), 451–460. https://doi.org/10.1016/j.jbusres.2008.01.038

Jankowski, T., Francuz, P., Oleś, P., & Chmielnicka-Kuter, E. (2018). The effect of temperament, expertise in art, and formal elements of paintings on their aesthetic appraisal. *Psychology of Aesthetics, Creativity, and the Arts*. http://dx.doi.org/10.1037/aca0000211

Jennath, K. A., & Nidhish, P. J. (2016). Aesthetic judgement and visual impact of architectural forms: A study of library buildings. Procedia Technology, 24, 1808–1818. https://doi.org/10.1016/j.protcy.2016.05.226

Johnston, J. C., & Pashler, H. (1990). Close binding of identity and location in visual feature perception. *Journal of Experimental Psychology: Human Perception and Performance,* 16(4), 843–856. https://doi.org/10.1037/0096-1523.16.4.843

Jonassen, D. H., Beissner, K., & Yacci, M. (1993). Structural knowledge: Techniques for representing, conveying, and acquiring structural knowledge (1st ed.). Erlbaum.

Joshi, A., & Mishra, G. (2010). Artificial Intelligence. *Proceedings of the International Conference and Workshop on Emerging Trends in Technology*. https://doi.org/10.1145/1741906.1742236

Julean, D. (2016). Why Architects See Things Differently An Architectural Approach On Teaching Space Perception. *European Scientific Journal, ESJ*, *12*(10). https://doi.org/10.19044/esj.2016.v12n10p%p

Juran, J. M., & Godfrey, A. B. (1999). *Juran's Quality Handbook*. McGraw-Hill.

Kahn, L. (1957). Architecture is the thoughtful making of spaces. Perspecta, 2-3.

Kaplan, R., & Kaplan, S. (1989). The experience of nature: A psychological perspective.New York: Cambridge University Press.

Kaplan, S. (1975). An informal model for the prediction of preference. In Landscape Assessment: Values, Perceptions and Values, Eds., E. H. Zube, R. Brush, and J. Fabos. Stroudsburg, Pa.: Dowden, Hutchinson & Ross.

Kaplan, S., (1973). Cognitive maps, human needs, and the designed environment. In Environmental Design Research, Vol. 1, Ed., W. Preiser. Stroudsburg, Pa.: Dowden Hutchinson & Ross.

Karakas, T., & Yildiz, D. (2020). Exploring the influence of the built environment on human experience through a neuroscience approach: A systematic review. *Frontiers of Architectural Research*, 9(1), 236–247. https://doi.org/10.1016/j.foar.2019.10.005

Kerbush , R. (2012). Dz-40 Khenchela. https://commons.wikimedia.org. Retrieved September 1, 2022, from https://commons.wikimedia.org/wiki/File:DZ-40_Khenchela.svg.

Kim, C., Zhao, W., & Yang, K. H. (2008). An empirical study on the integrated framework of e-CRM in online shopping. *Journal of Electronic Commerce in Organizations*, *6*(3), 1–19. https://doi.org/10.4018/jeco.2008070101

Kim, J. H., Kim, M., & Kandampully, J. (2009). Buying environment characteristics in the context of e-service. *European Journal of Marketing*, *43*(9/10), 1188–1204. https://doi.org/10.1108/03090560910976438

Kirby, K., & Kosslyn, S. (1990). Thinking visually. Mind &; Language, 5(4), 324–341. https://doi.org/10.1111/j.1468-0017.1990.tb00167.x

Kolarevic, B. (2003). *Architecture in the digital age: Design and manufacturing*. Taylor & Francis.

Koseoglu, E., & Onder, D. E. (2011). Subjective and objective dimensions of spatial legibility. *Procedia - Social and Behavioral Sciences*, *30*, 1191–1195. https://doi.org/10.1016/j.sbspro.2011.10.231

Koseoglu, E., & Onder, D. E. (2011). Subjective and objective dimensions of spatial legibility. *Procedia -Social and Behavioral Sciences*, 30, 1191–1195. https://doi.org/10.1016/j.sbspro.2011.10.231

Kotler, P. (1984). *Marketing management: Analysis, planning, and Control* (5th ed.). Prentice-Hall.

Kotnik, T., & Weinstock, M. (2012). Material, Form and Force. *ARCHITECTURAL DESIGN Material Computation*, 104–111.

Kuehn, A. A., & Day, R. L. (1962). Strategy of product quality. Harvard Business Review.

Kuliga, S. F., Thrash, T., Dalton, R. C., & Hölscher, C. 2015. Virtual reality as an empirical research tool—Exploring user experience in a real building and a corresponding virtual model. *Computers, Environment and Urban Systems*, 54, 363–375. https://doi.org/10.1016/j.compenvurbsys.2015.09.006

Küller, R. (1992). Environmental assessment from a neuropsychological perspective. *Environment, Cognition, and Action*, 111–111. https://doi.org/10.1093/oso/9780195062205.003.0012

Kupsch, P., Hufschmied, P., Mathes, H. D., & Schöler, K. (1978). *Die Struktur von Qualitätsurteilen und das informationsverhalten von Konsumenten Beim Kauf Langlebiger Gebrauchsgüter*. https://doi.org/10.1007/978-3-322-88605-7

Kurosu, M., & Kashimura, K. (1995, May 7-11). Apparent usability vs. inherent usability: experimental analysis on the determinants of the apparent usability. Denver, Colorado. Conference companion on Human factors in computing systems. 292-293.

Lachter, J., Forster, K. I., & Ruthruff, E. (2004). Forty-five years after Broadbent (1958): Still no identification without attention. *Psychological Review, 111*(4), 880–913. https://doi.org/10.1037/0033-295x.111.4.880
Ladwein, R. (may 2001). L'impact de la conception des sites de e-commerce sur le confort d'utilisation : une proposition de modèle. Congrès International de l'Association Française du Marketing ,vol 17,Deauville, France.
Laird, J. (2012). *The Soar Cognitive Architecture*. MIT Press.
Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for T-tests and ANOVAS. *Frontiers in Psychology*, *4*. https://doi.org/10.3389/fpsyg.2013.00863
Lang, J. (1988). Symbolic aesthetics in architecture: Toward a research agenda. In J. L. Nasar (Ed.), Environmental aesthetics: Theory, research, and applications (pp. 11-26). New York: Cambridge University Press.
Lansing, J. B., Marans, R W., & Zehner, R B. (1970). *Planned residential environments.* Ann Arbor: University of Michigan, Survey Research Center Institute for Social Research.
Le Corbusier. (1986). *Towards a new architecture*. Dover Publications .
Leatherbarrow, D., & Mostafavi, M. (2005). Surface architecture. Mit Press.
Lecourtois, C. (2009). Quelles qualités pour l'espace architectural ? *Revue Du Réseau Activités et Métiers de l'Architecture et de l'Urbanisme (RAMAU)*, *5*(2009), 71–87.
Leder, H. (2013). Next steps in neuroaesthetics: Which processes and processing stages to study? *Psychology of Aesthetics, Creativity, and the Arts*, *7*(1), 27–37. https://doi.org/10.1037/a0031585
Leder, H., Belke, B., Oeberst, A., & Augustin, D. (2004). A model of aesthetic appreciation and aesthetic judgments. *British Journal of Psychology*, 95(4), 489–508. https://doi.org/10.1348/0007126042369811
Lee, R., & Nan, L.S. (2013). How the Elements of Arquitectural Design, Color, Lighting and Layout of a Quick-service Restaurant Image (QSRI) Influences Perceived Value, Customer Satisfaction and Revisit Intentions. In *Proceedings of the Asian Conference on Media and Mass Communication 2013, Osaka, Japan.*
Lei, S. A. (2010). Classroom physical design influencing student learning and evaluation of college instructors: A review of literature. *Education*, 131(1), 128–134.
Lewalski, Z. M. (1988). *Product esthetics: An interpretation for designers*. Design and Development Engineering Press.
Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years? Journal of environmental psychology, 31(3), 207–230. DOI: https://doi.org/10.1016/j.jenvp.2010.10.001
Li, X., Li, P., Wu, Z., Luo, D., Yu, H.-Y., & Lu, Z.-H. (2021). Review and perspective of materials for flexible solar cells. *Materials Reports: Energy*, *1*(1), 100001. https://doi.org/10.1016/j.matre.2020.09.001
Lidwell, W., Butler, J., & Holden, K. (2003). Universal principles of design: A cross disciplinary reference. Rockport Publishers.
Liu, Y., Fu, Q. F., & Fu, X. L. (2009). The interaction between cognition and Emotion. *Chinese Science Bulletin*, *54*(22), 4102–4116. https://doi.org/10.1007/s11434-009-0632-2
Louzazni, M., Khouya, A., Crăciunescu, A., Amechnoue, K., & Mussetta, M. (2020). Modelling and parameters extraction of flexible amorphous silicon solar cell a-Si:H. *Applied Solar Energy*, *56*(1), 1–12. https://doi.org/10.3103/s0003701x20010090
Lowenthal, D., & Riel, M. (1972). The nature of perceived and imaged environments. Environment and Behavior, 4, 189–207. DOI: https://doi.org/10.1177/001391657200400203

Ludwig-Mies-van-Der-rohe-court-house-project-1934.jpg. Are.na. (n.d.). Retrieved April 12, 2023, from https://www.are.na/block/1054652

Lutz, R. (1986). Quality is as quality does: An attitudinal perspective on consumer quality judgments. In Presentation to the Marketing Science Institute Trustees' Meeting, Cambridge, MA.

Lynch, K. (1960). *The image of the city*. MIT Press.

Määttänen, P. (2017). Emotions, values, and aesthetic perception. *New Ideas in Psychology*, 47, 91–96. https://doi.org/10.1016/j.newideapsych.2017.03.009

Macarthur, J. (2002). The image as an architectural material. South Atlantic Quarterly, 101(3), 673–693. https://doi.org/10.1215/00382876-101-3-673

Malhis, S. (2016). Narratives in Mamluk architecture: Spatial and perceptual analyses of the madrassas and their mausoleums. *Frontiers of Architectural Research*, *5*(1), 74–90. https://doi.org/10.1016/j.foar.2015.11.002

Mangelsdorf, W. (2010). Structuring strategies for complex geometries. *ARCHITECTURAL DESIGN THE NEW STRUCTURALISM DESIGN, ENGINEERING AND ARCHITECTURAL TECHNOLOGIES*, *80*(4), 40–45.

Maynes, E. S. (1976). *Decision-making for consumers: An introduction to consumer economics*. Macmillan.

Mazouz, S., & Zerouala, M. S. (2001). The integration of environmental variables in the process of architectural design. *Energy and Buildings*, *33*(7), 699–710. https://doi.org/10.1016/s0378-7788(00)00109-2

Melgaard, E., Hadjimichael, G., Almeida, M., & Verhoef, L. G. W. (2007). *COST C16 Improving the Quality of Existing Urban Building Envelopes Needs*. IOS Press.

Menges, A. (2006). Instrumental Geometry. *ARCHITECTURAL DESIGN Techniques and Technologies in Morphogenetic Design*, *76*(2), 42–53.

Milligan, M. J. (2007). Buildings as history: The place of collective memory in the study of historic preservation. Symbolic Interaction, 30(1), 105–123. DOI: https://doi.org/10.1525/si.2007.30.1.105

Mitra, D., & Golder, P. N. (2006). How does objective quality affect perceived quality? short-term effects, long-term effects, and asymmetries. *Marketing Science*, *25*(3), 230–247. https://doi.org/10.1287/mksc.1050.0175

Monö Rune. (1997). *Design for product understanding*. Liber AB.

Mouh2jijel. (2020). Dz-40 (2019). https://commons.wikimedia.org. Retrieved September 1, 2022, from https://commons.wikimedia.org/wiki/File:DZ-40_(2019).svg.

Moussavi, F., & Polo, A. (2004). Types, Style and Phylogenesis. *ARCHITECTURAL DESIGN Emergence: Morphogenetic Design Strategies*, 34–39.

Mumcu, Y., & Kimzan, H. S. (2015). The effect of visual product aesthetics on consumers' price sensitivity. *Procedia Economics and Finance*, 26, 528–534. https://doi.org/10.1016/s2212-5671(15)00883-7

Murphy, K. R., Myors, B., & Wolach, A. (2014). *Statistical Power Analysis: A simple and general model for traditional and modern hypothesis tests*. Routledge.

Murray, S. (2009). *Contemporary Curtain Wall Architecture*. Princeton Architectural Press.

Myers, J. H., & Shocker, A. D. (1981). The nature of product-related attributes. *Research in marketing*, 5(5), 211-236.

Nadal, M., & Skov, M. (2013). Introduction to the special issue: Toward an interdisciplinary neuroaesthetics. *Psychology of Aesthetics, Creativity, and the Arts*, *7*(1), 1–12. https://doi.org/10.1037/a0031842

Naidja, A., & Bourbia, F. (2021). The using of generative algorithm aided design tool (Rhinoceros/Grasshopper/Ladybug) to control solar access in urban street of hot-arid climate (Ouargla). *Revue ELBahith en Sciences Humaines et Sociales*, *13(01)*, 487-496.

Nasar, J. L. (1983). Adult viewers' preferences in residential scenes: A study of the relationship of environmental attributes to preference. Environment and Behavior,15, 589-614.

Nasar, J. L. (1984). Visual preference in urban street scenes: A cross-cultural comparison between Japan and the United States. Journal of Cross-Cultural Psychology,15, 79-93.

Nasar, J. L. (1989a). Perception, cognition, and evaluation of urban places. In I. Altman & E. H. Zube (Eds.), Public places and spaces: Human behavior and environment: Vol. 10 (pp. 31-56). New York: Plenum.

Nasar, J. L. (1994). Urban design aesthetics: The evaluative qualities of building exteriors. Environment and Behavior, 26, 377–401. DOI: https://doi. org/10.1177/001391659402600305

Nasar, J. L., & Kang, J. (1988). Symbolic meanings of building style in small suburban offices. In G. Hardie, A. Moore, & H. Sanoff (Eds.), Changing paradigms: EDRA20 (pp. 165-172). Oklahoma City, OK: EDRA.

Newcombe, N. S., & Shipley, T. F. (2015). Thinking about spatial thinking: New typology, new assessments. *Studying Visual and Spatial Reasoning for Design Creativity*, 179–192. https://doi.org/10.1007/978-94-017-9297-4_10

Newman, O. (1996). *Creating defensible space*. Diane Publishing.

Ng, C. F. (2020). Perception and Evaluation of Buildings: The Effects of Style and Frequency of Exposure. Collabra: Psychology, 6(1): 44. DOI: https://doi.org/10.1525/collabra.324

Norman, D. (2013). *The design of everyday things*. New York: Basic Books.

Norman, D. A. (2004). *Emotional design: Why we love (or hate) everyday things*. Basic Books.

O'Neill, M. J. (1991). Evaluation of a conceptual model of architectural legibility. Environment and Behavior, 23:3, 259.

Olson, J. C. & Jacoby, J. (1972). Cue utilization in the quality perception process. In *Proceedings of the Third Annual Conference of the Association of Consumer Research*, ed. M. Venkate-San. Association for Consumer Research, Iowa City, 167-79.

Olson, J., & Reynolds, T. (1983). *Understanding Consumers' Cognitive Structures: Implications for Advertising Strategy*. In L. Percy, & A. Woodside (Eds.), Advertising and Consumer Psychology. Lexington, MA: Lexington Books.

Oostendorp, A., & Berlyne, D. E. (1978). Dimensions in the perception of architecture: Identification and interpretation of dimensions of similarity. Scandinavian Journal of Psychology,19,73-82.

Osgood, C. E., Suci, G. J., & Tannenbaum, P. H. (1967). *The measurement of meaning*. University of Illinois Press.

Oude Ophuis, P. A. M., & Van Trijp, H. C. M. (1995). Perceived quality: A market driven and consumer oriented approach. *Food Quality and Preference*, 6(3), 177–183. https://doi.org/10.1016/0950-3293 (94)00028-t

Oxenfeldt, A. R. (1950). Consumer knowledge: Its measurement and extent. *The Review of Economics and Statistics*, *32*(4), 300. https://doi.org/10.2307/1925578

Oxman , R., & Oxman, R. (2010). The new structuralism: design, engineering and architectural technologies. *ARCHITECTURAL DESIGN THE NEW STRUCTURALISM DESIGN, ENGINEERING AND ARCHITECTURAL TECHNOLOGIES*, *80*(4), 15–23.

Palmiero, M., & Piccardi, L. (2017). The role of emotional landmarks on topographical memory. *Frontiers in Psychology*, *8*, 763. https://doi.org/10.3389/fpsyg.2017.00763

Parasuraman, A., Zeithaml, VA. & Berry, L.L. (1988). SERVQUAL: A multi-item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, 64: 12-40.

Pasqualini, I., Blefari, M. L., Tadi, T., Serino, A., & Blanke, O. (2018). The Architectonic Experience of body and space in augmented interiors. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.00375

Pedersen, D. M. (1978). Dimensions of environmental perception. Multivariate Experimental Clinical Research, 3(5), 209–218.
Petrick, J. F. (2002). Development of a multi-dimensional scale for measuring the perceived value of a service. *Journal of Leisure Research*, *34*(2), 119–134. https://doi.org/10.1080/00222216.2002.11949965
Pham, M. T., Cohen, J. B., Pracejus, J. W., & Hughes, G. D. (2001). Affect monitoring and the primacy of feelings in judgment. Journal of Consumer Research, 28(2), 167–188. https://doi.org/10.1086/322896
Philippot, P. & Schaefer, A. (2001). Emotion and memory. In T.J. Mayne and G.A. Bonano (Eds.), Emotion: current issues and future directions, 82-122. New York: Guilford Press.
Pollio, V., & Morgan, M. H. (1960). *Vitruvius: The ten books on architecture*. Dover Publications.
Posner, M. I., Nissen, M. J., & Klein, R. M. (1976). Visual dominance: An information-processing account of its origins and significance. *Psychological Review*, 83(2), 157–171. https://doi.org/10.1037/0033-295x.83.2.157
Pottmann, H. (2010). Architectural Geometry as Design Knowledge. *ARCHITECTURAL DESIGN THE NEW STRUCTURALISM DESIGN, ENGINEERING AND ARCHITECTURAL TECHNOLOGIES*, *80*(4), 72–77.
Purcell, A. T. (1986). Environmental perception and affect: A schema discrepancy model. *Environment and Behavior*, 18, 3-30.
Rao, A. R., Qu, L., & Ruekert, R. W. (1999). Signaling unobservable product quality through a brand Ally. *Journal of Marketing Research*, *36*(2), 258. https://doi.org/10.2307/3152097
Rapoport, A. (1990). *History and precedent in Environmental Design*. Plenum Press.
Rattanaprichavej, N. (2019). An interaction of architectural design and perceived value toward revisit intention in artificially built attractions. *Real Estate Management and Valuation*, *27*(3), 69–80. https://doi.org/10.2478/remav-2019-0026
RIBA Publications.
Rönn, M. (2014). Quality in Architecture - A Disputed Concept. ARCC Spring Research Conference. Detroit, Michigan,USA.
Rosenthal, R. (1991). *Meta-analytic procedures for social research* (Rev. ed). Newbury Park: Sage Publications.
Rowe, P. G. (1987). *Design Thinking*. Cambridge, MA: MIT press.
Roy, S., Baruah, M. S., Sahu, S., & Nayak, B. B. (2021). Computational analysis on the thermal and mechanical properties of thin film solar cells. *Materials Today: Proceedings*, *44*, 1207–1213. https://doi.org/10.1016/j.matpr.2020.11.241
Rudolph, P. (1961). Paul Rudolph. for Perspecta. *Perspecta*, *7*, 51. https://doi.org/10.2307/1566866
Ruotolo, F., Claessen, M. H., & van der Ham, I. J. (2018). Putting emotions in routes: The influence of emotionally laden landmarks on spatial memory. *Psychological Research*, 83(5), 1083–1095. https://doi.org/10.1007/s00426-018-1015-6
Ruotolo, F., Sbordone, F. L., & van der Ham, I. J. M. (2021). The influence of stimuli valence and arousal on spatio-temporal representation of a route. *Brain Sciences*, *11* (6), 814. https://doi.org/10.3390/brainsci11060814
Saaty, T. L. (1990). How to make a decision: The Analytic Hierarchy Process. European Journal of Operational Research, 48(1), 9–26. https://doi.org/10.1016/0377-2217(90)90057-i
Sadalla, E. K., & Sheets, V. L. (1993). Symbolism in building materials. *Environment and Behavior*, *25*(2), 155–180. https://doi.org/10.1177/0013916593252001
Sánchez-Franco, M. J., Villarejo-Ramos, Á. F., Peral-Peral, B., Buitrago-Esquinas, E. M., & Roldán, J. L. (2013). Users' perception of visual design and the usefulness of a web-based

educational tool. Procedia - Social and Behavioral Sciences, 93, 1916–1921. https://doi.org/10.1016/j.sbspro.2013.10.140

Savoie, A. (2015). Aesthetic experience and creativity in arts education: Ehrenzweig and the primal syncretistic perception of the child. *Cambridge Journal of Education*, *47*(1), 53–66. https://doi.org/10.1080/0305764x.2015.1102864

Scheurer, F. (2010). Materialising Complexity. *ARCHITECTURAL DESIGN THE NEW STRUCTURALISM DESIGN, ENGINEERING AND ARCHITECTURAL TECHNOLOGIES*, *80*(4), 86–93.

Schuster, M., & Beisl, H. (1978). Kunst-Psychlogie: Wodurch Kunstwerke Wirken. DuMont Buchverlag.

Shannon, C. E. (1948). A mathematical theory of communication. *Bell System Technical Journal*, *27*(3), 379–423. https://doi.org/10.1002/j.1538-7305.1948.tb01338.x

Silvestri, C. (2009). *Perception et conception en architecture non standard: Une approche expérimentale pour l'étude des Processus de conception Spatiale des Formes complexes*. Architecture, aménagement de l'espace. Université Montpellier II - Sciences et Techniques du Languedoc.

Skaza, M. (2019). Architecture as a Consequence of Perception. In *IOP Conference Series: Materials Science and Engineering* (pp. 1–7). IOP Publishing.

Smith, P. (1974). The Dynamics of Urbanism, London: Hutchinson Educational.

Smith, P. (1987). Architecture and the Principle of Harmony, London:

Snoj, B., Pisnik Korda, A., & Mumel, D. (2004). The relationships among perceived quality, perceived risk and perceived product value. *Journal of Product & Brand Management*, *13*(3), 156–167. https://doi.org/10.1108/10610420410538050

Sonnenfeld, J. (1966). Variable values in the space and landscape: An inquiry into the nature of environmental necessity. Journal of Social Issues, 4, 71-82.

Spence, C. (2020). Senses of Place: Architectural Design for the multisensory mind. *Cognitive Research: Principles and Implications*, *5*(1). https://doi.org/10.1186/s41235-020-00243-4

Sprott, D. E., & Shimp, T. A. (2004). Using product sampling to augment the perceived quality of store brands. *Journal of Retailing*, 80(4), 305–315. https://doi.org/10.1016/j.jretai.2004.10.006

Stamps, A. E. III (1991). Public preferences for high-rise buildings: Stylistic and demographic effects. Perceptual and Motor Skills, 72, 839–844. DOI: https://doi.org/10.2466/PMS.72.3.839-844

Stamps, A. E. III (1999). Physical determinants of preference for residential facades. Environment and Behavior, 31(6), 723–751. DOI: https://doi.org/10.1177/00139169921972326

Steenkamp, J.-B. E. M. (1990). Conceptual model of the quality perception process. *Journal of Business Research*, 21(4), 309–333. https://doi.org/10.1016/0148-2963(90)90019-a

Storbeck, J., & Clore, G. L. (2007). On the interdependence of cognition and emotion. *Cognition & Emotion*, *21*(6), 1212–1237. https://doi.org/10.1080/02699930701438020

Subramanian, G. (2015). *Python Data Science Cookbook*. Packt Publishing Limited.

Summerfield, J. J., Rao, A., Garside, N., & Nobre, A. C. (2011). Biasing perception by spatial long-term memory. *Journal of Neuroscience*, 31(42), 14952–14960. https://doi.org/10.1523/jneurosci.5541-10.2011

Sussman, A., & Hollander, J. B. (2015). *Cognitive architecture: Designing for how we respond to the built environment*. Routledge, Taylor & Francis Group.

Taylor, H. A., & Brunyé, T. T. (2013). The cognition of spatial cognition: Domain-general within domain-specific. *Psychology of Learning and Motivation*, 77–116. https://doi.org/10.1016/b978-0-12-407237-4.00003-7

Tedeschi, A., Andreani, S., & Wirz, F. (2014). *AAD_Algorithms-aided design: Parametric strategies using grasshopper*. Le Penseur Publisher.

The University of Technology main building. Aalto University. (2018, June 17). Retrieved April 29, 2023, from https://www.aalto.fi/en/locations/undergraduate-centre

Tractinsky, N., Katz, A. S., & Ikar, D. (2000). What is beautiful is usable. *Interacting with Computers*, *13*(2), 127–145. https://doi.org/10.1016/s0953-5438(00)00031-x

Trębacz, P. (2019). Visual Perception of Architecture According to the Theory of Juliusz Żórawski. In *IOP Conference Series: Materials Science and Engineering* (pp. 1–5). IOP Publishing.

Tsigkari, M., Davis, A., & Aish, F. (2011). A Sense of Purpose: Mathematics and Performance in Environmental Design. *ARCHITECTURAL DESIGN MATHEMATICS OF SPACE*, *81*(4), 55–57.

Tsiotsou, R. (2006). The role of perceived product quality and overall satisfaction on purchase intentions. *International Journal of Consumer Studies*, *30*(2), 207–217. https://doi.org/10.1111/j.1470-6431.2005.00477.x

Van Gogh Purchase Fund. (2023). *Still Life*. moma. photograph, Artists Rights Society (ARS), New York / ADAGP, Paris / FLC. Retrieved April 28, 2023, from https://www.moma.org/collection/works/79312.

van Rompay, T. J., de Vries, P. W., Bontekoe, F., & Tanja-Dijkstra, K. (2012). Embodied product perception: Effects of verticality cues in advertising and packaging design on consumer impressions and Price Expectations. *Psychology & Marketing*, *29*(12), 919–928. https://doi.org/10.1002/mar.20574

Venturi, R. (1966). *Complexity and contradiction in architecture: With an introduction by Vincent Scully*. Doubleday.

Veryzer, Jr., R. W., & Hutchinson, J. W. (1998). The influence of unity and prototypicality on aesthetic responses to new product designs. Journal of Consumer Research, 24(4), 374–385. https://doi.org/10.1086/209516

Veryzer, R.W., Jr., (1995). The Place of Product Design and Aesthetics in Consumer Research, *Advances in Consumer Research*, 22, 641-645.

Ward, L. M., & Russell, J. A. (1981). The psychological representation of molar physical environments. *Journal of Experimental Psychology: General, 110, 121-152.*

Ware, C. (2012). Information visualization perception for design (3rd ed.). Elsevier/MK.

Watson, K. J., Evans, J., Karvonen, A., & Whitley, T. (2014). Re-conceiving Building Design Quality: A review of building users in their social context. *Indoor and Built Environment*, *25*(3), 509–523. https://doi.org/10.1177/1420326x14557550

Weinand, Y., & Hudert, M. (2010). Timberfabric: Applying Textile Principles on a Building Scale. *ARCHITECTURAL DESIGN THE NEW STRUCTURALISM DESIGN, ENGINEERING AND ARCHITECTURAL TECHNOLOGIES*, *80*(4), 102–107.

Wohlwill, J. F. (1976). Environmental aesthetics: The environment as a source of affect. In I. Altman & J. F. Wohlwill (Eds.), Human behavior and the environment: Advances in theory and research: Vol. 1 (pp. 37-86). New York: Plenum.

Wohlwill, J. F. (1982). The visual impact of development in coastal zone areas. *Coastal Zone Management Journal*, 9, 225-248.

Wolfinbarger, M., & Gilly, M. C. (2003). ETAILQ: Dimensionalizing, measuring and predicting Etail Quality. *Journal of Retailing*, *79*(3), 183–198. https://doi.org/10.1016/s0022-4359(03)00034-4

Woodbury, R. (2010). *Elements of parametric design*. Routledge.

Workman, J. E., & Caldwell, L. F. (2007). Centrality of visual product aesthetics, tactile and uniqueness needs of fashion consumers. *International Journal of Consumer Studies*, *31*(6), 589–596. https://doi.org/10.1111/j.1470-6431.2007.00613.x

Wrigley, C. (2013). Design dialogue: The visceral hedonic rhetoric framework. *Design Issues*, *29*(2), 82–95. https://doi.org/10.1162/desi_a_00211
Yazdanfar, S. A., Heidari, A. A., & Aghajari, N. (2015). Comparison of architects' and non-architects' perception of place. *Procedia - Social and Behavioral Sciences*, *170*, 690–699. https://doi.org/10.1016/j.sbspro.2015.01.071
Yeh, Y.-chu, Hsu, W.-C., & Yastrubinskiy, E. (2021). Decomposing the influences of aesthetic experience processes on creativity learning through various consciousness interventions. *Thinking Skills and Creativity*, 39, 100756. https://doi.org/10.1016/j.tsc.2020.100756
Yeom, D., Choi, J.-H., Zhu, Y. (2019). Investigation of physiological differences between immersive virtual environment and indoor environment in a building. *Indoor and Built Environment*, *28*(1), 46–62. https://doi.org/10.1177/1420326x17731945
Zajonc, R. B. (1968). The attitudinal effects of mere exposure. *Journal of Personality and Social Psychology Monograph Supplement*, 9(2 pt. 2),
Zeithaml, V. A. (1988). Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. *Journal of Marketing*, 52(3), 2–22. https://doi.org/10.1177/002224298805200302
Zeki, S., Romaya, J. P., Benincasa, D. M., & Atiyah, M. F. (2014). The experience of mathematical beauty and its neural correlates. *Frontiers in Human Neuroscience*, *8*. https://doi.org/10.3389/fnhum.2014.00068
Zhao, L., Luo, D., & Zhu, R. (2018). Flexible photovoltaic systems. *Flexible and Stretchable Medical Devices*, 105–137. https://doi.org/10.1002/9783527804856.ch5
Zulfaqar, M., Bashir, S., Yaghmour, S. M., Turi, J. A., & Hussain, M. (2023). The mediating roles of economic, socio-cultural, and environmental factors to predict tourism market development by means of regenerative travel: An infrastructural perspective of China–pakistan economic corridor (CPEC). *Sustainability*, *15*(6), 5025. https://doi.org/10.3390/su15065025
Zusne, L. (1970). *Visual perception of form*. New York: Academic Press.

Number of references: 288

Further readings:

Adad, M. C. ANOVA à 1 facteur , Analyse de variance (One-way ANOVA) ,https://www.academia.edu/31533642/ANOVA_%C3%A0_1_facteur_Analyse_de_variance_One_way_ANOVA_
Adad, M. C. Test U de Mann-Whitney (SPSS), test non-paramétrique, https://www.academia.edu/32588155/Test_U_de_Mann_Whitney_SPSS_test_non_param%C3%A9trique
Adad, M. C. Test t de student pour des échantillons indépendants, https://www.academia.edu/31493615/Test_t_de_student_pour_des_%C3%A9chantillons_ind%C3%A9pendants_pptx
Adad, M. C. Test de correlation simple, https://www.academia.edu/31533715/Test_de_correlation_simple
Adad, M.C. (2022). Maison Domotique. Editions Dar El Moutanabbi.

APPENDIXES

Appendix1 :

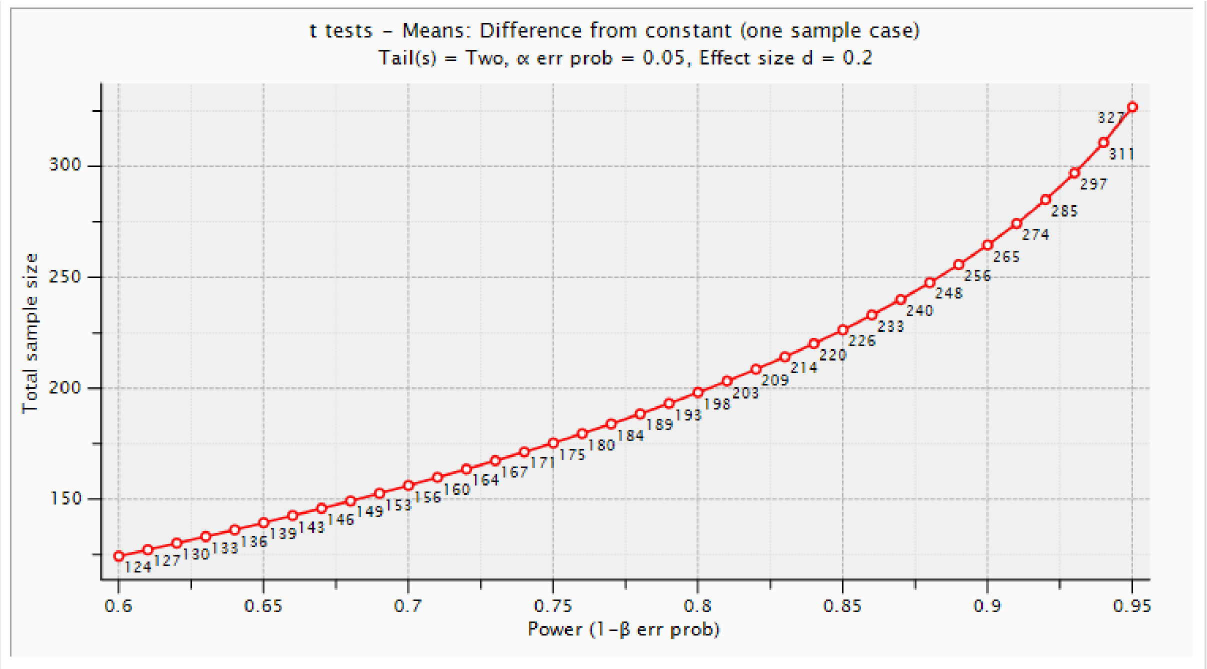


Figure A-1: *G*Power results for one-sample t-test*

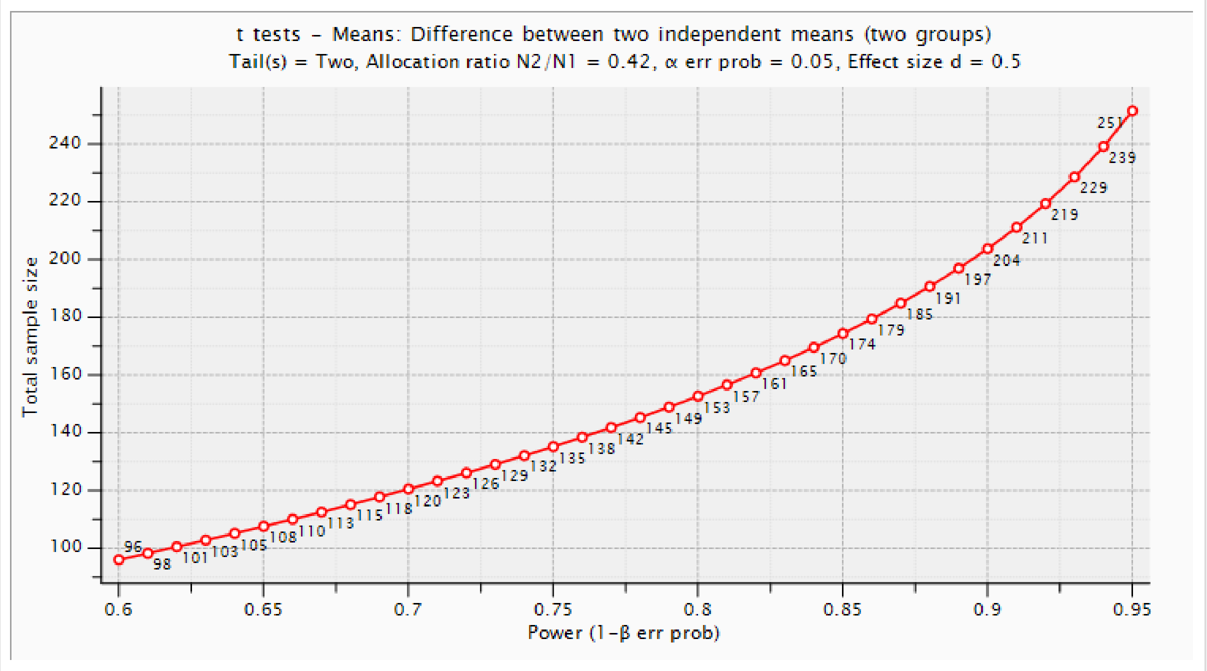


Figure A-2: *G*Power results for two-sample t-test*

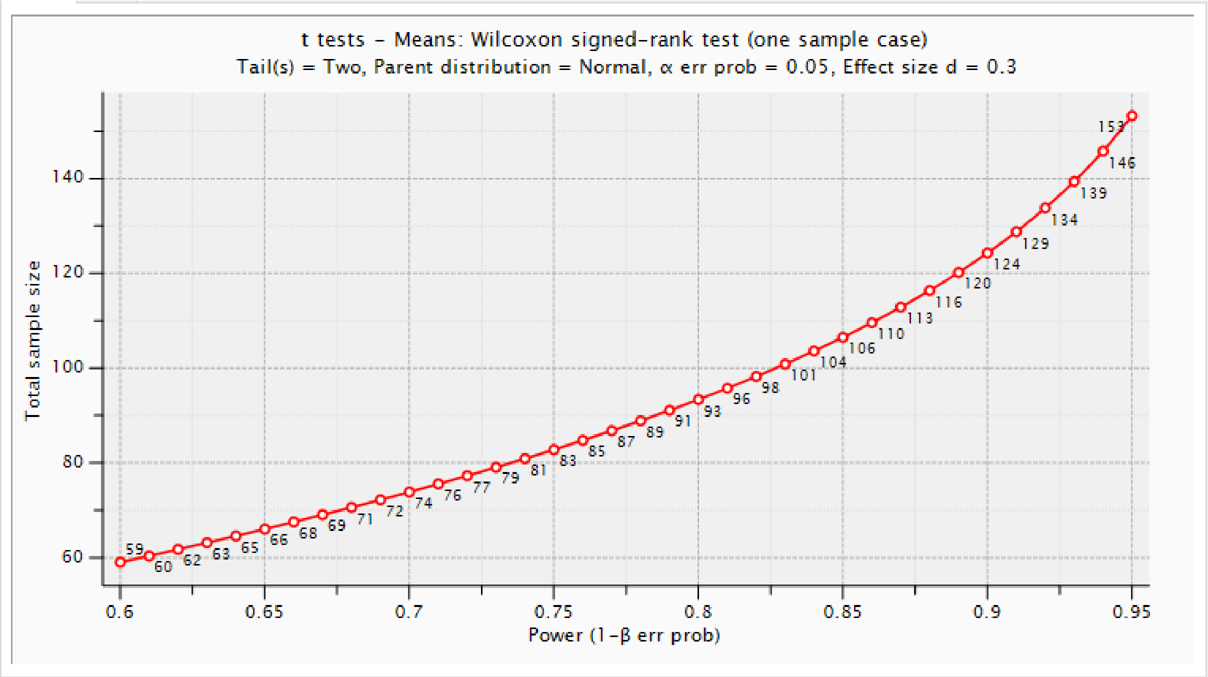


Figure A-3: *G*Power results for one-sample Wilcoxon signed-rank*

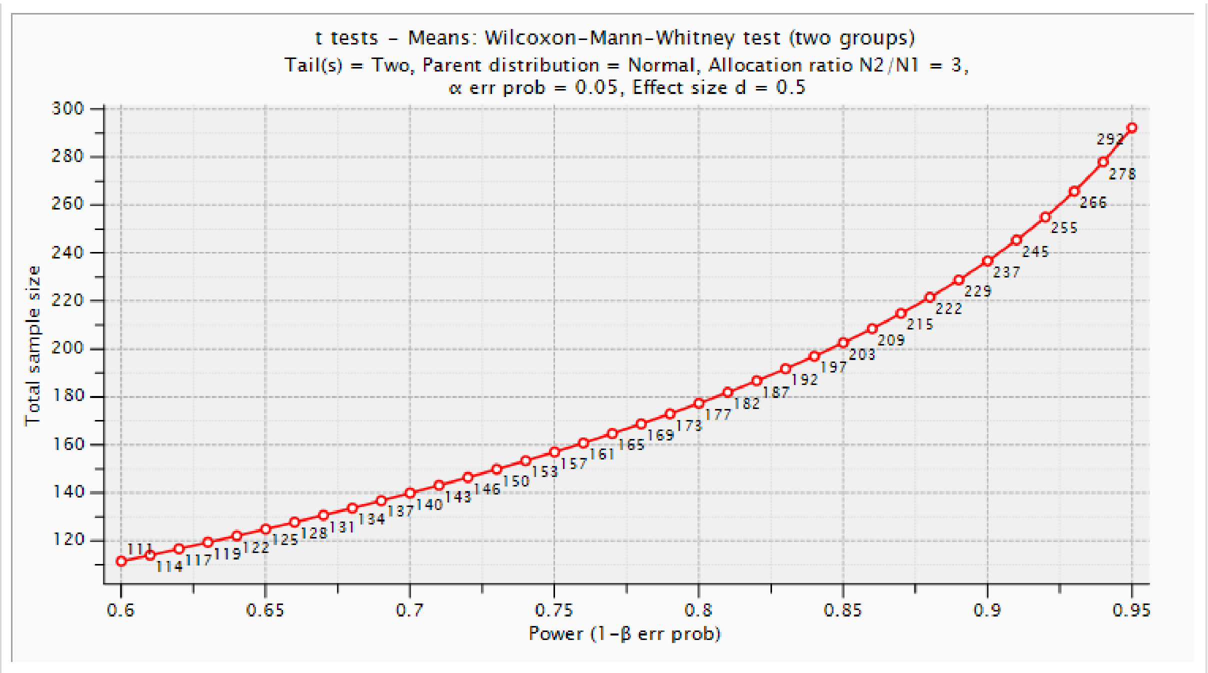


Figure A-4: *G*Power results for Mann-Whitney U test*

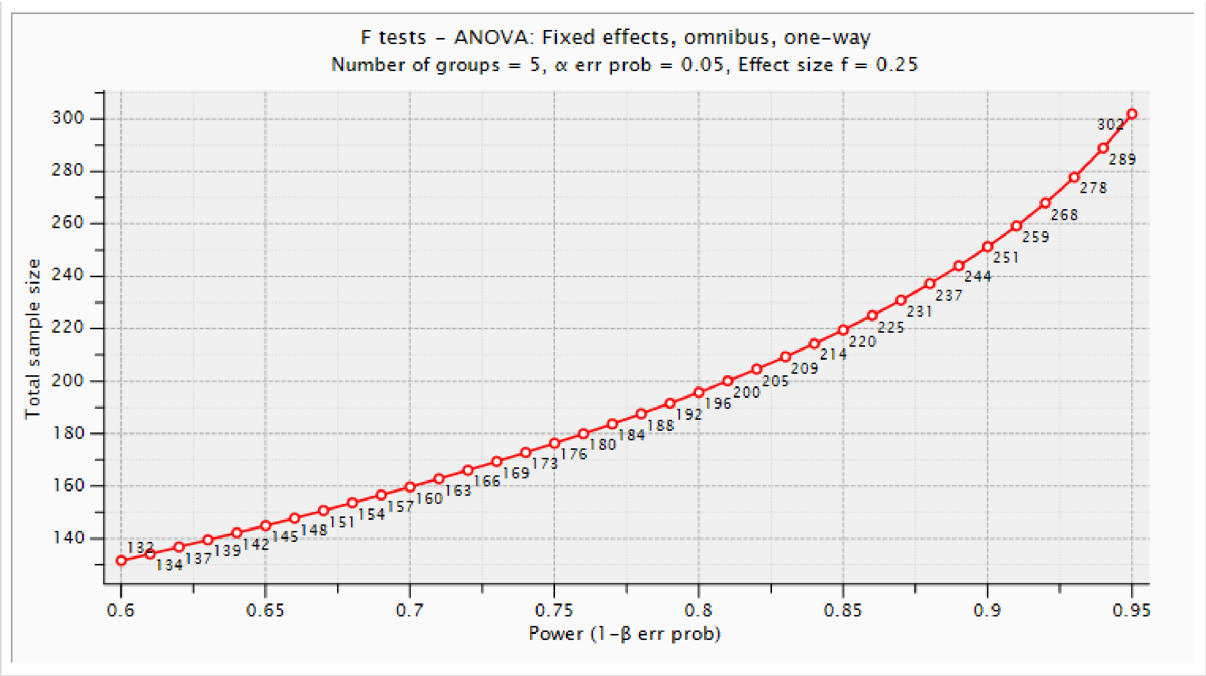


Figure A-5: *G*Power results for two-sided Analysis of variance (ANOVA test) and Kruskal-Wallis test*

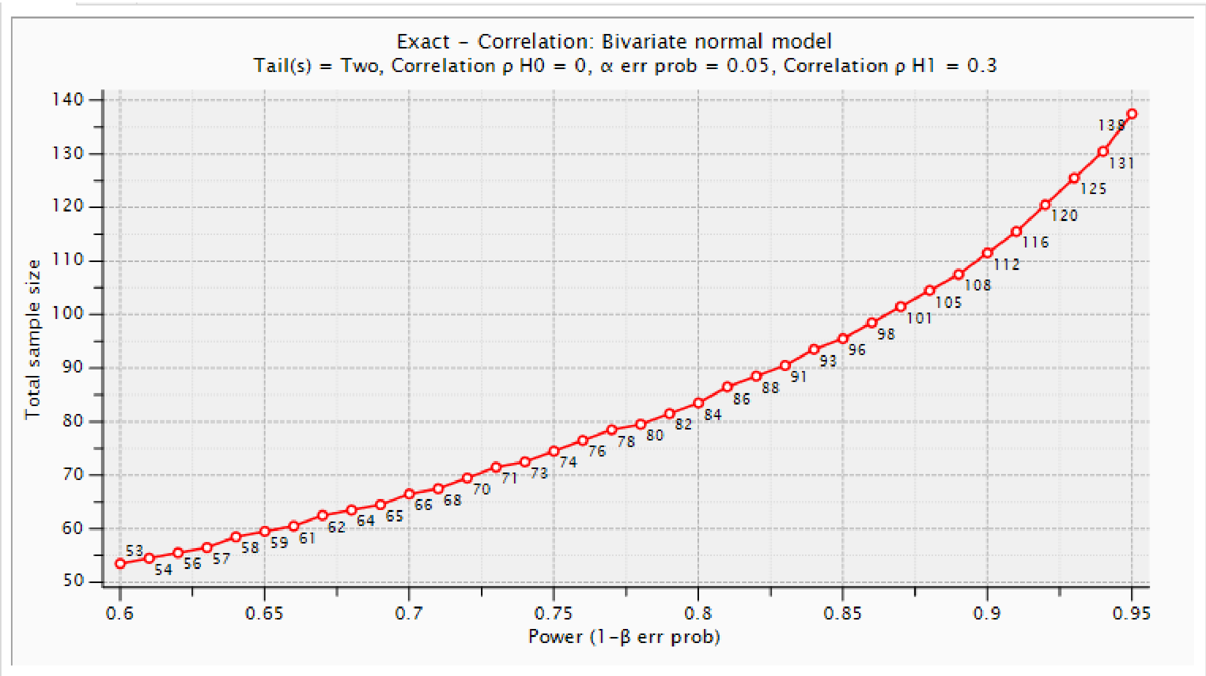


Figure A-6: *G*Power results for Correlation test*

Appendix2 :

Questions Form

An anonymous questionnaire (on a five-point Likert scale) was adopted from the theoretical analysis to evaluate the perceived architectural quality of the house of culture in Khenchela.

Please answer the questions to the best of your knowledge by choosing the most appropriate answer in your opinion.

Very Bad	Bad	Average	Good	Excellent
Definitely No	Mostly No	Not Sure	Most Likely	Definitely Yes
Rarely	Sometimes	Not Sure	Often	Always

Date: …………………………………………

Sex:

☐ Male

☐ Female

Age:

☐ < 20

☐ 30 > Age > 20

☐ 40 > Age > 30

☐ 50 > Age > 40

☐ > 50

Please indicate your level of education:

☐ < BAC (1)

☐ BAC (2)

☐ BAC+1 / BAC+2 (3)

☐ BAC+3 / BAC+4 (4)

☐ > BAC+5 (5)

Professional activity: ……………………………………………….

Place of residence: ……………………………………………

1. What do you think of the exterior appearance of the building?

1 — 2 — 3 — 4 — 5

2. Do you find it easy to walk around inside the building (don't feel lost)?

1 — 2 — 3 — 4 — 5

3. Can you easily enter the building without obstructions?

1 — 2 — 3 — 4 — 5

4. What do you think about the clarity of the building’s features (type of building. purpose. function. etc.)?

1 — 2 — 3 — 4 — 5

5. Do you think the main entrance to the building is clear?

1 — 2 — 3 — 4 — 5

6. What is your assessment of the organization of the working environment in the building (organization of chairs. size of desks and windows...)?

1 — 2 — 3 — 4 — 5

7. Do you think that the interior spaces of the building correspond to their own functions?

1 — 2 — 3 — 4 — 5

8. Does the building have a distinctive feature in its exterior design?

1 — 2 — 3 — 4 — 5

9. Can you create a clear mental image of the shape of the building?

1 — 2 — 3 — 4 — 5

10. Can you easily locate the building from anywhere in the city?

1 — 2 — 3 — 4 — 5

11. Is the building considered a landmark?

1 — 2 — 3 — 4 — 5

12. Do you feel that you have some kind of attachment to this place?

1 — 2 — 3 — 4 — 5

13. How often do you visit the Khenchela Culture House?

1 — 2 — 3 — 4 — 5

14. Do you think that the building conforms to the quality and performance standards?

1 — 2 — 3 — 4 — 5

15. What do you think about the degree of mastery of construction?

1 — 2 — 3 — 4 — 5

16. What do you think about the colors used in painting the building?

1 — 2 — 3 — 4 — 5

17. Does the building give the impression that it needed a large budget to construct it?

1 — 2 — 3 — 4 — 5

18. What is your evaluation of the quality of the building materials used in the building?

1 — 2 — 3 — 4 — 5

19. Does the building structure look solid and will it last for a long time?

1 — 2 — 3 — 4 — 5

20. What do you think about the building's performance in terms of (electricity. gas. water. heating. air conditioning. etc.)?

1 — 2 — 3 — 4 — 5

21. Is the building technologically well equipped (surveillance system. equipment. etc.)?

1 — 2 — 3 — 4 — 5

22. What do you think of the quality of natural lighting inside the building?

1 — 2 — 3 — 4 — 5

23. What do you think about the quality of artificial lighting inside the building?

1 — 2 — 3 — 4 — 5

24. What do you think about the quality of the building's exterior night lighting?

1 — 2 — 3 — 4 — 5

25. Is the temperature appropriate inside the building in winter?

1 — 2 — 3 — 4 — 5

26. Is the temperature appropriate inside the building in the summer?

1 — 2 — 3 — 4 — 5

27. How do you find the building's sound insulation (are you listening to the outside chaos inside the building)?

1 — 2 — 3 — 4 — 5

28. Do you find the building to be homogeneous and harmonious with the surrounding buildings?

1 — 2 — 3 — 4 — 5

29. Do you think the building design indicates ideas or connotations?

1 — 2 — 3 — 4 — 5

30. Does the building's design give the impression that it has a cultural function?

1 — 2 — 3 — 4 — 5

31. Do you think that the building's design is original?

1 — 2 — 3 — 4 — 5

32. Do you think the building's architects used advanced techniques in its design?

1 — 2 — 3 — 4 — 5

33. Does the building's style match modern architecture (does it look modern)?

1 — 2 — 3 — 4 — 5

34. Does the building need modifications to improve its exterior appearance?

1 — 2 — 3 — 4 — 5

35. Does the building meet your personal standards aesthetically?

1 — 2 — 3 — 4 — 5

36. Does the shape of the Culture House building remind you of another building you know?

1 — 2 — 3 — 4 — 5

37. Is there a message behind the building’s design that it aims to convey (architectural. historical...)?

1 — 2 — 3 — 4 — 5

38. Can you evaluate the aesthetic impact of the building after seeing it for the first time?

1 — 2 — 3 — 4 — 5

39. Do you think that the design of Khenchela Cultural Center reflects the social and cultural values of the city?

1 — 2 — 3 — 4 — 5

40. What element of the building catches your eye?

Appearance — Function — Rigidity

Appendix3 :

استبيان

تم اعتماد استبيان لتقييم الجودة المعمارية **لدار الثقافة علي سوايحي لولاية - خنشلة -** يرجى الرد على الأسئلة عن طريق اختيار الإجابة الأكثر ملاءمة حسب رأيكم.

- التاريخ:..
- الجنس: ذكر ☐ أنثى ☐
- العمر:..
- المؤهل العلمي: ....
- الوظيفة:..
- الإقامة: قريب من دار الثقافة ☐
  بعيد عن دار الثقافة ☐
  خارج مدينة خنشلة ☐

01	ما رأيك بالمظهر الخارجي للمبنى؟	سيء جدا	سيء	متوسط	جيد	ممتاز
02	هل تجد التجول داخل المبنى سهل (لا تشعر بالضياع)؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
03	هل تستطيع دخول المبنى بسهولة دون عوائق؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
04	ما رأيك في وضوح معالم المبنى (نوع المبنى، الهدف منه، وظيفته، إلخ)؟	سيء جدا	سيء	متوسط	جيد	ممتاز
05	هل تعتقد أن المدخل الرئيسي للمبنى واضح؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
06	ما هو تقييمك لتنظيم بيئة العمل في المبنى (تنظيم الكراسي، حجم المكاتب والنوافذ ...)؟	سيء جدا	سيء	متوسط	جيد	ممتاز
07	هل تعتقد أن الفضاءات الداخلية للمبنى تتوافق مع وظائفها الخاصة بها؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
08	هل المبنى به علامة مميزة في تصميمه الخارجي؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
09	هل يمكنك تخيل شكل المبنى بوضوح؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
10	هل يمكنك بسهولة تحديد موقع المبنى من أي مكان في المدينة؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
11	هل يعتبر المبنى معلما بارزا؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
12	هل تشعر أن لديك نوع من الارتباط بهذا المكان؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
13	كم مرة تزور بيت ثقافة خنشلة؟	نادرا	بعض الأحيان	غير متأكد	كثير من الأحيان	دائما
14	هل تعتقد أن المبنى مطابق لمعايير الجودة والأداء؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
15	ما رأيك في درجة اتقان البناء؟	سيء جدا	سيء	متوسط	جيد	ممتاز
16	ما رأيك في الألوان المستخدمة في طلاء المبنى؟	سيء جدا	سيء	متوسط	جيد	ممتاز
17	هل يعطي المبنى انطباعًا بأنه احتاج ميزانية كبيرة لبنائه؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد

18	ما هو تقييمك لجودة مواد البناء المستخدمة في المبنى؟	سيء جدا	سيء	متوسط	جيد	ممتاز
19	هل يبدو هيكل المبنى صلبا وانه سيدوم لفترة طويلة؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
20	ما رأيك في أداء المبنى من حيث (الكهرباء والغاز، الماء، التدفئة، التكييف، وما إلى ذلك)؟	سيء جدا	سيء	متوسط	جيد	ممتاز
21	هل المبنى مجهز تجهيزًا جيدًا من الناحية التكنولوجية (نظام المراقبة، المعدات، إلخ.)؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
22	ما رأيك في جودة الإضاءة الطبيعية داخل المبنى؟	سيء جدا	سيء	متوسط	جيد	ممتاز
23	ما رأيك في جودة الإضاءة الاصطناعية داخل المبنى؟	سيء جدا	سيء	متوسط	جيد	ممتاز
24	ما رأيك في جودة الإضاءة الليلية الخارجية للمبنى؟	سيء جدا	سيء	متوسط	جيد	ممتاز
25	هل درجة الحرارة ملائمة داخل المبنى في الشتاء؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
26	هل درجة الحرارة ملائمة داخل المبنى في الصيف؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
27	كيف تجد العزل الصوتي للمبنى (هل تستمع للفوضى الخارجية داخل المبنى)؟	سيء جدا	سيء	متوسط	جيد	ممتاز
28	هل تجد شكل المبنى متجانس ومتناسق مع البنايات المحيطة؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
29	هل تعتقد أن تصميم المبنى يشير إلى أفكار أو دلالات؟ (مثال: تصميم بعض المباني على شكل كتاب دلالة على الدور الثقافي)	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
30	هل يعطي تصميم المبنى انطباعًا بأنه ذو وظيفة ثقافية؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
31	هل تعتقد أن تصميم المبنى يتميز بالأصالة؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
32	هل تعتقد أن مهندسي المبنى قد استخدموا تقنيات متطورة في تصميمه؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
33	هل يتوافق أسلوب المبنى مع العمارة الحديثة (هل يبدو عصريا)؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
34	هل يحتاج المبنى إلى تعديلات لتحسين شكله الخارجي؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
35	هل يتوافق المبنى مع معاييرك الشخصية من الناحية الجمالية؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
36	هل يذكرك شكل مبنى دار الثقافة بمبنى آخر تعرفه؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
37	هل يوجد وراء تصميم المبنى رسالة يهدف الى إيصالها (معمارية،تاريخية...)؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
38	هل يمكنك تقييم التأثير الجمالي للمبنى بعد رؤيته للمرة الأولى؟	سيء جدا	سيء	متوسط	جيد	ممتاز
39	هل تعتقد أن تصميم مركز خنشلة الثقافي يعكس القيم الاجتماعية والثقافية للمدينة؟	لا بالتأكيد	لا على الاغلب	غير متأكد	نعم على الاغلب	نعم بالتأكيد
40	ما هو العنصر الذي يلفت انتباهك في المبنى؟	شكله ☐		وظيفته ☐		صلابته ☐

Appendix4 :

Table A-1: *Ratings percentages of PAQ for every question*

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Answer with code #1	16%	18%	9%	12%	7%	12%	17%	42%	22%	13%
Answer with code #2	16%	24%	12%	18%	10%	14%	17%	17%	14%	10%
Answer with code #3	44%	18%	14%	47%	9%	45%	36%	15%	22%	6%
Answer with code #4	22%	26%	30%	22%	37%	26%	23%	16%	23%	23%
Answer with code #5	3%	16%	37%	3%	38%	3%	9%	12%	20%	49%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
Answer with code #1	26%	42%	55%	32%	19%	28%	21%	15%	12%	11%
Answer with code #2	13%	13%	25%	21%	16%	22%	16%	16%	15%	13%
Answer with code #3	14%	11%	4%	28%	50%	37%	25%	54%	38%	54%
Answer with code #4	23%	19%	7%	15%	14%	12%	21%	14%	28%	21%
Answer with code #5	25%	16%	10%	6%	2%	2%	19%	2%	9%	3%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
Answer with code #1	26%	14%	13%	16%	11%	14%	11%	34%	42%	36%
Answer with code #2	19%	13%	22%	24%	12%	13%	13%	18%	18%	21%
Answer with code #3	32%	46%	47%	47%	42%	40%	40%	20%	25%	15%
Answer with code #4	18%	25%	17%	10%	27%	24%	30%	22%	10%	21%
Answer with code #5	6%	3%	2%	4%	9%	9%	7%	7%	7%	8%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39
Answer with code #1	39%	40%	42%	60%	38%	36%	43%	16%	33%
Answer with code #2	23%	21%	21%	20%	23%	15%	18%	18%	25%
Answer with code #3	22%	27%	14%	12%	21%	22%	26%	46%	21%
Answer with code #4	13%	10%	19%	6%	12%	16%	11%	19%	14%
Answer with code #5	4%	4%	6%	3%	7%	12%	4%	2%	8%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%

Appendix5 :

Table A-2: *Total number and total percentage of each rating value of PAQ for the 39*

	Total Number	Total Percentage
Dissatisfied". Code #1	1966	25%
Rather Dissatisfied". Code #2	1339	17%
Neutral". Code #3	2248	29%
Rather Satisfied". Code #4	1476	19%
Satisfied". Code #5	771	10%
TOTAL	7800	100%

questions

Table A-3: *Total number and total percentage of each rating value of question 40*

	Q40	
	Total Number	Total Percentage
Appearance	51	26%
Function	120	60%
Rigidity	29	15%
TOTAL	200	100%

Table A-4: *Total number and total percentage of each rating value of PAQ for the 39 questions by gender*

	By Gender	
	Number	**Percentage**
M	141	71%
F	59	30%
TOTAL	200	100%

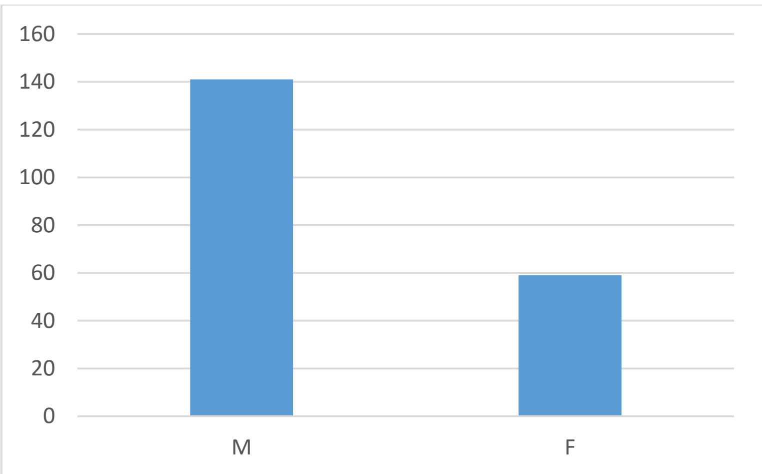


Figure A-7: *Respondents' distribution by gender*

Table A-5: *Total number and total percentage of each rating value of PAQ for the 39 questions by Age*

By Age		
	Number	**Percentage**
<20	9	5%
20-30	72	36%
30-40	66	33%
40-50	36	18%
>50	17	9%
TOTAL	200	100%

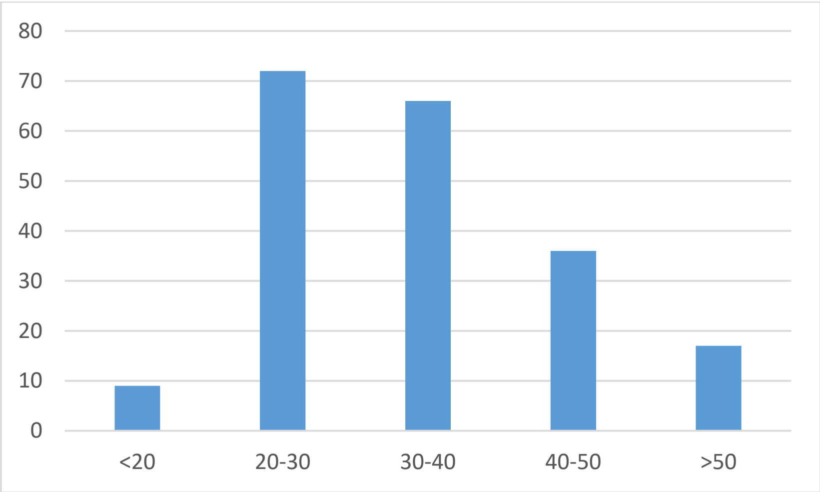


Figure A-8: *Respondents' distribution by Age*

Table A-6: *Total number and total percentage of each rating value of PAQ for the 39 questions by education*

By Education		
	Number	**Percentage**
< HSD	80	40%
HSD	18	9%
BD	28	14%
MD	56	28%
PhD	18	9%
TOTAL	200	100%

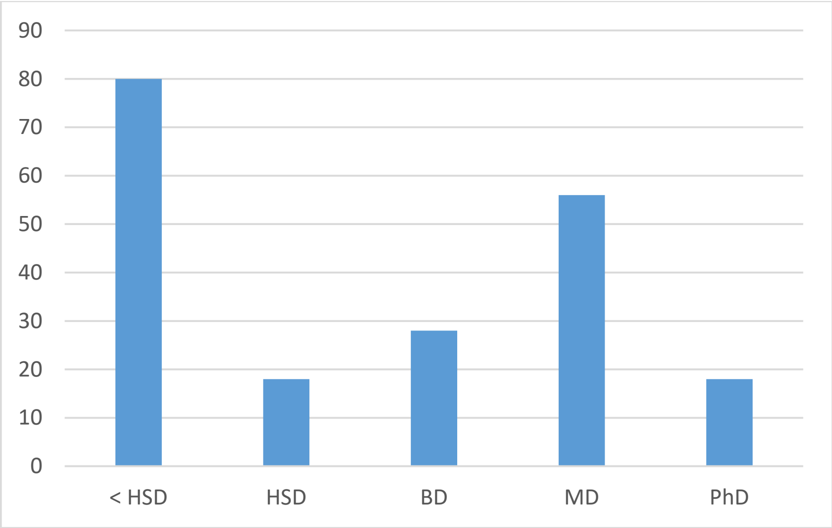


Figure A-9: *Respondents' distribution by education*

Table A-7: *Total number and total percentage of each rating value of PAQ for the 39 questions by residency*

By Residency		
	Number	**Percentage**
Near the building	91	46%
Far from the building	78	39%
Outside the city	31	16%
TOTAL	200	100%

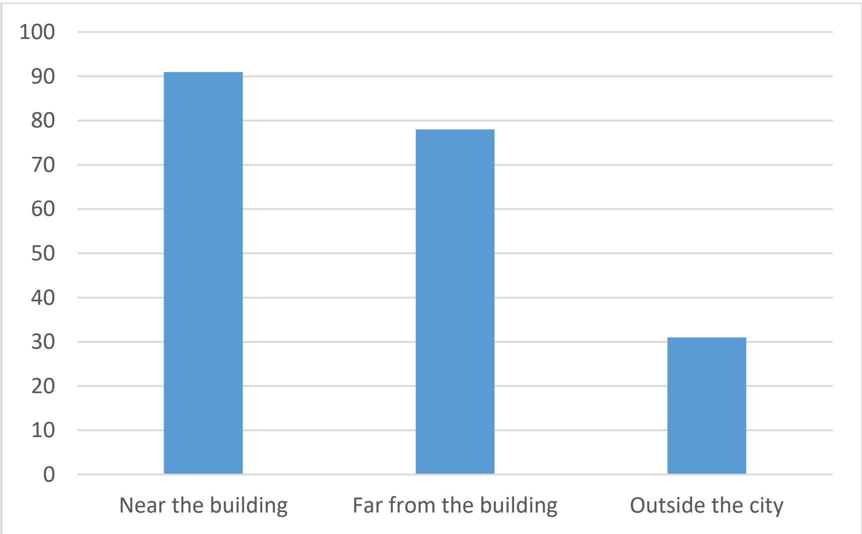


Figure A-10: *Respondents' distribution by residency*

Table A-8: *Total number and total percentage of each rating value of PAQ for the 39 questions by occupation*

By Occupation		
	Number	**Percentage**
Architecture	23	12%
Commerce	31	16%
Education	22	11%
Administration	30	15%
Other	10	5%
Unemployment	39	20%
Student	16	8%
Engineering	8	4%
Social work	11	6%
Art/Culture	10	5%
TOTAL	200	100%

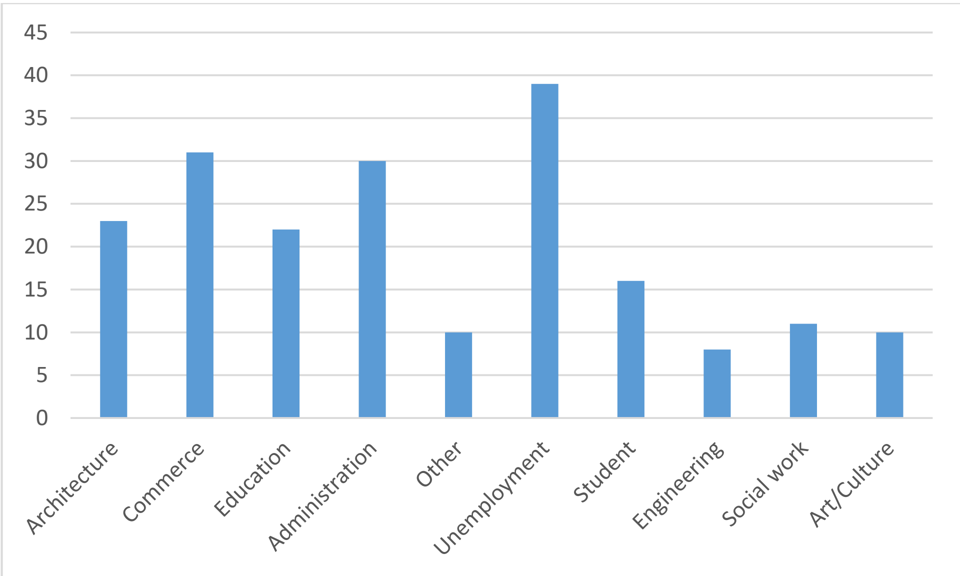


Figure A-11: *Respondents' distribution by occupation*

Appendix6 :

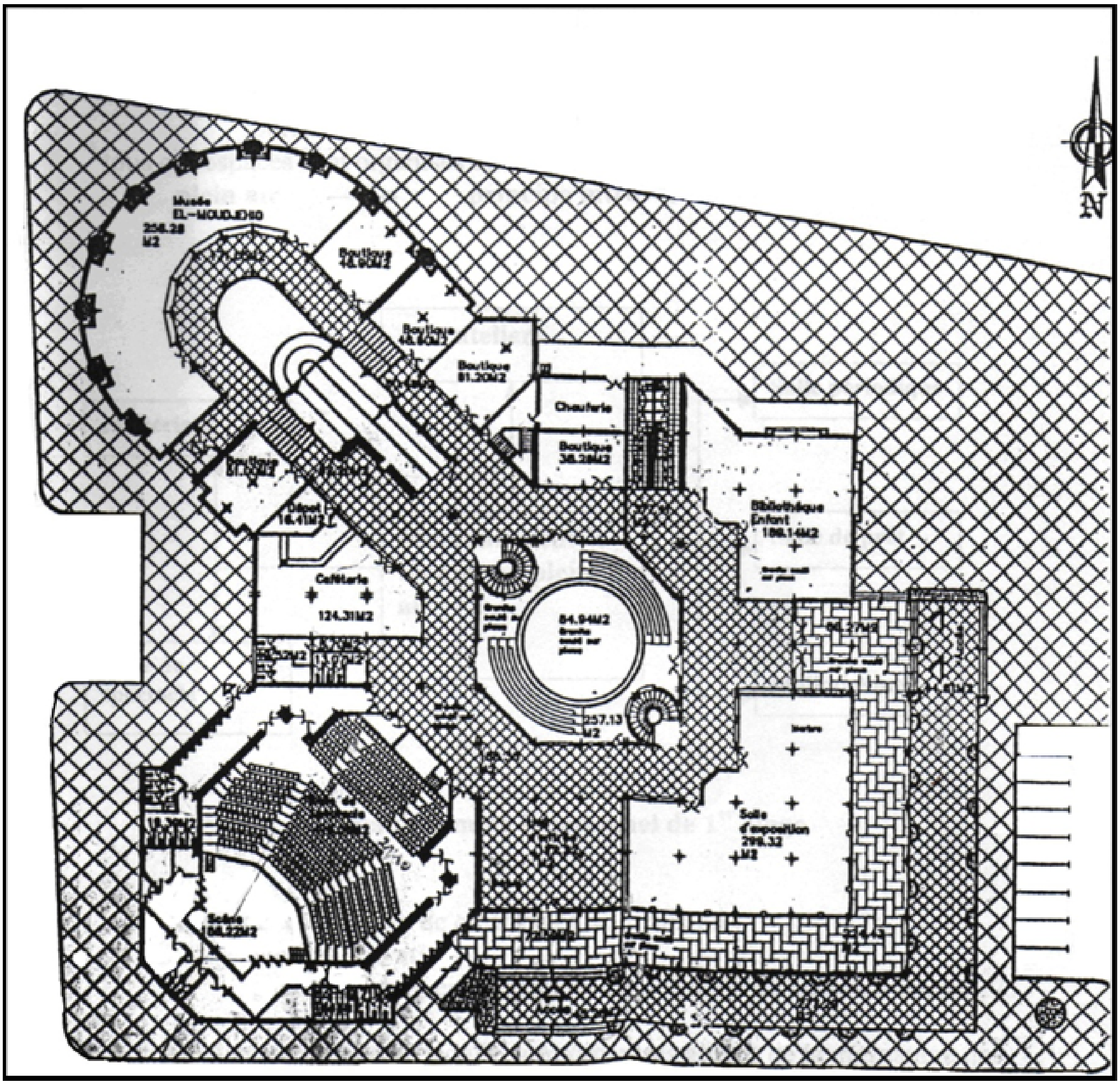


Figure A-12: *Floor plan of the culture house.*

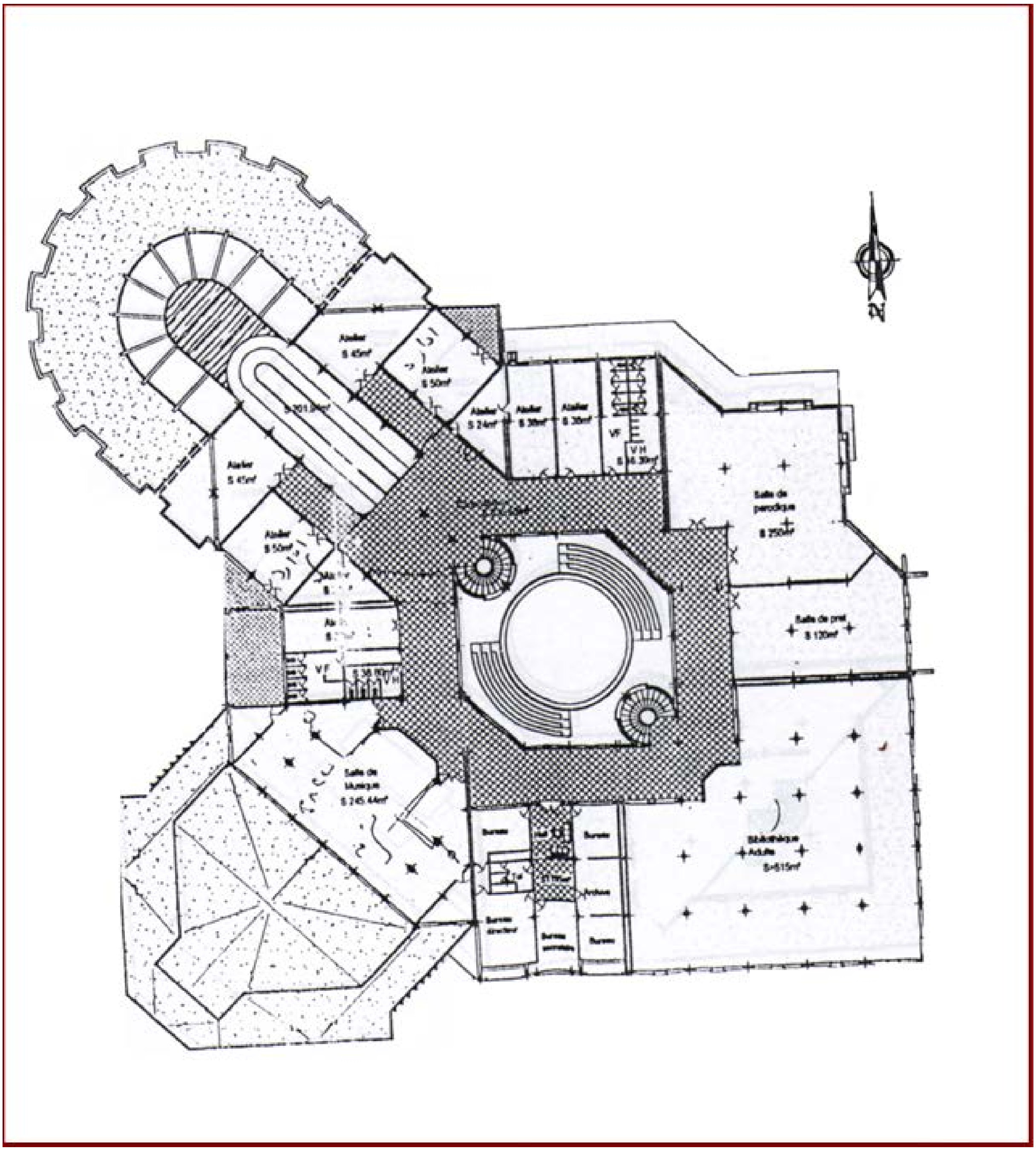


Figure A-13: *First Floor plan of the culture house.*

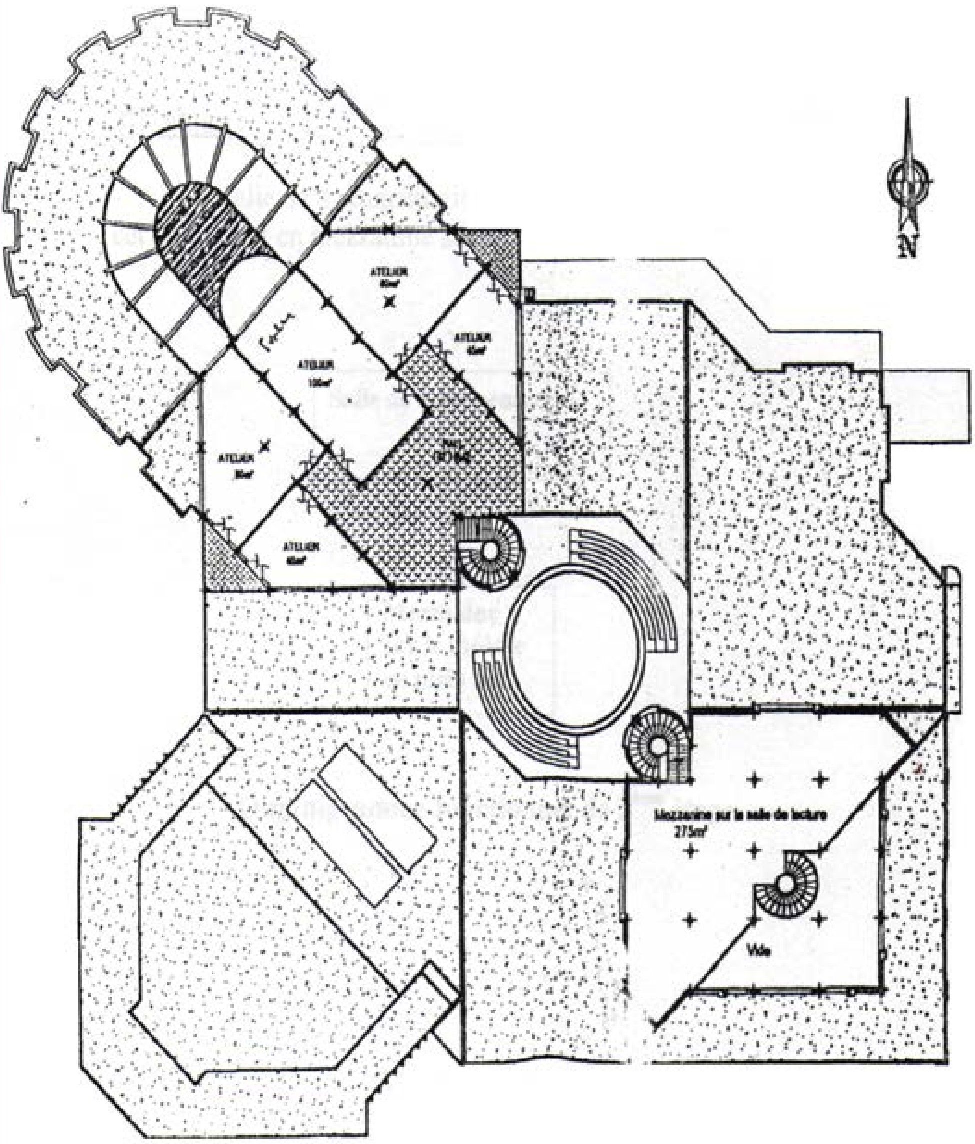


Figure A-14: *Second Floor plan of the culture house.*

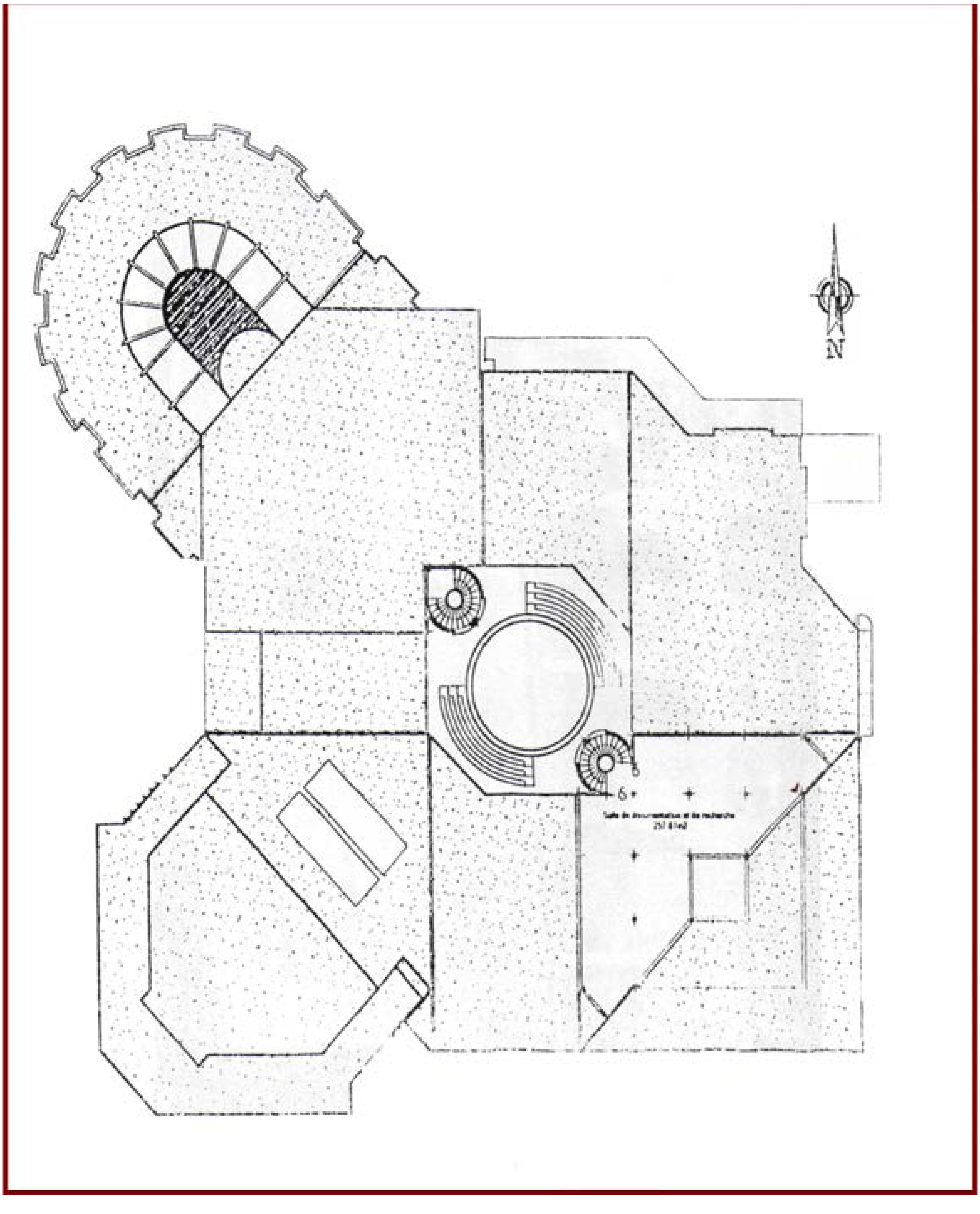


Figure A-15: *Roof plan of the culture house.*

Appendix7 :

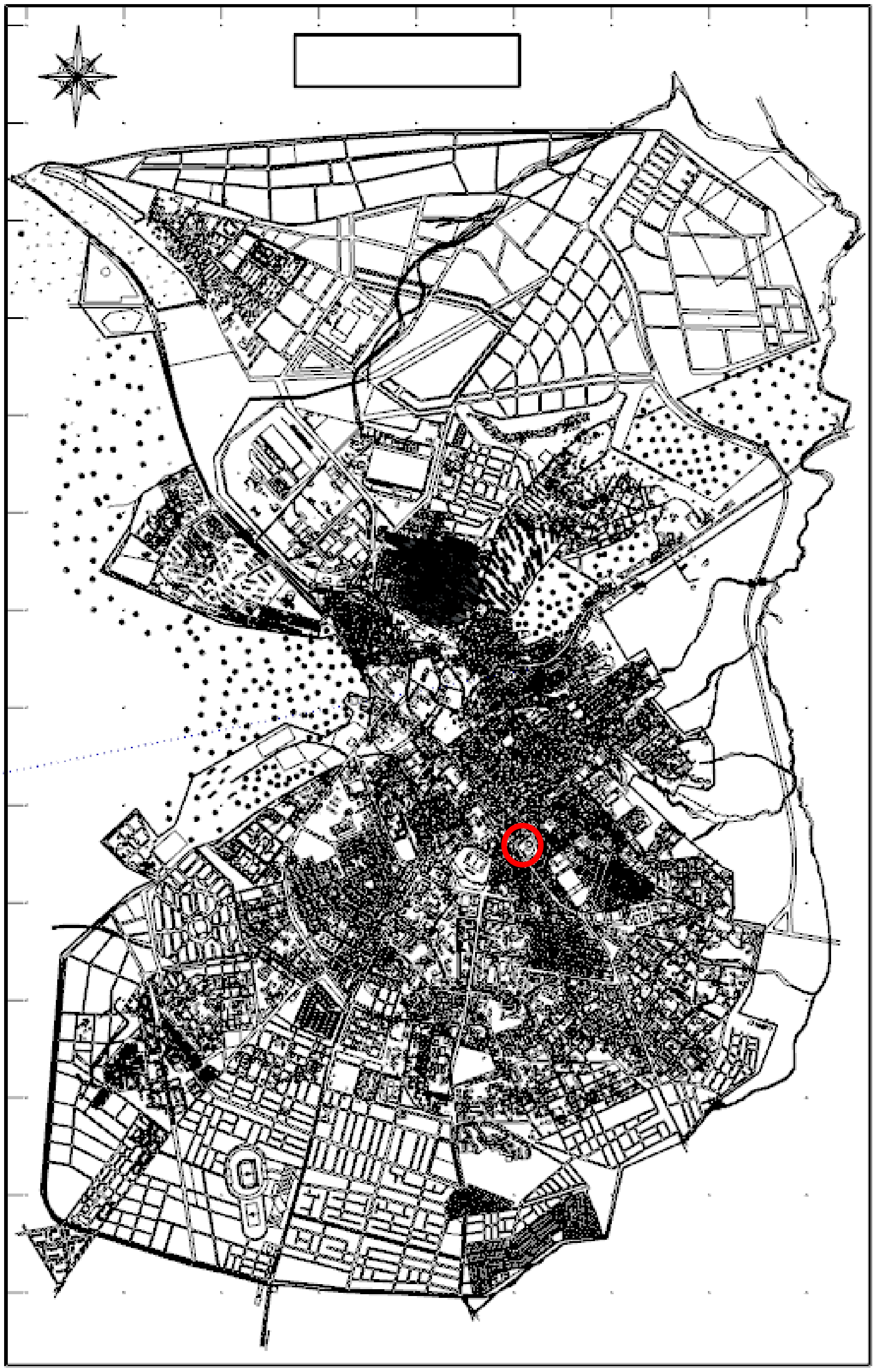


Figure A-16: *Master plan for development and town planning of the city of Khenchela.*

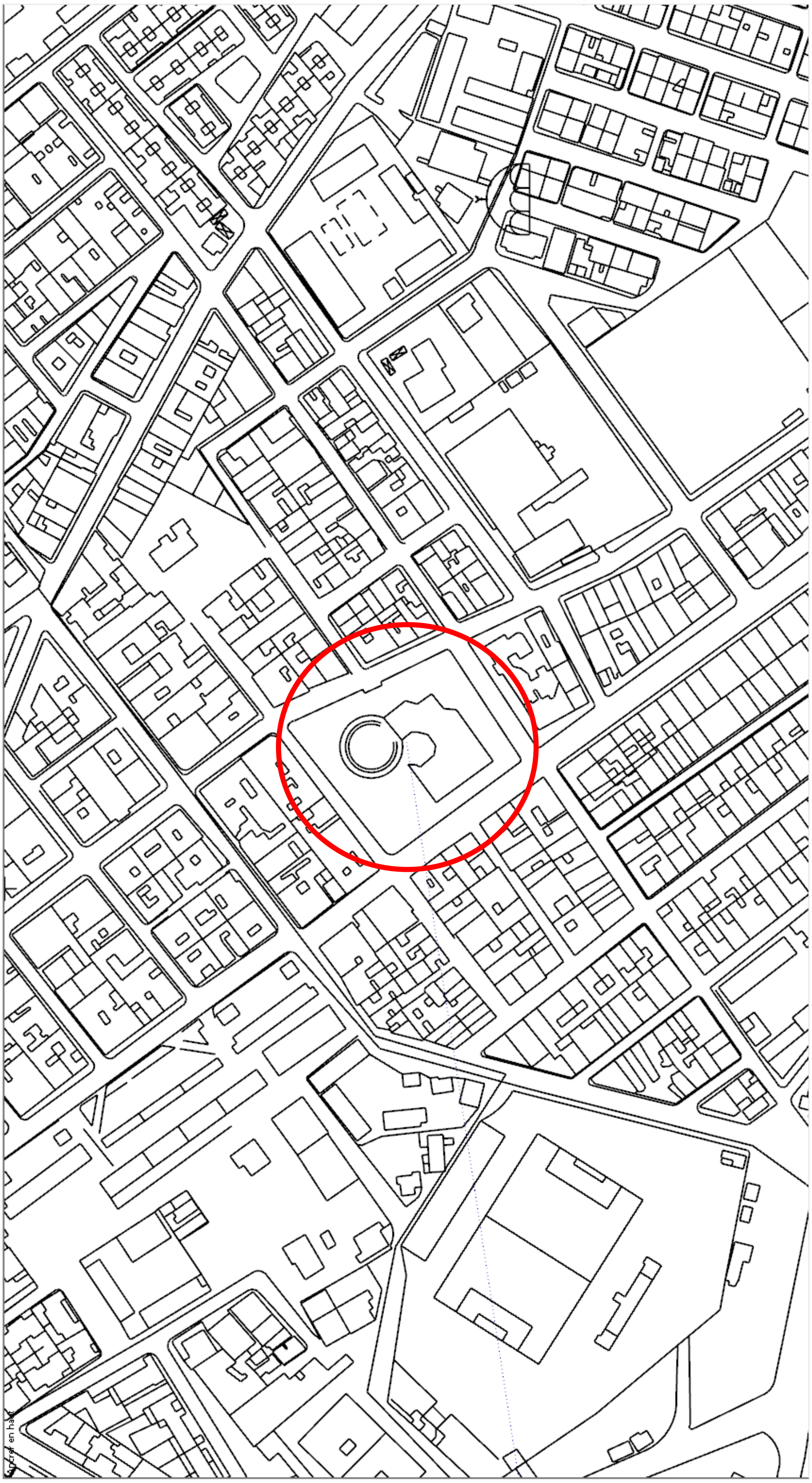


Figure A-17: *Location plan of the culture house.*

Appendix8 :

Table A-9: *The 36 removed panels above the patio*

Number	Opening size	Surface	Cell radiation	Opening radiation	Flexible solar panel efficiency 15%(Kwh)
114	84	3.697	1783.205	6592.34122	988.85
115	81	3.590	1718.420	6169.94708	925.49
116	79	3.542	1680.938	5954.23333	893.13
117	80	3.624	1703.000	6172.48343	925.87
118	83	3.781	1754.419	6632.75483	994.91
119	84	3.863	1772.072	6846.03537	1026.91
132	87	3.807	1856.817	7068.01435	1024.37
133	83	3.682	1782.754	6563.43601	1000.72
134	80	3.586	1711.608	6138.00033	966.03
135	79	3.615	1697.994	6139.04408	923.29
136	81	3.736	1728.936	6459.24007	880.85
137	81	3.795	1736.435	6589.70666	827.41
150	90	3.902	1912.854	7464.08188	780.34
151	87	3.811	1858.865	7084.13856	1214.45
152	83	3.708	1783.889	6615.45458	1198.84
153	80	3.663	1723.740	6314.26894	1177.84
154	79	3.697	1705.623	6306.53617	1151.36
155	79	3.708	1691.919	6273.72757	1116.04
168	91	3.953	1944.669	7687.95918	1060.20
169	89	3.931	1920.081	7547.57798	984.52
170	87	3.877	1874.314	7267.3755	920.70
171	83	3.780	1787.630	6758.10297	920.86
172	79	3.694	1707.163	6305.6351	968.89
173	77	3.635	1660.722	6036.63987	988.46
186	91	3.957	1954.292	7732.80666	975.03
187	91	4.000	1949.899	7800.07477	945.90
188	90	4.031	1938.813	7815.44482	908.32
189	87	3.955	1879.865	7435.05674	864.52
190	82	3.805	1786.551	6797.83726	825.83
191	79	3.691	1708.724	6306.63803	779.20
204	90	3.939	1957.576	7711.81183	745.11
205	91	4.016	1960.407	7873.29689	1190.96
206	92	4.123	1972.332	8132.3649	1191.26
207	91	4.137	1960.205	8109.62664	1183.99
208	88	4.039	1910.167	7715.26019	1168.75
209	84	3.906	1832.035	7155.18182	1152.95

Appendix9 :

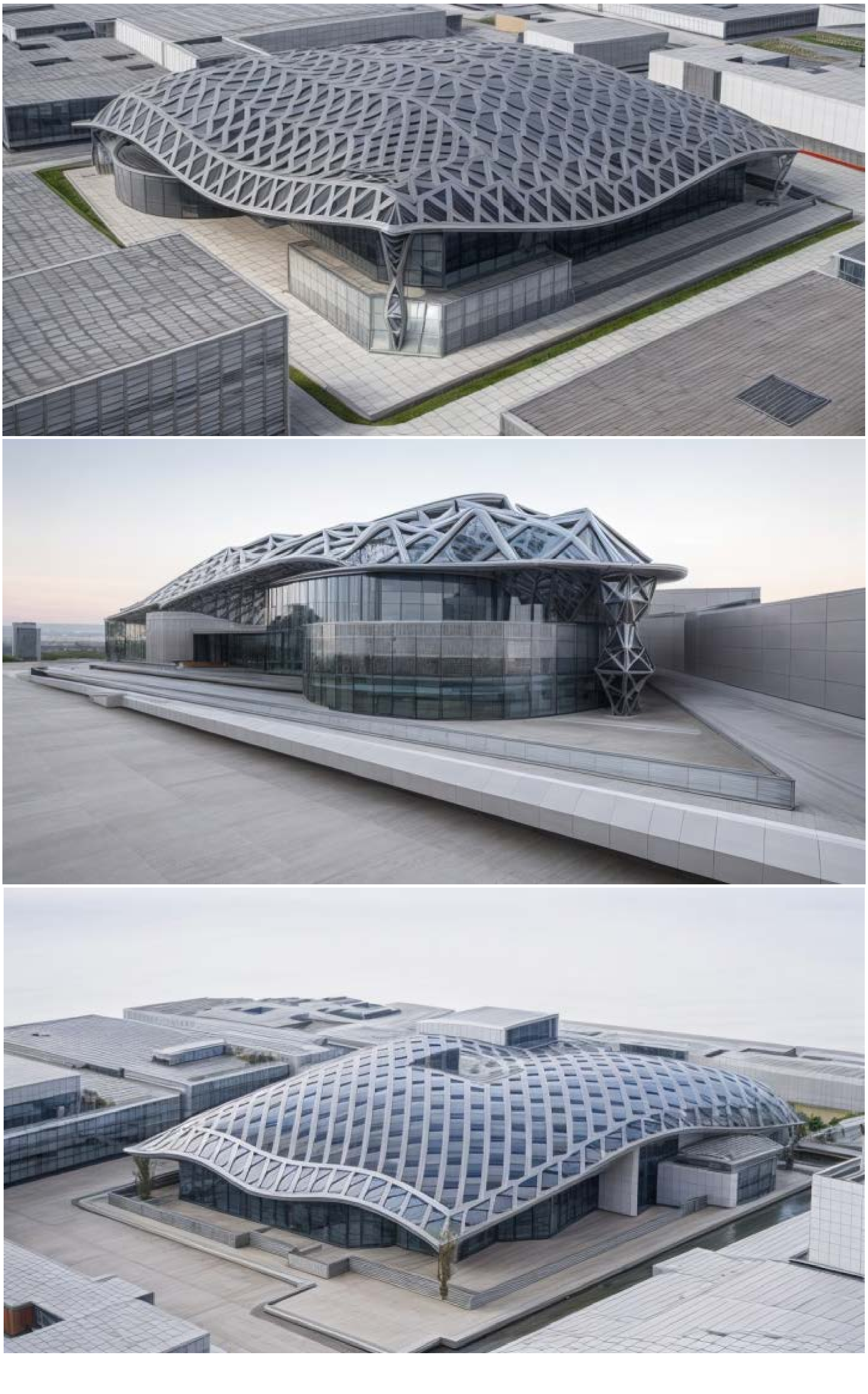


Figure A-18: *Culture house concept 3D rendering*

Appendix10 :

Insight into the Book Expo Event: An interview with the Director and his Secretary.

In an exclusive interview with the director of the culture house and his secretary, several significant insights were revealed:

- Architects have a crucial responsibility to engage in consultations with individuals who are closely associated with the cultural domain. Their role is not only to gather insights but also to diligently document the needs and recommendations.
- The lack of prior research and planning has significantly affected the house's ability to accommodate people. This absence of thorough studies and strategic programming has had negative consequences on the culture house's reception capacity.
- The inadequate sizing of doors and openings is a significant issue, to the extent that the equipment in question needs to be disassembled in order to be brought into the building. This problem of poor pre-sizing poses a major hindrance.
- One of the major drawbacks of the current functional setup is the absence of crucial functional areas such as exhibition rooms and artistic workshops.
- Problem of conformity to the plan.
- Difficulty of visibility within the theater. This issue is primarily attributed to the inadequate choice of the structural system employed in the construction of the culture house.
- Challenges related to ventilation and lighting (Natural/Artificial).

الحمد لله الذي بنعمته تتم الصالحات