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The architectural variables (shape, function, and durability) and their impact in the architectural design to guarantee the design efficiency

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Abstract. This research, by analysis, deals with the importance of durability, aesthetic, functionality, and the various opinions in this regard. These principles, with their aspects, concepts and formations, are as a deep and large sea for philosophers and thinkers. They tried to explain them and determinate them with standards and signs, despite the complexity, such the architects who proved that these principles are part and parcel from the thing, and they stuck in the mind of the recipient to embody them materially and remarkably. A field study was conducted by establishing a questionnaire and selecting a sample of architects, with various interests and experience. Then, the collected data were analysed, and the final results were extracted, in a way that enhances the importance of each variable to achieve the optimal design.

1. Introduction

Architecture is defined as the scientist art for implementing buildings that involve durability and aesthetic elements and can achieve the target of the architectural design and meet physical and spiritual needs.

Development of modern construction techniques and using ingenuity to present the design is one of the architecture basis, which participated in developing the formal and meaningful aspects of architecture. Various patterns and shapes were produced throughout history by adopting these techniques, which also distinguished in the shape of many designs and granted them the modernity feature associated with that time.

2. Shape Aesthetics

The beautiful thing is defined as something that results from a benefit, and that feeling can be done without using a mental tool or logical proofs. Some people may consider that the integral shape is the standard of beauty and others may see that the standard of beauty is the success in reaching the target, and that is the difference between the beauty's self and the beauty's objectivity, with emphasis of what Plato saw "The beauty isn't based on the matter itself, but in the matter formation idea" [1].

Santiana states that "The feeling of beauty is not only a perception, but it is an understanding of a value or discovering an aesthetic indication", and when defining the architectural beauty, we find that Alberte defines it as "The harmony of all things so that no part can be added, removed or changed without an offence to the design, and it is a precise harmonization among all of the building's elements". While Cliff Bill sees it as an expressive photo of any relation between lines, colors, and volumes intrinsically. Therefore, aesthetics in architectural design are divided into two parts; [2]

a- Formal aesthetic: It is produced from the relations between the shape's parts and components.



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b- Nominal aesthetic: it connects between components or architectural element and an idea or a specific content.

Architects have set a group of known characteristics to create a mutual rule among them to evaluate the architectural aesthetic, thus it can be judged and evaluated: unit – equilibrium – homogeneity and, variation – proportionality – harmony – scale - character and personality - simplicity and complexity.

3. Function

No illustration for the function's concept is required due to the clarity of its meaning and importance, but we emphasize the necessity of this concept comprehension to make sure taking into consideration the motion paths, need for ventilation, lighting, relations among the design spaces, technical requirements, motion and communication elements, and all human needs whether they are psychological, social or cultural. For all these matters, the function becomes an essential necessity for the success of the architectural design [3].

The function is almost intuitive. The benefit component is a prerequisite that must be satisfied in all human's productions. The consistency between the function and the shape hints to the contentment and confidence of the production's validity. The function is one of the basic conditions that must be fulfilled in architectural work. Architecture is the scientific art to construct buildings that includes the conditions of benefit, beauty, and economy, and meet the people's financial, psychic, mental, individual and collective needs.

4. The relationship between function and shape

The controversy of the preference between function and shape is no longer exist. Robert Venturi mentioned in his book, *Complexity and Contradiction in Architecture*, that each one of them depends on the other, while Sullivan defined the function as "a power that wants to express itself and it is the life and the soul, and functions look for their forms, and forms are the exterior look of powers and interior needs, function and shapes are connected, interlocked and integrated" [4].

5. Durability

The definition of durability is wide, it is the ability to stay as long as possible without the occurrence of a significant deterioration. The definition of durability is wide, it is the ability of staying as long as possible without occurrence of a significant deterioration. Canadian Standards Society defines durability as the capability the building or any of its components on performing required tasks in its service environment for a period of time with excluding the unexpected costs of maintenance and repair [5].

There are two components for durability, materials, and structure, and without them, the building does not materialize and does not become real. Furthermore, the top view of the building is configured by them, and its various needs are determined. Due to the importance of materials and structure, and the dependence of construction's presence on them, available materials and construction techniques were used to solve the problems of roofing, covering and architectural styles. Due to the development of engineering, construction technology, innovative methods and creativity, the buildings' height has increased up to the skyscrapers. The durability of buildings is affected by climatic conditions surrounding them, so that construction may perform the function, but the exterior cover of the building has many functions, it serves as a barrier that prevents moisture from infiltrating inside the building, as well as rains and snows. In addition, the exterior cover resists the thermal loss from and to the building, thus energy is provided by heating and cooling. It is also able to resist fire, strong sunshine, and frost [6].

6. Field study

6.1. Research methodology

Researchers used the analytical descriptive approach, which depends on collecting facts and information, and then comparing and interpreting them to reach acceptable generalizations, and that was conducted by establishing a questionnaire and distributing it on the research sample.

6.2. Research sample

The research sample consists from (100) architects, so (100) questionnaires were distributed on them. However, (91) questionnaires were adopted, while the other (9) questionnaires were ignored due to missing data. Therefore, 91% of the sample was adopted. Questionnaires were distributed according to the information and the statistical description below, which includes gender, age, and education.

Table 1. Distribution of the research sample according to gender

Gender	Number	Percentage
Male	50	%55
Female	41	%45
Total	91	%100

Table 2. Distribution of the research sample according to age

Age (years)	Number	Percentage
20-30	42	%46
31-40	30	%33
41-50	11	%12
>50	8	%9
Total	91	%100

From table 2, it is noted that the category (20-30) is the most targeted category, following by the category (31-40).

Table 3. Distribution of the research sample according to education

Education	Number	Percentage
Bachelor	58	%64
Master	25	%27
Doctorate	8	%9
Total	91	%100

The usefulness of the statistical description mentioned above is to ensure the comprehensiveness of the study sample for different categories of society, in terms of gender, age, and education.

6.3. Research tool

The questionnaire of the research was prepared according to the research's objective, and included two sections:

First section: General personal information.

Second section: It was divided into three axes of questions, which concern function, durability aesthetic values.

6.4. The validity of research tool (Virtual validity)

The virtual honesty of the research tool was verified by presenting it to a group of specialist arbitrators and identifying their views in terms of;

- Integrity of formulation of questionnaire terms.

- Clarity of the terms and their appropriateness to the research objective.

According to the opinions and directions of the arbitrators regarding the appropriateness of a questionnaire to the research objective, some terms were edited and some of them were deleted. Also, some terms were added.

6.5. Stability of the research tool

A questionnaire was applied to a sample by two groups of (30) architects, represent %19 from the research community. They were selected randomly to answer the questionnaire in order to measure the stability of the tool. Two weeks later, it was applied again on the same sample, and data entry in computers was conducted, to check the stability of the research tool. Cronbach's alpha was used, which was (0.97), and it indicates that the stability factors of all axes were acceptable.

Table 4. Cronbach's alpha values of the questionnaire's axes.

Axes of questionnaire	No. of phrases	Cronbach's alpha
1 st axis / Function	7	0.799
2 nd axis / Durability	5	0.711
3 rd axis / Aesthetical values	5	0.798
	17	Av.= 0.769

The value of Cronbach's alpha ranges between (0-1), whenever the value is near 1, this indicates the existence of a high stability. In contrast, whenever the value is near zero, this indicates the lack of stability. However, the agreed minimum value is 0.6.

We can conclude that the study tool is valid and stable in all terms, and it is applicable on the research sample.

7. Statistical methods used in the research

After data was collected, entered and analysed, results were extracted by (spss) software by using the following statistical methods;

1. Cronbach's alpha, to check the stability of the questionnaire.
2. Pearson correlation coefficient, to confirm the stability of the questionnaire.
3. Arithmetic means, to identify the values of estimates of the research sample members.
4. Standard deviations, to measure the coefficient of variation about the arithmetic mean of the response of research members.
5. Percentage, to describe the variables of the study and identify them.

Table 5. Degree of importance of family members according to the arithmetic mean

Arithmetic mean	A degree of importance of family members
When arithmetic mean is 4.21-5.00	Very high
When arithmetic mean is 3.41-4.20	High
When arithmetic mean is 2.61-3.40	Fair
When arithmetic mean is 1.81-2.60	Poor
When arithmetic mean is 1.00-1.80	Very poor

Table 6. Arithmetic mean and standard deviation of the answers of the study sample (Design of interior spaces – Function)

No.	Term	Arithmetic mean	Standard deviation	Percentage	Order	Degree of importance
1	Function	4.17	0.67	%83.43	3	High
2	Achieving flexibility	4.43	0.85	%88.51	1	High
3	Interest in the project location	4.12	0.82	%82.32	5	High
4	Interest in the interior spaces	4.36	0.59	%87.18	2	High
5	Relevance to the environment	3.98	0.80	%79.56	6	High
6	Providing lighting and ventilation	4.13	0.72	%82.65	4	High
7	Consideration the mental state of the owner	3.86	0.67	%77.24	7	High

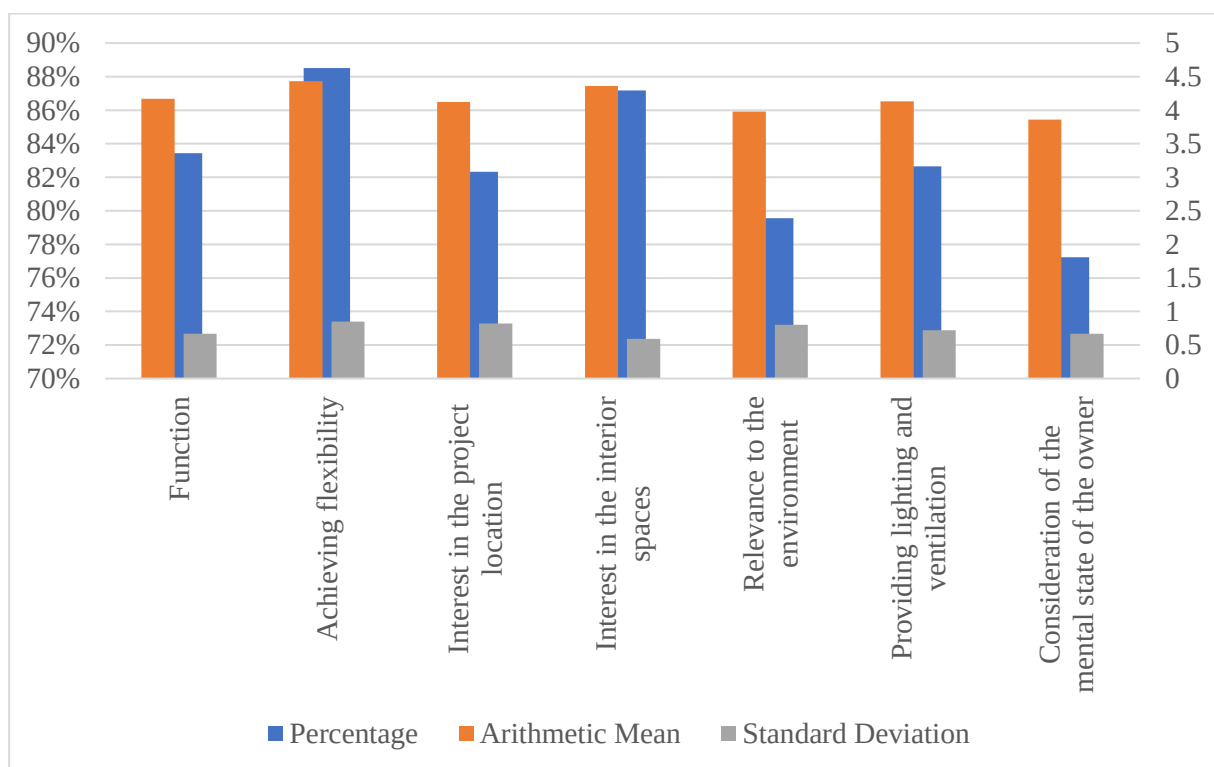
**Figure 1.** Representation of arithmetic mean and standard deviation of the answers of the study sample about function

Table 7. Arithmetic mean and standard deviation of the answers of the study sample (Aesthetic values)

No.	Term	Arithmetic mean	Standard deviation	Percentage	Order	Degree of importance
1	Using construction materials saves the general structure of the building	4.45	0.58	%89.06	1	High
2	Using materials that reduce heat loss inside a building	4.12	0.70	%82.43	3	High
3	Consideration of design to the climate circumstances	3.96	0.76	%79.23	5	High
4	Consideration of sustainable construction characteristics	4.09	0.71	%81.88	4	High
5	Consideration of using durable materials for building roofs	4.21	0.69	%84.20	2	High

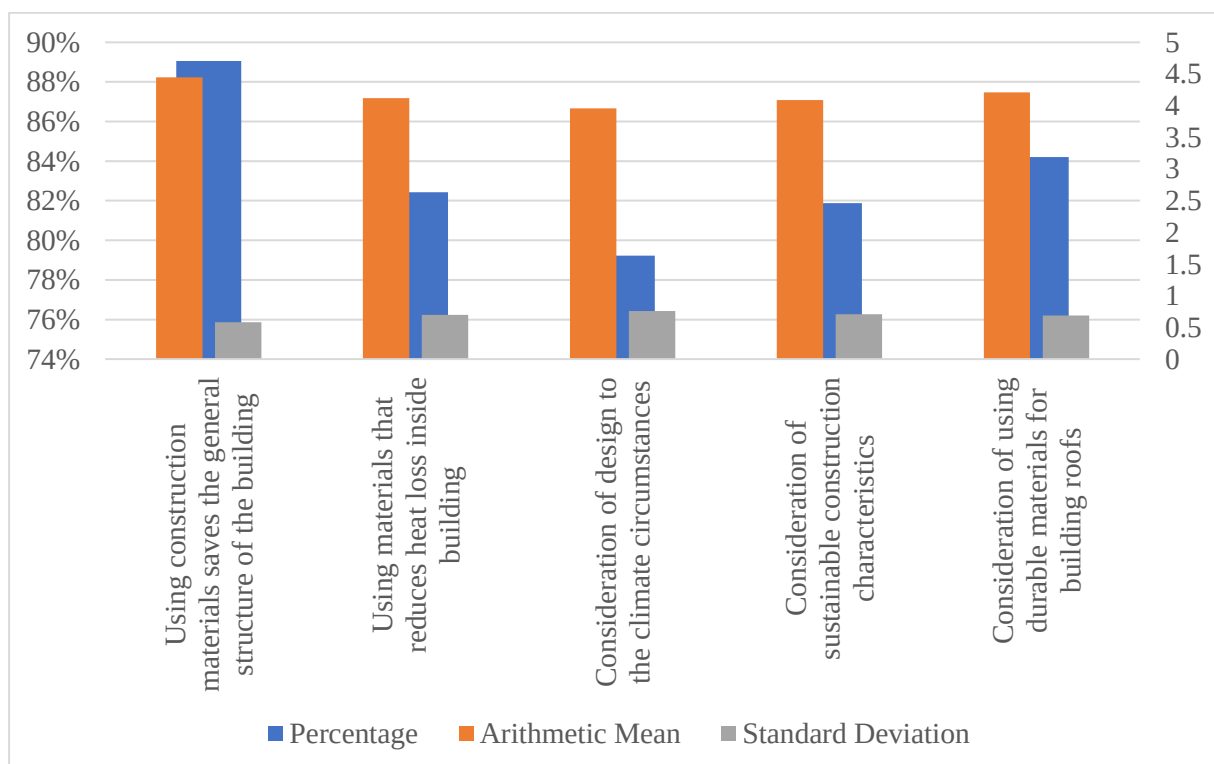
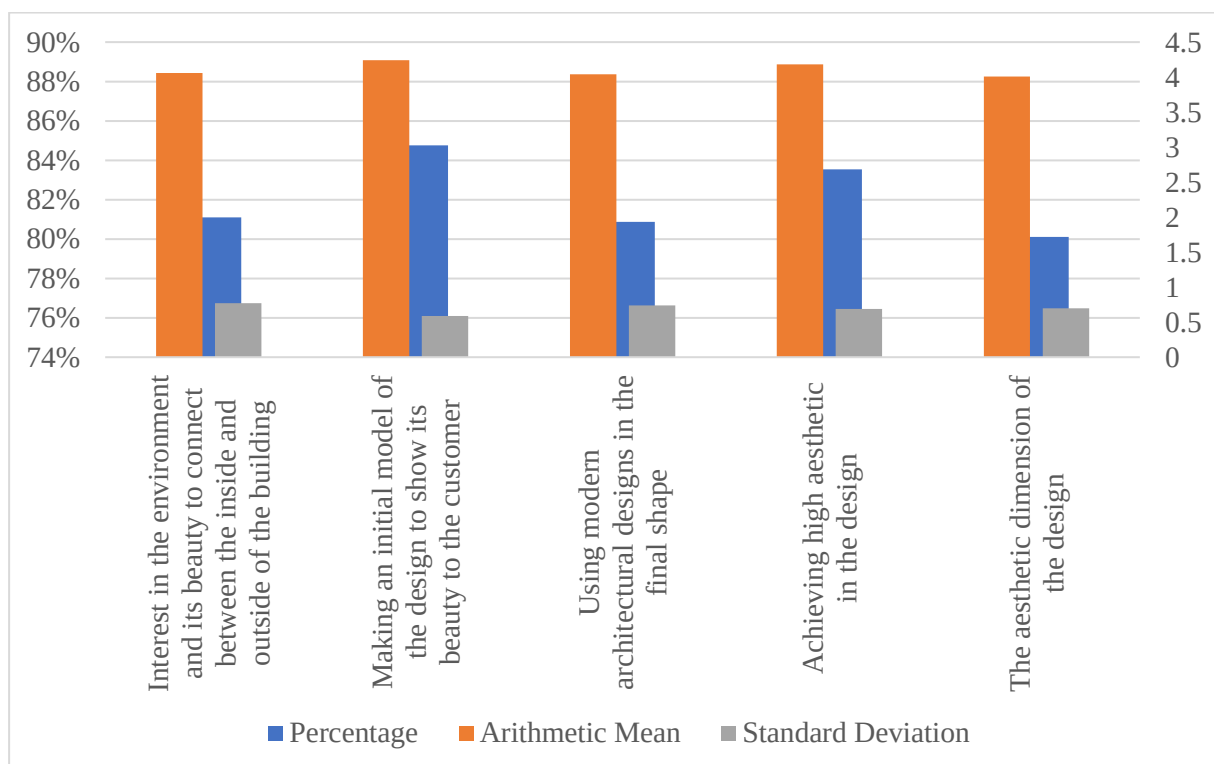
**Figure 2.** Representation of arithmetic mean and standard deviation of the answers of the study sample about aesthetic values

Table 8. Arithmetic mean and standard deviation of the answers of the study sample (Durability)

No.	Term	Arithmetic mean	Standard deviation	Percentage	Order	Degree of importance
1	Interest in the environment and its beauty to connect between the inside and outside of the building	4.06	0.77	%81.10	3	High
2	Making an initial model of the design to show its beauty to the customer	4.24	0.59	%84.75	1	High
3	Using modern architectural designs in the final shape	4.04	0.74	%80.88	4	High
4	Achieving high aesthetic in the design	4.18	0.69	%83.54	2	High
5	The aesthetic dimension of the design	4.01	0.70	%80.11	5	High

**Figure 3.** Representation of arithmetic mean and standard deviation of the answers of the study sample about durability

8. Conclusions of the questionnaire

8.1. Conclusions of table 6

Table 6 refers to the answers of the sample members regarding the design of interior spaces (function). Values of the arithmetic mean ranges within (3.86-4.34):

- The second term (flexibility) was ranked first, with an arithmetic mean (4.43), which represents %88.51, which was higher than the general arithmetic mean (4.20).
- The seventh term (consideration the mental state of the owner), which means the person who uses the architectural product, was ranked last, with an arithmetic mean (3.86) and a standard deviation (0.67), which represents %77.24, and that indicates the interest of the research sample in the function and the fluency of movement inside the architectural spaces, in addition to the interest in the mental state of the beneficiaries from the design.
- The general arithmetic mean of the factor of consideration function in design is (4.20) and the standard deviation is (0.45), which means that this factor was important and high.

8.2. Conclusions of table 7

The table refers to the answers of the questionnaire sample for their interest in (durability). Arithmetic values ranged within (3.96-4.45), and the standard deviation (0.58-0.76). It is noted that the first term (using construction materials saves the general structure of the building) was ranked first, with an arithmetic mean (4.45) and a standard deviation (0.58). In contrast, the third term, which relates to consideration of design to the climate circumstances, was ranked last, with an arithmetic mean (3.96) and a standard deviation (0.76), and that tells the interest of the sample in the safety of buildings, durability and keeping their beautiful appearance as long as possible. However, it should increase the interest in studying climate factors and conditions when designing projects.

The general arithmetic mean was (4.17) with a standard deviation (0.51), which indicates that the interest in durability during the design was high, and it is normal because the durability, strength, and resistance of the structure are important for usability. So that, the structure cannot be used unless the design is durable and safe, regardless of aesthetic value.

8.3. Conclusions of Table 8

The table refers to the answers of the questionnaire sample regarding the (aesthetic values of the design), the arithmetic means ranged between (4.01-4.24). It is noted that the second term (making an initial model of the design to show its beauty to the customer) was ranked first, with an arithmetic mean (4.24), standard deviation (0.59) and a percentage (%84.75). On the other hand, the fifth term (the aesthetic dimension of the design) was ranked last, with an arithmetic mean (4.01), standard deviation (0.70) and a percentage (%80.11).

The general arithmetic mean was (4.12) with a standard deviation (0.47), which indicates that the importance level of the aesthetical value of the design was high, and that variable is important in terms of aesthetic the interest in the aesthetics of the architectural design, and it has a significant impact on the acceptance of the customers on the design presented to him.

Table 9 presents the general evaluation of the architectural design efficiency by reviewing the percentages. Interest in function was ranked first, with a general arithmetic mean (4.20), which represents (%83.95), while the aesthetic was ranked third, with a general arithmetic mean (4.12), which represents (%82.46).

Table 9. The general evaluation of the architectural design efficiency

Term	Arithmetic mean	Standard deviation	Percentage	Order
Function	4.20	0.45	%83.95	1
Durability	4.17	0.51	%83.36	2
Aesthetic	4.12	0.47	%82.45	3

9. General conclusion

The three variables (function, durability, and shape) are interconnected to show the best architectural product. Design became more efficient if there was a serious interest in achieving the solid function to ensure the continuance and the beauty of the shape to meet the beneficiary's desire, consistent with the development of construction technology.

10. Recommendations

1. More focus of durability is recommended, the target of the design is to be durable to ensure the safety of the occupants in the first place.
2. The shape is an important part of the design in addition to function and durability, it gives an additional value to design.

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