

Original Article

Impact of Logic on Formal Minimalism in Modern Architecture

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Abstract - The research addresses the concept of logic as an influential design approach to achieve formal minimalism in modern architecture. By reviewing many studies that dealt with the concept of formal minimalism, it was found that they did not shed light on this complex relationship between it and logic. From here, the knowledge gap emerged, which is the weak clarity of the relationship of logic as a design method to the concept of formal minimalism. The research question and its problem emerged: "Does logic affect formal minimalism?" Therefore, the research sought to clarify this relationship and answer the research question by building a theoretical framework that explains both logic and formal minimalism. The research also aims to conduct a practical study that includes graphic analysis and examination of the works of famous architects to determine the main architectural formal characteristics and provide a comprehensive analysis of this subject. The conclusion summarizes how these architects' approached minimalism, emphasizing the use of basic shapes, simplified lines, flat surfaces, and various other factors.

Keywords - Logic, Method, Formal, Minimalism, Modern Architecture.

1. Introduction

According to the methodological approach, architecture was a pure instrument whose forms were a reflection of function and whose task was to change the world rather than to represent it. Architecture was a pure methodology and a process (Moustafa, 1988, p.10). The concept of logic and formal minimalism in modern architecture has been an important topic in previously various theoretical architectural studies. Despite the multiplicity of these studies, they did not clarify and specify in a precise manner the holistic architectural characteristics and criteria that can be used to generate minimalist architecture in terms of form. Therefore, the research aims to build a more comprehensive theoretical framework on the mechanisms in architecture to produce modern minimalist architecture and to define holistic characteristics of the concept of minimalism, then apply these characteristics to a group of architectural models to know the extent of the influence and relationship of these characteristics to the selected projects. The study identifies key architectural characteristics through an examination of works by renowned architects like Ludwig Mies van der Rohe and Tadao Ando. This work serves as a resource for architects, scholars, and enthusiasts - offering insights into the design philosophies of influential architects.

2. Literature Review

In order to build the theoretical framework of the research to clarify cognitive deficiencies related to the research problem, it is necessary to review and discuss the

previous architectural studies. These studies were chosen based on their approach to the concept of minimalism in modern architecture. This is consistent with the subject of the research. These studies did not address the aspects that were addressed by the research.

Eeno Study (2011). Minimalism in Art and Design; Concept, influences, implications, and perspectives: interest in comprehending simple design. This points out what social influence minimalism has on lifestyle and defines an idea for a design that concentrates on reduction as a positive technique and draws on the idea of minimalism as a tool for distinguishing comprehension and simplicity. Nikolic & Vasilski Study (2017). Minimalism in Contemporary Architecture as One of the most Usable Aesthetically-Functional Patterns: the goal of the study is to uncover minimalism's impact on contemporary life and define the correlation of this phenomenon to the fact, then analyzing impacts and features of minimalism in contemporary space including specific examples from practice. Mehta et al. Study (2019). Minimalism in Architecture: addresses the elements, principles and characteristics of minimalism. It discusses research on the plan and design concepts of the architects included in the minimalist approach and construction procedures of the buildings. YOSSEF Study (2014). Language of Minimalism in Architecture: interpret the language of 'Minimalism' in architecture to comprehend which design elements must be used to give a space character of being 'minimal'. Reveal the philosophy of 'Minimalism' and extract its design criteria.



Taghilooha Study (2011). Use of Color in Minimalist Interior Spaces: explains Minimalism with Different Function in Different Regions, beginning with its emergence and its relationship to design, Interior Design, Art and Color. Mentions color as an important character of design element and the particular role it has in interior design. Sever & Akbulak Study (2020). The Effects of The Concept of Minimalism on Today's Architecture, Expectations after Covid-19 Pandemic: show how the minimalist approach can change living spaces for designers and users and show the significance of this approach for users. The actuality of the subject expectations in architecture after the COVID-19 pandemic is discussed, too. Through previous studies, it is found that despite its multiplicity and coverage of various aspects of the concept of minimalism, it did not identify comprehensive architectural characteristics for the production of Logical modern minimalist architecture. It also lacks practical and graphic analysis.

3. Logic

The English word "Logic" or the French "Logique" was derived from the Greek word "logos" meaning "the word" and then it took an idiomatic meaning, which is beyond the word from a mental process (Al-Nashar, 2000 p.3). Keynes defines logic as the science that researches the general principles of correct thinking. Its subject is the investigation of the properties of rulings, not as psychological phenomena, but in terms of their significance to knowledge and beliefs, and he means in particular by defining the conditions by which justify the transition from known rulings to others that are necessary for them, (Badawi, 1977, p. 4). Logic is the study of argument, criteria for distinguishing successful from unsuccessful arguments and the study of methods for applying those criteria (Gregory, 2017, p. 3). Logic in the strict sense is divided into two main parts: formal logic and Informal logic. However, logic does not mean special attention to the real content of these perceptions as much as it cares about the mental processes that lead to the correct acquisition of perceptions and affirmations.

For this reason, the formal aspect is more important than the material aspect (Badawi, 1977, p. 6). Logic can be divided into Formal logic, Informal logic, Mathematical logic, Objective logic and Philosophical logic. There are many types of logic:

Deductive reasoning: reasoning of formal logic, if a is the same as b, and b is the same as c, then a must be the same as c (Cross, 2023, p.26). Requires starting with a little general idea, called premises, and applying them to a specific situation. Recognized rules, laws, theories, and broadly accepted truths are used to prove that a conclusion is right, as in Figure 1 (Wilson,2016, p1). Inductive reasoning: uses a group of specific observations to get an overarching conclusion as in Figure 2. So, a little specific premise creates a pattern that gives the path to a wide idea that is likely true (Wilson,2016, p1,2). Abductive reasoning: leads to a plausible or satisfactory, but not certain,

conclusion from a set of observations or problematic situations. It provides a reasonable and defensible suggestion that something may be, but not that it definitely is or must be an appropriate conclusion. It is the rhetorical, persuasive logic of design (Cross,2023, p.177). This idea goes back to the philosopher Charles Sanders Peirce, and it is called inference towards the best interpretation, as a well-known rule is used to derive a conclusion within an acceptable percentage of credibility, and through which new conclusions can be drawn from acceptable and non-conflicting familiarities, as in Figure 3, (Coyne, 1988, p98).

4. Architectural Design Methods

The study of design approaches ranged between two lines of thought that took two somewhat different directions; the first adopted the concept of Intuition, while the other adopted the rational concept. Christopher Jones (1992), in his book Design Methods, distinguished three approaches to architectural design. First is the designer as a black box: From the creative point of view, the design results from the ambiguous creative leap, as in Figure 4. Second, designed as a glass box: From the logical point of view, the design is the product of a justified logical process, as in Figure 5. Third: the designer as a self-organizing system: From the point of view of control, design is the product of a strategy and a design process, as in Figure 6.

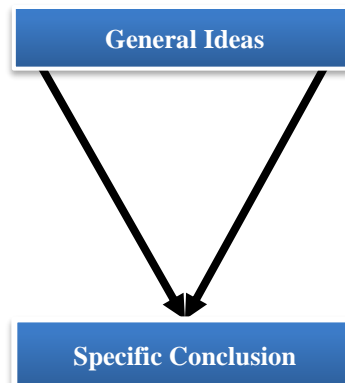


Fig. 1 Deductive reasoning in theory (Wilson,2016, p1).

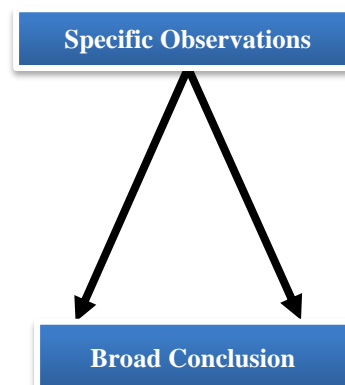


Fig. 2 Inductive reasoning in theory (Wilson,2016, p2).



Fig. 3 Abductive reasoning (Researcher after Cross, 2023, p.177)

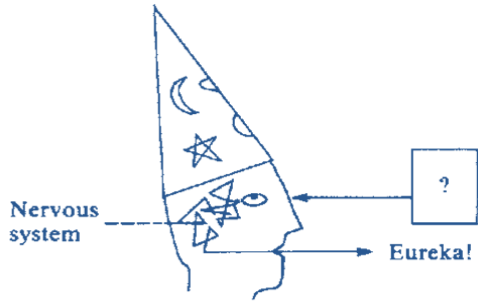


Fig. 4 Black box method, designers as magician (Jones,1992, p48)

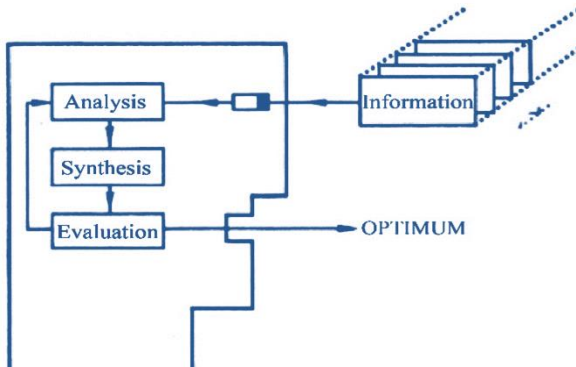


Fig. 5 Glass box method, designers as computer (Jones,1992, p48)

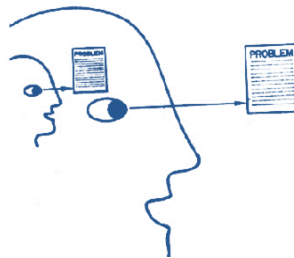


Fig. 6 Designer as a self-organizing system (Jones,1992, p55)

5. Logical Thinking in Design

According to the vision of the Hasso-Plattner Design Institute at Stanford University, design thinking stages have been marked. The stages do not go in one line as in Figure

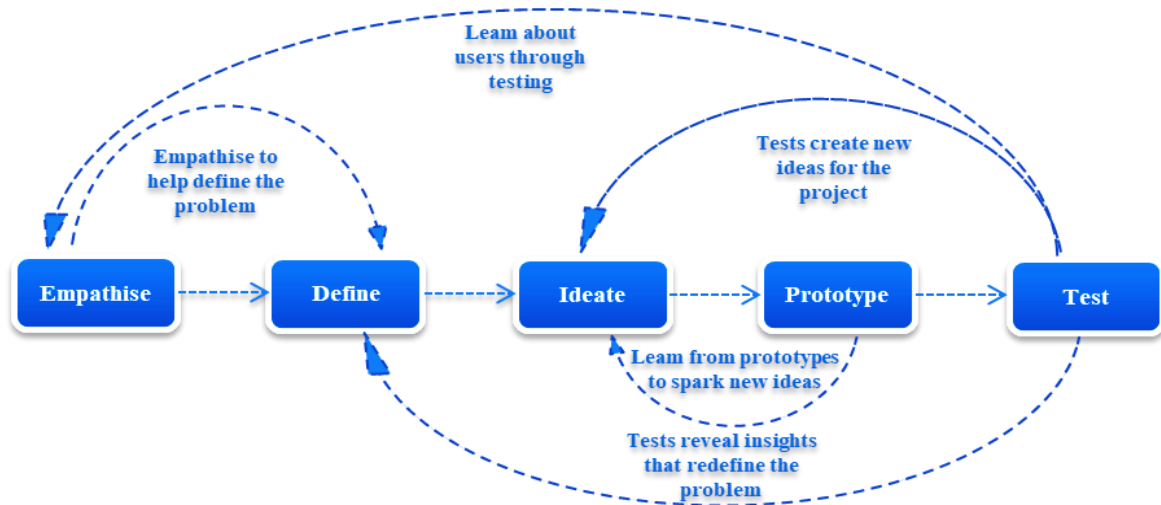


Fig. 7 Design thinking: is anon-linear process. (interaction-design.org,2022)

7. The 1st stage is Empathy when the designer takes care of his customer to understand his needs and desires to reach a product. The 2nd stage is to Define: identify the problem it is concerned with and then define and express it in terms of the need for a specific function through the language of architecture. The 3rd stage is the Ideate, where the thought consists of generating ideas through the data. Here come up with thinking methods that help the designer to generate the largest number of alternatives (ideas), and the solution is one of the most likely ideas.

The 4th stage, the Prototype, is when transforming ideas into formations (products and services) to be tested, approved, and purified nor; they are final thoughts. The 5th stage, the Test, is when the product is presented to its users to obtain feedback on the use of the most successful model, how it is more practical, and the reaction to the proposed model, as well as personal feelings and expressions towards it and belief in its work. The resulting information is used to redefine the problem of the product, leading to changing and arranging the prototype, eliminating its problems and then testing it again (Al-Yousef, 2019, pp. 47,48).

6. Minimalism

‘Minimalism’ is a trend in abstract painting and sculpture that accentuates outrageous rearrangements of form, utilizing fundamental shapes and monochromatic ranges of primary colors, objectivity and anonymity of style. Additionally known as the art of reductivism that utilizes least and barest basics or components as in art, literature, music or design. It comes from the reductive parts of Modernism. The term ‘minimalist’ frequently alludes to whatever is extra or stripped to its basics. The word was first utilized in English in the early twentieth century to depict “a 1913 organization by the painter Kazimir Malevich of a black square on a white ground”. At the same time, Leo Babauta deciphered the significance of ‘Minimalism’ socially as just disposing of unneeded things, leaving a cleaned-up, straightforward life, living without a fixation on material things or a fixation on making everything, and making excessively (YOSSEF,2014, p414).

Formally, there is no received definition of minimalism. It is exceptionally hard to make an overall definition of minimalism as there are no exact set-up standards that help to distinguish what is and what isn't a minimalistic design. There are numerous attempts to define minimalist design in architecture and every case may be qualified as an individual approach of its author. "Minimalism is a simple articulation of comprehensive thought" Donald Judd. "Minimalism is the pursuit of the essence of things and not for their occurrence" Massimo Vignelli. "Minimalism involves "reducing architecture to its most basic qualities of space, light and weight" Peter Murray. "Essentially, it is reductionism in architecture that encompasses simplicity, linearity, muted color palettes, sophisticated finishing & contemplation "Vice Pip. "Perfection and quality that the object is achieved when it is no longer possible to improve subtraction and when all the components and details are reduced to the essence" John Pawson, (Nikolik and Vasilski,2018, p. 334-335). Minimalism is an art and design trend that began in the twentieth century. As an idea, minimalism in architecture, yet in addition to other art and design areas, also ways of life, see Figure 8. Minimal implies least in amount or degree.

Additionally, minimal art implies nonrepresentational art comprising mostly geometric shapes and forms. "Minimalism is a new sensation, a new arrangement of creation emerging from "minimal art" and dependent on various modernist ideals" and different forms and designs to describe movements of optical art, music, theatre, and film where the work is done to deep down major characteristics.

It tends to be referenced as a particular movement in arts, that it is generally identified as improvements in post-2nd World War with Western art, and emphatically with USA optical arts in the last part of the 1960s and 1970s. The most famous artists related to this movement are known as Donald Judd, Agnes Martin, Frank Stella, and Robert Morris, (Taghilooha,2011, p6).

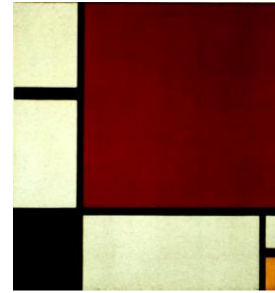


Fig. 8 Piet Mondrian, composition in red, blue, and yellow 1930, (Taghilooha, 2011, p9)

7. Minimalism & Modern Architecture

Because of modern progressions, the minimalist movement has spread to architecture shaped after a rigid-hard design of geometrical forms in the light of conceptual purism and formal limitations. Thinking back to 1920, minimalism arose as a sequel of current movements, and during the 1960s it was perceived as a development of art and design until the 1980s when it came up once more. Minimalism remains alive in a few architectural structures from an earlier time and still takes interest from designers today. As in painting and sculpture, minimalism shows up in the form of abstraction in architecture as well (Sever and Akbulak,2020, p69).

The sources of architecture of minimalist can be seen in the Cubist design movements of De Stijl and Bauhaus of the 1920s. For example, the De Stijl movement supported simplicity and abstraction by lessening art to its fundamental colors and forms. Schroder House is a curated environment where a variety of normally disparate components—roofs, balconies, walls, windows, partitions and furniture—are conceived and executed under a rigorously consistent system. The geometry, surfaces and color of all of these components were carefully controlled and considered by Rietveld. While providing a reasonably accommodating domestic environment, the house is organized as a singular declarative representation of principles of De Stijl as in Figure 9 (Simitch &Warke,2014, p110).



Fig. 9 Schroder house, Utrecht-Netherlands, 1923, interior and exterior, (Simitch &Warke,2014, p110)

8. Conceptual Framework

The utilization of elementary geometric shapes is the basis of the minimalist organization; consequently, just a single essential shape or a little similar and orthogonal form is being used. Essentially, the contemporary idea of forming an inside uses spatial simplicity, white tone related to nature, soft textures and colors, and all the time high-tech items. Inside space typically has industrial design components or super modern style in lamps, stairs, heaters and so forth. Color or texture, in a real sense, doesn't deliver equivalent impacts and experience as form outlines, yet it is a powerful factor that shapes the character of the form (Nikolic and Vasilski, 2017, p335). Hue-range language is communicated through cooperation between form and color. A broad scope of colors is improper in the Minimalistic design; hence essential coloristic domain is regularly white (plaster), dark (raw concrete), clean surfaces, etc. An uncommon spot in design involves the white tone as essential for tackling the lighting problem. Pure whiteness is the better expression mechanism of form and material feature showing the emptiness and it is the symbol of spatial all-inclusiveness (Nikolic and Vasilski, 2017, p336).

9. Materials and Method

(a) Identifying (Independent Variable-X) Holistic characteristics and criteria of minimalist architecture and

Secondary Variables extracted from the theoretical framework as in Table 1. (b) Identifying (Dependent Variable-Y) Case studies of minimalism in architecture as in Table 2. Mies van der Rohe, the German architect and the First pioneer of 'Minimalist' Architecture, remained the most significant and soonest forerunner of 'Minimalist' architecture, especially from the 1920s to 1960s. His famous essay 'less is more' is for modernists, characterizing an explanation for minimalists; it has become a mantra for stripping away undesirable detail.

Another significant architect from the next generation who followed minimalism was the Japanese architect Tadao Ando, who created 'minimalist' works that had the right to be experienced. So, the researchers chose their projects because every single one of the previous had his own 'minimalist' approach, whether functional, structural or philosophical. Rohe and Ando created distinctive minimalist methodologies because both came from different societies. Theoreticians and critics agreed that their projects became milestones of 'Minimalism' in the first and second half of the twentieth century. The research will analyze picked projects for them. Three minimalist projects for Mies van der Rohe and three minimalist projects for Ando will be investigated in Figures 10,11,12,13,14 and 15. c- Graphic & Data Analysis-Statistics as in Tables 3,4,5,6,7,8,9,10 and 11.

Table 1. Classification of the independent variable and encoding (Researcher)

Holistic Characteristics of Minimalist (The minimalist design vocabulary) - X			
Form (Appearance)	Shape (Xa)	Usage of basic shapes (geometric shapes)	Xa1
		Simplicity of form	Xa2
	Elements (Xb)	Minimum of necessary elements	Xb1
		Minimal interior partitions	Xb2
		simple objects	Xb3
		Simplified lines	Xb4
		Flat Surfaces	Xb5
	Decoration (Xc)	A lack of surface decoration	Xc1
		Smooth finishes	Xc2
		Industrial manufacturing	Xc3
Color (Xd)	Monochromatic surfaces	Xd1	
	Primary colors palette	Xd2	
Substance	Principles (Xe)	Repetition	Xe1
		Unification	Xe2
	Concepts (Xf)	Abstraction	Xf1
		Purity	Xf2
		Clarity	Xf3
		Plain	Xf4
		Bareness	Xf5
	Meanings & Symbols (Xg)	Anonymity of style	Xg1
		Eliminating indications and referential subjects	Xg2

Table 2. Classification of the dependent variable and encoding (Researcher)

Case studies-Projects (Y)		
Mies van der Rohe (Ya)	Barcelona Pavilion	Ya1
	Tugendhat House	Ya2
	Farnsworth House	Ya3
Tadao Ando (Yb)	The Church of the Light	Yb1
	Koshino house	Yb2
	4x4 House, Tarumi-ku	Yb3













Ludwig Mies van der Rohe Projects		
<p>Fig. 10 The Barcelona Pavilion, exterior & interior (YOSSEF,2014, p421).</p>		
<p>Fig. 11 Tugendhat House, exterior & interior (en.wikiarquitectura.com,2023)</p>		
<p>Fig. 12 Farnsworth House, exterior & interior (en.wikipedia.org,2023)</p>		
Tadao Ando Projects		
<p>Fig. 13 Church of the Light, exterior & interior (Sever and Akbulak,2020,p77).</p>		
<p>Fig. 14 Koshino house, exterior & interior (Mehta, Dave et al.,2019,p652).</p>		
<p>Fig. 15 4x4 House, exterior & interior (Nikolic and Vasilski, 2017,p338)</p>		

Table 3. Graphical analysis of the barcelona pavilion (Researcher)


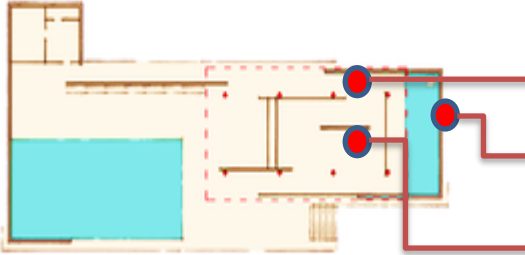
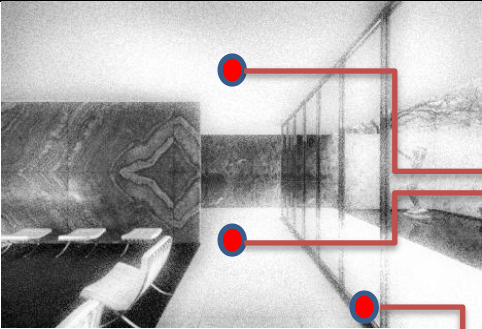

<input checked="" type="checkbox"/> Existing	<input type="checkbox"/> Not Existing	
 <p>Forms</p>	Usage of basic shapes (geometric shapes)	<input checked="" type="checkbox"/>
	Simplicity of form	
 <p>Elements</p>	Minimum of necessary elements	
	Minimal interior partitions	<input checked="" type="checkbox"/>
	simple objects	
	Simplified lines	<input checked="" type="checkbox"/>
 <p>Decoration</p>	A lack of surface decoration	<input checked="" type="checkbox"/>
	Smooth finishes	<input checked="" type="checkbox"/>
	Industrial manufacturing	<input checked="" type="checkbox"/>
 <p>Colors</p>	Monochromatic surfaces	<input checked="" type="checkbox"/>
	Primary colors	
Principles	Repetition	<input checked="" type="checkbox"/>
Concepts	Unification	
	Abstraction	<input checked="" type="checkbox"/>
	Purity	<input checked="" type="checkbox"/>
	Clarity	<input checked="" type="checkbox"/>
	Plain	<input checked="" type="checkbox"/>
Meanings & Symbols	Bareness	<input checked="" type="checkbox"/>
	Anonymity of style	
	Eliminating indications and referential subjects	

Table 4. Association between independent & dependent variable - Mies & Tadao projects (Researcher)

		X																				
		Xa 1	Xa 2	Xb 1	Xb 2	Xb 3	Xb 4	Xb 5	Xc 1	Xc 2	Xc 3	Xd 1	Xd 2	Xe 1	Xe 2	Xf 1	Xf 2	Xf 3	Xf 4	Xf 5	Xg 1	Xg 2
Y	Ya 1	■			■		■	■		■	■	■		■		■	■	■	■	■		
	Ya 2	■	■		■	■	■	■		■	■	■		■		■	■	■	■	■		■
	Ya 3	■	■				■	■		■	■	■		■	■	■	■	■	■	■		■
	Yb 1	■	■				■	■		■	■	■		■		■	■	■	■	■		■
	Yb 2	■	■				■	■		■	■	■		■		■	■	■	■	■		■
	Yb 3	■	■	■			■	■		■	■	■		■		■	■	■	■	■		■
		■ Existing										□ Not Existing										

Table 5. Association between independent & dependent variable - Mies projects (Researcher)

		X																				
		Xa 1	Xa 2	Xb 1	Xb 2	Xb 3	Xb 4	Xb 5	Xc 1	Xc 2	Xc 3	Xd 1	Xd 2	Xe 1	Xe 2	Xf 1	Xf 2	Xf 3	Xf 4	Xf 5	Xg 1	Xg 2
Y	Ya 1	■			■		■	■		■	■	■		■		■	■	■	■	■		
	Ya 2	■	■		■	■	■	■		■	■	■		■		■	■	■	■	■		■
	Ya 3	■	■				■	■		■	■	■		■	■	■	■	■	■	■		■
		■ Existing										□ Not Existing										

Table 6. Association between independent & dependent variable - Tadao projects (Researcher)

		X																				
		Xa 1	Xa 2	Xb 1	Xb 2	Xb 3	Xb 4	Xb 5	Xc 1	Xc 2	Xc 3	Xd 1	Xd 2	Xe 1	Xe 2	Xf 1	Xf 2	Xf 3	Xf 4	Xf 5	Xg 1	Xg 2
Y	Yb 1	■	■				■	■		■	■		■		■	■	■	■	■	■		
	Yb 2	■	■				■	■		■	■		■		■	■	■	■	■	■		■
	Yb 3	■	■	■			■	■		■	■	■		■		■	■	■	■	■		■
		■ Existing										□ Not Existing										

10. Results and Discussion

Results related to Forms: usage of the basic shapes Xa1 achieved 100 % while simplicity of form Xa2 achieved 83.3 % - for all Projects Y. Results related to Elements: minimum of necessary elements Xb1 achieved 16.6%, Minimal interior partitions Xb2 achieved 33.3%, simple objects Xb3 achieved 33.3%, Simplified lines Xb4 achieved 100%, and Flat Surfaces Xb5 achieved 100% - for all Projects Y. Results related to Decoration: A lack of surface decoration Xc1 achieved 50%, Smooth finishes Xc2 achieved 50%, and Industrial manufacturing Xc3 achieved 100% - for all Projects Y. Results related to Colors: Monochromatic surfaces Xd1 achieved 50%, Primary colors Xd2 achieved 16.6% - for all Projects Y. Results related to Principles: repetition Xe1 achieved 66.6%, Unification Xe2 achieved 66.6% - for all Projects Y. Results related to Concepts: Abstraction Xf1 achieved 100%, Purity Xf2 achieved 100%, Clarity Xf3 achieved 100%, Plain Xf4 achieved

50%, and Bareness Xf5 achieved 100% - for all Projects Y. Results related to Meanings & Symbols: Anonymity of style Xg1 achieved 0%, while eliminating indications and referential subjects Xg2 achieved 66.6% -for all Projects Y. as shown in Table 4.

Results related to Forms: usage of the basic shapes Xa1 achieved 100 %, simplicity of form Xa2 achieved 66.6% - for Mies van der Rohe projects Ya. Results related to Elements: minimum of necessary elements Xb1 achieved 0%, Minimal interior partitions Xb2 achieved 66.6%, simple objects Xb3 achieved 66.6%, Simplified lines Xb4 achieved 100%, and Flat Surfaces Xb5 achieved 100% - for Mies van der Rohe projects Ya. Results related to Decoration: A lack of surface decoration Xc1 achieved 0%, Smooth finishes Xc2 achieved 100%, and Industrial manufacturing Xc3 achieved 100% - for Mies van der Rohe projects Ya. Results related to Colors: Monochromatic

surfaces Xd1 achieved 100%, Primary colors Xd2 achieved 33.3% - for Mies van der Rohe projects Ya. Results related to Principles: repetition Xe1 achieved 100%, Unification Xe2 achieved 33.3% - for Mies van der Rohe projects Ya. Results related to Concepts: Abstraction Xf1 achieved 100%, Purity Xf2 achieved 100%, Clarity Xf3 achieved 100%, Plain Xf4 achieved 100%, and Bareness Xf5 achieved 100% - for Mies van der Rohe projects Ya. Results related to Meanings & Symbols: Anonymity of style Xg1 achieved 0% while eliminating indications and referential subjects Xg2 achieved 66.6% - for Mies van der Rohe projects Ya. As shown in table 5. Results related to Forms: usage of the basic shapes Xa1 achieved 100 % while simplicity of form Xa2 achieved 100% - for Tadao Ando projects Yb. Results related to Elements: minimum of necessary elements Xb1 achieved 33.3%, Minimal interior partitions Xb2 achieved 0%, simple objects Xb3 achieved 0%, Simplified lines Xb4 achieved 100%, and Flat Surfaces Xb5 achieved 100% - for Tadao Ando projects Yb. Results related to Decoration: A lack of surface decoration Xc1 achieved 100%, Smooth finishes Xc2 achieved 0%, and Industrial manufacturing Xc3 achieved 100% - for Tadao Ando projects Yb. Results related to Colors: Monochromatic surfaces Xd1 achieved 0%, Primary colors Xd2 achieved 0% - for Tadao Ando projects Yb. Results related to Principles: repetition Xe1 achieved 33.3%, Unification Xe2 achieved 100% - for Tadao Ando projects Yb. Results related to Concepts: Abstraction Xf1 achieved 100%, Purity Xf2 achieved 100%, Clarity Xf3 achieved 100%, Plain Xf4 achieved 0%, and Bareness Xf5 achieved 100% - for Tadao Ando projects Yb. Results related to Meanings & Symbols: Anonymity of style Xg1 achieved 0% while eliminating indications and referential subjects Xg2 achieved 66.6% - for Tadao Ando projects Yb, as shown in Table 6.

11. Conclusion

Ludwig Mies van der Rohe and Tadao Ando were very tend to use basic shapes, Simplified lines, Flat Surfaces, Industrial manufacturing, Abstraction, Purity, Clarity, and Bareness – in all of the selected Projects. Ludwig Mies van der Rohe and Tadao Ando did not very tend to use the anonymity of style– in all of the selected Projects. Ludwig Mies van der Rohe and Tadao Ando were completely

opposite in using: A lack of surface decoration, Smooth finishes, Monochromatic surfaces and Plain– in all of the selected Projects. Ludwig Mies van der Rohe and Tadao Ando were varied in different degrees for the rest of the vocabulary – in all of the selected Projects.

Ludwig Mies van der Rohe very tended to use basic shapes, Simplified lines, Flat Surfaces, Smooth finishes, Industrial manufacturing, Monochromatic surfaces, repetition, Abstraction, Purity, Clarity, Plain, and Bareness. Ludwig Mies van der Rohe was not very tend to use a minimum of necessary elements, A lack of surface decoration and anonymity of style. Ludwig Mies van der Rohe was varied in different degrees for using the rest of the vocabulary.

Tadao Ando was very tends to use basic shapes, simplicity of form, Simplified lines, Flat Surfaces, A lack of surface decoration, Industrial manufacturing, Unification, Abstraction, Purity, Clarity, and Bareness. Tadao Ando does not very much tend to use Minimal interior partitions, simple objects, Smooth finishes, Monochromatic surfaces, Primary colors, Plain and Anonymity styles. Tadao Ando was varied in different degrees for using the rest of the vocabulary.

Through comparison of the results of analyzing the projects of these two leading architects, the research finds that they share the use of most of the design characteristics extracted from the theoretical framework with the exception of a few of them. Therefore, the application of logic to achieve formal minimalism varies from one architect to another according to his philosophy and interpretation of the concept of logic.

The study was able to achieve better results compared to the results in previous literature because it relied on graphic analysis of the selected models, analysis of the relative frequency of design characteristics, and tabular data representation.

Data Availability Statement

Data supporting the findings of this study are available within the article and its supplementary materials.

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Appendix

Table 7. Graphical analysis of Tugendhat house (Researcher)


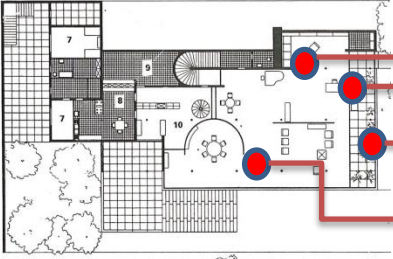
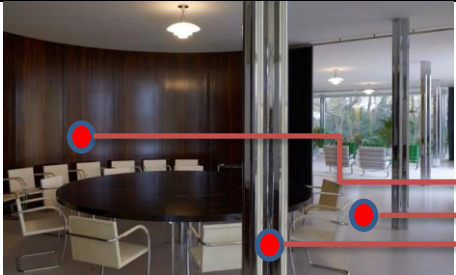

Existing <input checked="" type="checkbox"/>		Not Existing <input type="checkbox"/>	
Forms		Usage of basic shapes (geometric shapes)	<input checked="" type="checkbox"/>
		Simplicity of form	<input checked="" type="checkbox"/>
Elements		Minimum of necessary elements	<input type="checkbox"/>
		Minimal interior partitions	<input checked="" type="checkbox"/>
		simple objects	<input checked="" type="checkbox"/>
		Simplified lines	<input checked="" type="checkbox"/>
		Flat Surfaces	<input checked="" type="checkbox"/>
Decoration		A lack of surface decoration	<input checked="" type="checkbox"/>
		Smooth finishes	<input checked="" type="checkbox"/>
		Industrial manufacturing.	<input checked="" type="checkbox"/>
Colours		Monochromatic surfaces	<input checked="" type="checkbox"/>
		Primary colours	<input checked="" type="checkbox"/>
Principles	Repetition	<input checked="" type="checkbox"/>	
	Unification	<input type="checkbox"/>	
Concepts	Abstraction	<input checked="" type="checkbox"/>	
	Purity	<input checked="" type="checkbox"/>	
	Clarity	<input checked="" type="checkbox"/>	
	Plain	<input checked="" type="checkbox"/>	
	Bareness	<input checked="" type="checkbox"/>	
Meanings & Symbols	Anonymity of style	<input type="checkbox"/>	
	Eliminating indications and referential subjects	<input checked="" type="checkbox"/>	

Table 8. Graphical analysis of farnsworth house (Researcher)


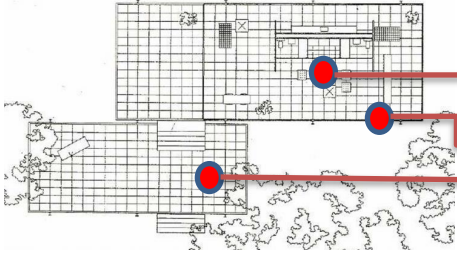


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		Simplicity of form		<input checked="" type="checkbox"/>
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		Minimal interior partitions		
		simple objects		<input checked="" type="checkbox"/>
		Simplified lines		<input checked="" type="checkbox"/>
Decoration		Flat Surfaces		<input checked="" type="checkbox"/>
		A lack of surface decoration		<input checked="" type="checkbox"/>
		Smooth finishes		<input checked="" type="checkbox"/>
Colors		Industrial manufacturing		<input checked="" type="checkbox"/>
		Monochromatic surfaces		<input checked="" type="checkbox"/>
Principles	Primary colors			
	Repetition		<input checked="" type="checkbox"/>	
Concepts	Unification		<input checked="" type="checkbox"/>	
	Abstraction		<input checked="" type="checkbox"/>	
	Purity		<input checked="" type="checkbox"/>	
	Clarity		<input checked="" type="checkbox"/>	
	Plain		<input checked="" type="checkbox"/>	
	Bareness		<input checked="" type="checkbox"/>	
Meanings & Symbols	Anonymity of style			
	Eliminating indications and referential subjects		<input checked="" type="checkbox"/>	

Table 9. Graphical analysis of church of light (Researcher)

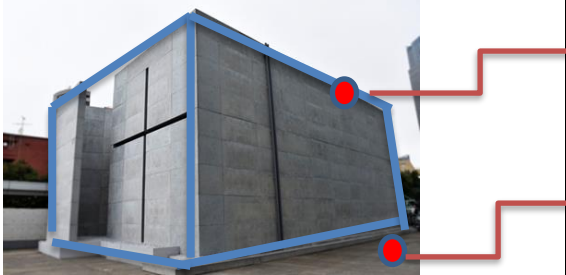

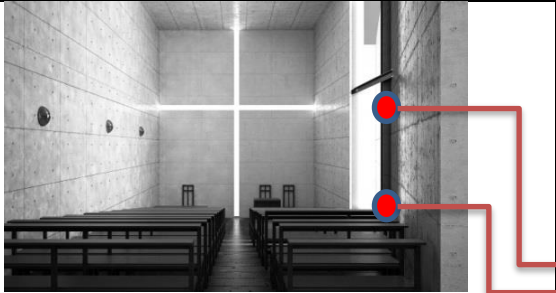
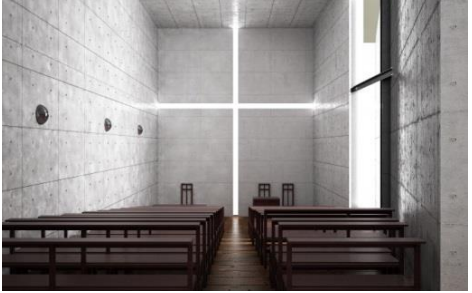
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		Simplicity of form	<input checked="" type="checkbox"/>
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		Simple objects	<input type="checkbox"/>
		Simplified lines	<input checked="" type="checkbox"/>
Decoration		Flat Surfaces	<input checked="" type="checkbox"/>
		A lack of surface decoration	<input type="checkbox"/>
		Smooth finishes	<input type="checkbox"/>
Colors		Industrial manufacturing	<input checked="" type="checkbox"/>
		Monochromatic surfaces	<input type="checkbox"/>
Principles	Primary colors	<input type="checkbox"/>	<input type="checkbox"/>
	Repetition	<input type="checkbox"/>	<input type="checkbox"/>
Concepts	Unification	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Abstraction	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Purity	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Clarity	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Plain	<input type="checkbox"/>	<input type="checkbox"/>
Meanings & Symbols	Bareness	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Anonymity of style	<input type="checkbox"/>	<input type="checkbox"/>
	Eliminating indications and referential subjects	<input type="checkbox"/>	<input type="checkbox"/>

Table 10. Graphical analysis of koshino house (Researcher)

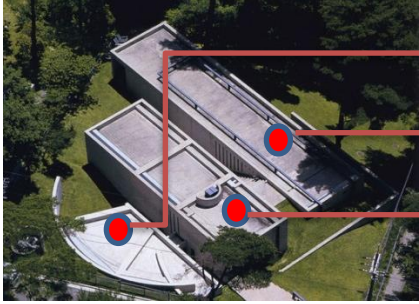
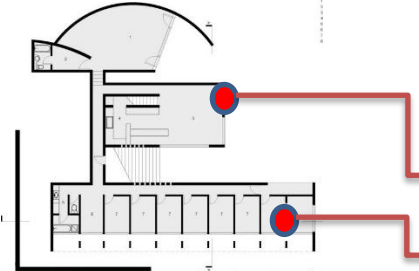






		<input checked="" type="checkbox"/> Existing	<input type="checkbox"/> Not Existing
Forms		Usage of basic shapes (geometric shapes)	<input checked="" type="checkbox"/>
		Simplicity of form	<input checked="" type="checkbox"/>
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		Minimal interior partitions	<input type="checkbox"/>
		Simple objects	<input type="checkbox"/>
		Simplified lines	<input checked="" type="checkbox"/>
Decoration		A lack of surface decoration	<input type="checkbox"/>
		Smooth finishes	<input type="checkbox"/>
		Industrial manufacturing	<input checked="" type="checkbox"/>
Colors		Monochromatic surfaces	<input type="checkbox"/>
		Primary colors	<input type="checkbox"/>
Principles	Repetition	<input checked="" type="checkbox"/>	
	Unification	<input checked="" type="checkbox"/>	
Concepts	Abstraction	<input checked="" type="checkbox"/>	
	Purity	<input checked="" type="checkbox"/>	
	Clarity	<input checked="" type="checkbox"/>	
	Plain	<input type="checkbox"/>	
	Bareness	<input checked="" type="checkbox"/>	
Meanings & Symbols	Anonymity of style	<input type="checkbox"/>	
	Eliminating indications and referential subjects	<input checked="" type="checkbox"/>	

Table 11. Graphical analysis of 4x4 House, Tarumi-ku (Researcher)

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Forms		Minimum of necessary elements	<input checked="" type="checkbox"/>
		Minimal interior partitions	<input type="checkbox"/>
		Simple objects	<input type="checkbox"/>
		Simplified lines	<input checked="" type="checkbox"/>
		Flat Surfaces	<input checked="" type="checkbox"/>
Elements		A lack of surface decoration	<input type="checkbox"/>
		Smooth finishes	<input type="checkbox"/>
		Industrial manufacturing.	<input checked="" type="checkbox"/>
Decoration		Monochromatic surfaces	<input type="checkbox"/>
		Primary colours	<input type="checkbox"/>
Colors			<input type="checkbox"/>
			<input type="checkbox"/>
Principles		Repetition	<input type="checkbox"/>
		Unification	<input checked="" type="checkbox"/>
Concepts		Abstraction	<input checked="" type="checkbox"/>
		Purity	<input checked="" type="checkbox"/>
		Clarity	<input checked="" type="checkbox"/>
		Plain	<input type="checkbox"/>
		Bareness	<input checked="" type="checkbox"/>
Meanings & Symbols		Anonymity of style	<input type="checkbox"/>
		Eliminating indications and referential subjects	<input checked="" type="checkbox"/>