

## **Fluid Design in Contemporary Architecture: Balancing Design and Application**

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**Abstract:** The design has a direct impact on our emotions and psychological well-being, making it crucial to achieve a seamless experience, both in terms of design and movement inside a given space. Colour balance is a fundamental design element because it conveys the ambiance and evokes a sense of relaxation, all while preserving a luxurious character.

With the introduction of computer programmes and the use of contemporary techniques in architecture and interior design, fluid architecture emerged as a new trend in design and technology. Prominent practitioners of this movement include Frank Geery and Zaha Hadid. It is believed that technology can be achieved through the design process, which has evolved into a means by which the designer can generate ideas for an interior architecture marked by fluidity and unexpected engineering that draws inspiration from nature and is unconstrained by conventional design and structural constraints. Both energetic and geometrical.

When planning a building's exterior and interior, as well as how it interacts with its environment, architects and designers must take streamlined design into account. The buildings are stable, but they nevertheless gain an advantage from the winds and air circulation around them.

The introduction of computers and their programmers, along with the use of contemporary technologies in interior design, furniture, and architecture, exposed many early architects, including Frank Gehry and Zaha Hadid, to technology in fluid architecture. The purpose of this work is to provide an interior architectural style that is both free from conventional design and construction constraints and defined by a fluidity of form and unexpected geometry drawn from nature. The article begins with a short introduction to fluid design before moving on to discuss its characteristics and features, generic design, layout, and actual applications. Lastly, we highlight a few opportunities and threats found in the vast fluid architecture design literature review.

**Keywords:** Fluid design, Contemporary architecture, Design architecture.

### **1. Introduction**

Given the abundance of creative shapes and irregular complex design formations found in nature, such as clouds, seas, and dunes, the architects took inspiration from these curved formations and began to replicate their intricate structures. However, they encountered an issue with the challenge of implementing traditional techniques in design. The growth of the digital revolution, mathematical information, biological sciences, and computer programs has resulted in the emergence of a great number of intricate designs and architectural styles in the 21st century. Designers benefited from this, as it enabled them to create intricate designs with flowing forms inspired by nature. Conventional procedures are not capable of producing such designs.

Furthermore, contemporary design trends rely on the concept of form-finding, as opposed to traditional methods of producing forms. The research investigates the idea of fluidity, which is one of the most current trends in digital design. It explains the concept of fluidity, its features, and the possibility of introducing new design modifications during the design process. Architect Frank Lloyd Wright first coined the term "fluidity" in 1990 AD. He also made it a key aspect of his architectural projects. Subsequently, many designers, including architects, started incorporating the concept of fluidity into their architectural projects. Described as having fluidity and a free-flowing, dynamic quality, Zaha Hadid is a well-known designer. Zaha Hadid's work is characterized by an all-encompassing and multifaceted architectural style that is dependent on the deformation, shaping, compression, and movement of its forms. In addition, several furniture designers, including Zaha Hadid, have relied on the idea of fluidity as a source of inspiration while developing a variety of furniture components, Fig. (1).



## 2. The First Theme: The Theoretical Part

### 2.1 Fluid design between form and function

The concept of fluidity has been inherent since the inception of the universe, owing to the existence of water, which was the first recognised liquid by mankind. Since the inception of

buildings, humans have demonstrated an innate understanding of incorporating water into their designs, dating back to the earliest shelters built by our ancestors. Although the concept of this principle was not well defined, ancient Egyptian architects prioritised the incorporation of water flow in the interior architecture of their palaces. They did this with the intention of using water as a cooling method. This idea gradually evolved and emerged over time as architecture thrived. In Islamic culture, the use of fountains and other water features became apparent. These water features evolved beyond their basic form and started to imitate natural phenomena such as waves, eddies, and other creative forms seen in nature.

Energy is the fundamental component of this emerging architectural language, since it represents the dynamics and fluidity of motion. Dynamism and motion form the core of this concept. It has the capability to articulate the evolving ideas of force and dynamic space in a novel architectural structure. This is a novel manifestation of liberty, characterized by an inclination towards mobility and insignificance, with the aim of restricting potential energy and maximizing inertia in all circumstances. As a result, a new architectural principle emerged. In order to transition the final form from a static structure to the new theory of displacement, the pattern exhibits intricate non-linear forms. This will ultimately result in the creation of a novel architectural design, a fresh spatial arrangement, and an innovative aesthetic. This new architectural design will embody a transition from a fixed and unchanging state to a more fluid and adaptable one, ultimately culminating in a state of vibration. The focus of our conversation is on uncovering this concealed aspect as a fresh reality and a novel commencement. This new architectural style embodies the essence of acidity. The hidden core of emerging opportunities in modern architecture arises from the fusion of scientific and technological advancements with the principles of form and natural surroundings. He believes that categorization has come to an end, and formation has begun. Engineers believe that rheology, or the movement of matter, results in interrelated levels of freedom and constraint. 2

Therefore, it was imperative for the designer to capitalize on this concept not only in terms of aesthetics but also in terms of functionality. The intended objective of any successful design is to achieve harmony between the interior and exterior elements, as well as seamless integration between form and function. We can achieve an aesthetically pleasing outside design that seamlessly integrates with the surrounding environment, but it does not provide functional areas inside. It's not the achievement of the function that defines a good design, but the relationship between achieving it that matters.

Certain international designers and architects have achieved success and universality due to their recognition of the importance of form and function. Figure 2 illustrates how these designers prioritise the value of internal spaces, ensuring their intended purpose and seamless integration into the overall architectural design.

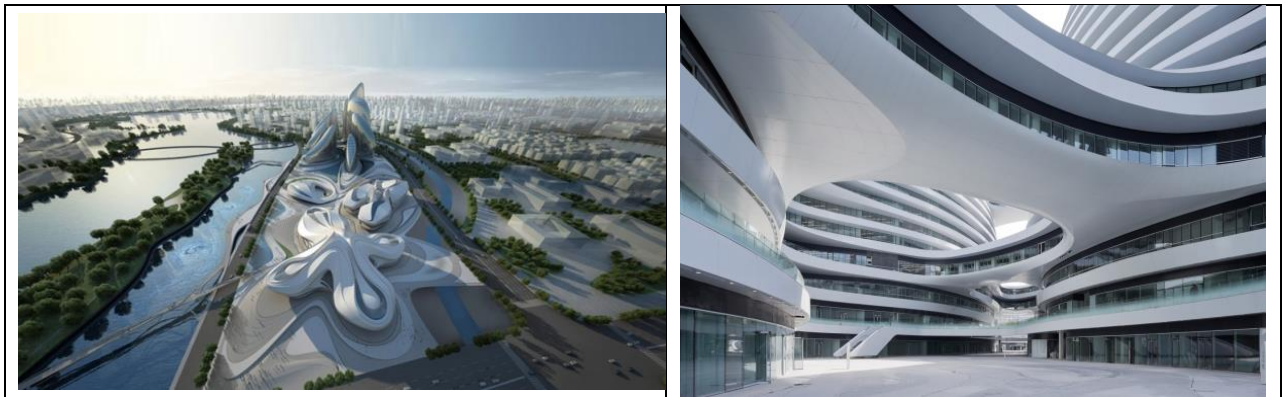
Zaha Hadid, known for her emphasis on fluidity and dynamic movement, is considered one of the most significant worldwide architects. These artworks challenge categorization and astonish the visitor with their originality. A uniquely constructed structure in the plaza of the Arab World Institute houses the exhibition honouring her, captivating passersby with its graceful and flowing architecture. When the walker approaches, he realizes that he is vulnerable and unprotected. Zaha Hadid, a British architect of Iraqi descent who has gained worldwide recognition and whose structures and designs are visible on every continent, showcases his architectural works. The concept of flow is also evident in the design of the cable car station in Innsbruck, Austria. The station's architecture imitates the natural surroundings, resulting in a harmonious and functional structure that seamlessly integrates with the environment. The object seen in Figure 2 is both contemporary and remarkable.



Some models clearly show how streamlined architecture can effectively structure internal spaces in response to external design, thereby influencing the interior environment. Zaha successfully created a design that combined aluminium and white glass, resembling an artistic painting. Zaha specifically created this design for buildings near the galaxy in Beijing. She achieved this by adding a 60-meter-long, twisting white arch in the shape of a large egg. Incorporating this acrobatic twist guides visitors to the central building, a challenging task given the prevalent architectural style in China. The Royal Institute of British Designers honoured Zaha Beh with the prestigious Summit Award. Figure 3 illustrates the impact of the exterior shape on creating an eco-friendly environment. The interior is characterised by a captivating sense of motion and energy, with versatile areas that offer ample room for various activities and convey a sense of expansiveness.

Social, material, and operational elements all come together in architectural fluidity, creating a socio-spatial expression. Fluidity maintains the constituent parts in close proximity to one another, similar to how intermolecular interactions define states of matter.





<https://designalog.wordpress.com/tag/zaha-hadid-architects/>

**Figure 3:** Linking the flow of design between architectural form and interior design.

The space's interior design streamlines to achieve both functionality and movement. It creates a dynamic and lively interaction between the space and the furniture, resulting in a cohesive design with a diverse rhythm and a sense of spaciousness. This is particularly beneficial in narrow spaces. Furthermore, it implies liveliness and motion in various orientations with seamless transitions, as shown in Figure 3. We can apply it more extensively, especially in virtual museums, theaters, tourist destinations, and other venues that provide amusement and direct audience engagement.

## 2.2 Fluidic architecture and technology

People often perceive architecture as a profession that focuses on building solid structures, making the term "fluid" seem unusual in this field. However, the concept of fluidity has recently become crucial in the profession due to the growing popularity of flowing, nonrational geometry, unbroken expanses, and seamless linkages between neighboring places.

Visualising architectural flexibility is, of course, nothing new. From the early 1990s, when pioneers in computational design began creating swirls and blobs, the industry began to incorporate smooth, curvilinear forms. The new parametric frenzy has amplified this decades-old movement, from designing furniture to city planning, producing fluid shapes at all scales. But what about more modern structures designs? Is shape the only kind of flow? Is fluidity inherent in architecture's materials, forms, or spaces? The architects' success lies not in creating a representation of flow but in creating flows inside the structure, even though the centre represents fluid geometry. The visitor's perception and navigation of the space, in conjunction with the geometry of the structure, determine the flow, which is a multi-faceted interplay amongst the building and its occupants. Therefore, in order to think about architectural flow, one must carefully separate the two definitions of architecture: architecture as an arrangement of space and directors of action, and architecture as a material presence or shape. A fresh perspective on architecture may be possible through fluidity, which arises from the interplay of physical, social, material, and sensory registers.

The rise of digital technology led to the creation of ethereal environments, contrasting with the dominant focus on tangible locations. Computer-based methods supplanted traditional physical mediums of expression like paper and pen. Designers began to create representative experimental settings using digital components, computer programs, and new design techniques. Innovative principles guide its aesthetics, fusing reality and imagination, freeing it from space and conventional design constraints, dissolving barriers between interior and exterior, and showcasing a unique and unconventional form. The advent of virtual reality has facilitated the creation of a simulated representation of reality, yet it remains distinct from actual reality, resulting in significant transformations. Convert physical pictures into digital ones using design techniques. 6

1. In the design process, tools are used.

2: The process of designing itself.

The procedure for production and implementation.

The interaction between design and virtual reality is both interactive and complementary. Virtual reality contributes by providing time-based, three-dimensional simulations that use animation methods, facilitated by form-finding programs.

When the designer creates a design in an interactive environment,

We construct a model and subsequently analyse it using a robust electronic, scientific methodology to provide insights.

The current shape is suitable for practical execution, hence enhancing designers' creative capacity. Individuals in interior design have the ability to explore the virtual realm in order to experiment, gain knowledge about its elements and qualities, and determine whether any modifications are necessary before adopting the design in the physical world. The advent of digital technology, aided by novel tools and capabilities, has played a role in eradicating the barriers that once existed between...

Recent legislation regulates the interior and exterior to produce avant-garde designs that are visually symbolic, groundbreaking, and more unconstrained and adaptable than physical spaces. This enables the designer to overcome a variety of design challenges and accommodate potential functional modifications in design 3.

In recent years, there has been a significant shift in architecture and interior design due to the digital revolution and the widespread use of technology. This includes the extensive use of computers and their programs in the design process. For instance, in the field of interior design, digital technology has successfully eliminated the barriers between internal and external spaces beyond conventional proportions. The text discusses the challenges related to both the shape formation, as seen in Figure 4, and the resolution of structural and design difficulties. For instance, this technology has merged the conventional measurements of ceilings, walls, and floors into a single unit. The wall can serve as a complementing element to the floor or ceiling, creating a unified and streamlined design. 6 The initial image showcases the intricate and elaborate external design of the structure, characterised by its complex and flowing lines. The image displays the design phases and layers, along with their interconnections, at the bottom. Similarly, within the same image, the top right portion displays the building's sequential horizontal projections, providing a comprehensive perspective of their arrangement and showcasing the various stages of execution and composition. The second image on the left of the figure displays the final external design. It provides detailed information about the horizontal projections and internal spaces, illustrating how they function and their connection to the exterior design. Additionally, a vertical section of the building demonstrates the relationship between the interior spaces and their connection to the exterior. This section also highlights the fluidity of the lines and the design relationships between them. The seamless transition of lines into the building demonstrates the degree of integration between the inner environment and the outer design.

Hence, it is evident that digital technology had a significant impact on the design process, leading to the emergence of new architectural trends such as transformed architecture. These trends are primarily associated with the integration of technology and the use of computers in architecture. 7. Therefore, fluid architecture is characterized by its unique nature, encompassing a future idea and a design style that aims to achieve interaction by merging imagination and reality into a unified space. This is an example of virtual architectural imagery. Thus, the notion of fluid architecture was originally associated with the virtual realm that integrates the physical and virtual dimensions. It is seen as a sequence of manifestations that represent a location. Physical environments are characterized by their adaptability to changing technological

advancements, allowing for flexible use of space. This concept has been extended to physical spaces by incorporating virtual elements through software programmers. Three Other software programmers, like DMAX, 3D Max, Maya, and Maya Rivet, utilize borrowed elements to varying extents in order to create actual architecture within virtual surroundings.

### 2.3 The fluid design indications that are the most highly significant

Using the information in the preceding sentence, one can determine the most important spatial indications in the context of fluid design architecture. It is now abundantly clear that there is no one term that can adequately convey or explain the unique characteristics of fluid architecture all by itself. The grouping of multiple items strongly expresses these qualities, as Table (1.1) demonstrates. This is in contrast to the situation described above. Therefore, to achieve the research objective, an evaluation will take place at a later stage in the practical study. The incorporation of fluidity as a design concept is an essential addition to the fundamentals of design. Fluidity, a fundamental principle, transforms the form and function of design, irrespective of its application in building, interior, or furniture design. Fluidity is a connected concept, closely linked to fundamental principles such as line, movement, rhythm, repetition, harmony, and other foundational principles. This is because when we link these components together, we discover that they generate fluidity. In summary, the application of modern fluid technology enables the creation of countless unconventional designs, the specifics of which would be challenging to develop or execute using traditional methods.

| <b>Table1.1:</b> Describes the key indicators of fluid design architecture.<br><b>Source:</b> the researchers |  |                                  |                                |                                      |      |         |
|---|--|----------------------------------|--------------------------------|--------------------------------------|------|---------|
| <b>Main Indicator</b>   |  | <b>Fluid Architecture design</b> |                                |                                      |      |         |
| <b>Secondary Indicator</b>  |  | Curve                            | •Flexibility-ability to change | Dynamic-new idea to change the world | Flow | Complex |

### 3. THE SECOND THEME: THE PRACTICAL PART

As for the second part of the research, it picked a few projects that included fluid design into their designs in an effort to study the signals of fluid design and its impacts in architecture, which emerged from the theoretical framework on the first axis.

This section focuses on the investigation's foundation and the chosen approach. The researchers tested the indicators of fluid design, as well as their effect on the functionality of the architectural design. The researchers employed both the descriptive-analytical method and the observation technique to accomplish this. The research sample's accessible data served as the foundation for testing. We selected the study sample from a set of worldwide and Arab projects, aligning it with the research direction. We took into account the geographical and spatial variations. Regarding the research sample, please refer to Table (1.2).

|   |                                  |                                |                                      |      |
|---|----------------------------------|--------------------------------|--------------------------------------|------|
| <b>Table1.1:</b> Describes the key indicators of fluid design architecture.<br><b>Source:</b> the researchers |                                  |                                |                                      |      |
| <b>Indicator</b>  | <b>Fluid Architecture design</b> |                                |                                      |      |
|   | Curve                            | •Flexibility-ability to change | Dynamic-new idea to change the world | Flow |

**Discussion**

The desire to integrate both the natural environment and technology has significantly impacted the design and architecture industries for a considerable period of time. We are entering a period characterized by interconnection, when biology and technology are intertwined. The similarities between architecture, fashion, and the space business are becoming increasingly plausible. However, other than theoretical and manifesto documents, what is the initial evidence to support it?

Across various domains, experiences have become highly significant for creative professionals and designers in the contemporary era. Previously, experimentation was primarily confined to scientific disciplines and excluded artistic fields. However, it has now broadened to encompass diverse scientific fields, prompting designers to actively stay updated and engaged in the pursuit of novel experiences within their own field. In the realm of the arts, and specifically in the design of theatre scenes, the designer employed a research-based and experimental approach to develop novel visual conceptions and visions that have a profound impact on the audience's awareness. Artistic experimentation, while aligned with the essential principles of scientific exploration, diverges from it in terms of the process of creativity and the resultant design (6).

Expertise in theatrical design enables the development of a unique means of communication with the audience, achieved through the exploration of inventive and sustainable visual concepts.

The significant advancement in computational science has greatly accelerated imaginative thinking and innovation. The computer offers a multitude of solutions and patterns that deviate from typical Euclidean geometry, resulting in complicated curves in the designs.

Scientists and specialists have made it possible to use powerful digital systems in current programs such as Maya and Rhino to build formations and installations with intricate curves. This was not achievable using previous approaches.

The digital revolution and the use of technology have greatly transformed the world of software, leading to a significant improvement in architectural concepts. The integration of architecture and technology has led to the emergence of new design trends, one of which is the notion of streamlined architecture.

The technological revolution has significantly advanced creative design thinking in the fields of architecture and interior design by removing limitations imposed by capabilities and tools. This has led to a surge of innovative ideas and designs that are characterised by dynamism and vitality.

The fundamental principles of design incorporate fluidity as an additional element that has a tangible impact on both the shape and purpose of the design. It also impacts me by imbuing a sense of motion, energy, and the recipient's state of being through the suggestion of movement, dynamism, and liveliness. This adds an extra layer of depth to the design.

There is a concept of continuity and flow throughout the area.



Computers facilitated precise control over designs, enabling interior designers to generate spatial solutions and explore novel concepts, while also granting access to very intricate designs that were previously inaccessible.

Digital technology has facilitated the creation of innovative designs that integrate architecture, interior design, and furniture. Traditional constraints do not limit these designs, which are characterised by dynamic interaction and a strong connection between interior and exterior spaces. Advanced design programmes have made this possible. Innovative advancements in creative thinking for the design process enable the creation of unique, distinctive, and efficient designs. The endeavour is challenging to execute using conventional approaches.

Fluidity in design is an essential addition to the basics of design because it is a pivotal principle and changes the form and function of design, whether in the field of architecture, interior design, or furniture. It is also closely related to basic principles such as line, movement, rhythm, repetition, harmony, and others, as linking these elements together creates fluidity. In summary, the utilization of advanced digital technology enables the creation of countless unconventional designs, the intricacies of which are challenging to design or execute using conventional methods.

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