

The nature of the architectural surfaces and the structural relationships to build stability and formal balance.

طبيعة السطوح المعمارية والعلاقات التركيبية التي تنتظم بموجبها لبناء الاستقرار والتوازن الشكلي.

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KEY WORDS

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Formal configuration,
Stability and balance.

ABSTRACT

The architectural surface represents one of the main pillars of formal configuration that work with each other to give the building an external appearance and its formal properties. In general, the most important challenge facing the architect is the analysis of the structural relationships under which the formal configuration and formulas for generating its patterns within the different architectural trends to be used in understanding the formal structure and how to generate multiple patterns and configurations and their effect on structural stability and equilibrium. This research paper represented a step in the way of analyzing and establishing an information base for architectural works that dealt with surfaces according to structural relationships with multiple linking and modulating mechanisms, then applying this to selected models of distinguished architectural works throughout the history of architecture. The research approach adopted building a comprehensive theoretical framework on the form, architectural surfaces, and structural relations by presenting previous studies, then building a knowledge framework that includes the definition, classification, and determination of the properties of surfaces, and an applied study analytically descriptively to discover the detailed mechanisms of form surfaces in the Modernity and Deconstruction architecture and their effect on structural stability and equilibrium.

الكلمات المفتاحية

التكوين الشكلي، السطوح المعمارية،
العلاقات التركيبية، الاستقرار
والتوازن.

الملخص

يمثل السطح المعماري أحد ركائز التكوين الشكلي الأساسية والتي تعمل مع بعض لإعطاء المظهر الخارجي للمبنى وخصائصه الشكلية، وأهم التحديات التي تواجه المعماري بشكل عام هو تحليل العلاقات التركيبية التي ينتظم بموجبها الشكل وصيغ توليد أنماطه ضمن التوجهات المعمارية المختلفة للاستفادة منها في فهم البنية الشكلية وكيفية توليد أنماط وتكوينات متعددة. مثلت هذه الورقة البحثية خطوة في طريق تحليل وتأسيس قاعدة معلوماتية لطروحات وأعمال معمارية تعاملت مع السطوح وفق علاقات تركيبية واليات ارتباط وتحويل متعددة، وتطبيق ذلك على نماذج منتخبة لأعمال معمارية بارزة عبر تاريخ العمارة وصولاً إلى كيفية توليد الشكل وخصائص التكوين على مستوى التوازن والاستقرار الشكلي. اعتمد منهج البحث بناء إطار نظري شامل عن الشكل والسطوح المعمارية والعلاقات التركيبية من خلال عرض دراسات سابقة تناولت السطوح المعمارية من وجهات نظر مختلفة، وبناء إطار معرفي يتضمن تعريف وتصنيف وتحديد خصائص الأسطح المعمارية، ومن ثم إجراء دراسة تطبيقية بشكل تحليلي ووصفي للكشف عن اليات تركيب سطوح الشكل في عمارة الحداثة والتفكيك وتأثيرها على الاستقرار والتوازن الشكلي.

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Introduction

Architectural surfaces represented a physical environment for the transmission of different ideas, contents, and meanings, so the process of change that takes place on the nature of surfaces in the form, color, texture, and structural relations according to which these surfaces are organized represented a fundamental factor in the creation and generation of multiple formal configurations. The technical and technological development has a direct impact on structures and Architectural surfaces where the architect was able to break the familiar box-shaped form and reached to the digital forms dynamic and continuous movement. The departure from the stable regular lines draws morphological deviations and various sensory aspects towards stability and formal balance. The research problem was represented in (clarify a comprehensive theoretical conception of the nature of architectural surfaces). The research aimed to reveal the structural relationships by which architectural surfaces are organized and their effect on structural stability and balance. The research approach is represented in three aspects: First: Building a theoretical framework by presenting previous studies that dealt with architectural surfaces, Second: Building a knowledge framework for the definition, classification, and the surfaces characteristics in different architectural trends, Third: Conducting an applied study analytically and descriptively to reveal the detailed mechanisms of surface composition and their effect on stability and formal balance.

1. A previous studies that dealt with architectural surfaces:

1.1. The study (Ali, Sultan) 2019:

The study dealt with shapes that flexible surfaces and free dynamism by the concept of weaving in architecture and how to employ technological techniques in weaving surfaces according to the different foundations and rules. The study focused on membrane surfaces with double layers, which invests the technology of materials, construction, and design in surface treatment to achieve the flow, curved and continuous surfaces, and sometimes the stiffness and tectonic modeling of the tissue to innovative structures, surfaces, and various internal environment, different from the familiar Cartesian space (p. 103-105).

1.2. The study (Abdul Wahid) 2018:

The study focused on the transformations of the architectural surfaces by their ornament and clarified the indicators of the intellectual and material ornament of the architectural surfaces in the different architectural trends. Architectural surfaces are a physical environment for conveying ideas and announcing the formal characteristics of that architecture. The study considers the architectural surface like fabric or envelope of decorative layers that work between the inside and the outside. The study confirmed that the surfaces of classical architecture were characterized by a high density of details and uniqueness of its elements, and the use of symmetry and balance to transfer forces according to the mathematical laws of gravity. In Gothic architecture, the surfaces took a sculptural curve, as the walls were made with carved stone, statues, and ornaments around the openings, which reached a great degree of complexity until the surfaces became like a decorative fabric, especially after the introduction of colored glass on them. With the expressionist trend, surfaces became dependent on the organic rhythm of nature with its curved lines. As for the architecture of deconstruction, the surfaces were changed to reflect the ideology of liberation from any law and the creation of superposition surfaces at different levels, as in the works of Tschumi and Jerry. The surfaces were eroded, buried, broken, incomplete and inclined elements that emphasized chaos instead of order to stimulate visual perception and achieve tension.

1.3. The study (Al-Khafaji) 2015:

The study clarified the systematic construction of support elements and the transfer of loads from surfaces and structures, and the interactive relationship between these elements. The relationship between the structural elements and the external surfaces surrounding the space is one of showing the structural

elements or retreating and surrounding the facade with closed walls. The study showed the possibility of granting the closed shape and space interference to create a new experience based on a special system of balance. The enclosure is an essential aspect in constructing the boundaries of space. The study showed that architectural surfaces as structural elements vertically carrying loads with the forces of gravity or non-bearing elements working on surrounding space. As for the tectonic surfaces, the outer crust is decorated, in addition to its function of enclosure, support, and stability with the forces of gravity (p. 130-133).

1.4. The study (Hiba) 2013:

The study showed the direct effects of technology on architecture in materials, construction methods, and means of implementation. It appeared from modern architecture and reaching to deconstructive architecture, as the world witnessed an unprecedented revolution in the field of technological and digital development. It is adaptation to draw a new language in the architectural formation that seeks to destroy the principles and methods of using materials and their formation systems to break out of what is usual and traditional. This architecture tried to reach collision, refracted, oblique, wavy, spiral, and stripe shapes and surfaces (pp. 55-56) in order to break the square shape with perpendicular surfaces as the surfaces flow, merge and float smoothly from the inside out, by following an intelligent structural system (p. 62).

1.5. The study (Oleg):

The research emphasized the engineering characteristic of tectonic morphological formations and their positive and negative effects on the aesthetics of the shape and the directional flow of surfaces, shapes, forces, and space. The study focused on analyzing the morphological transformation according to the forces of gravity, as in plants and humans ... and the structures of things around us. The study of digital tectonics is described: that it determines the degree of dynamism of the form. Either engineering tectonics may be regular or irregular. The architect must understand the law of form, transformation, and application that take place on it under the load imposed upon them. For example, shapes that have a central and symmetrical axis around a medial axis at the level of the plan or the facade must be subject to the objective law in designing the shapes and obtaining an ideal aesthetic as in the creative works of modern and old buildings where the objective nature of tectonics is presented. Sometimes the shapes deviate from the regularity, so the work is on walls, ceilings, or floors or movement to produce strange feelings that affect users.

The most important extraction from previous studies: The previous studies showed that the nature of architectural surfaces and the structural relations of surfaces have a great effect in generating multiple formations, including geometric and regular ones that adopt the system of perpendicular surfaces to achieve stability and formal balance with the forces of gravity, or including (superposition, refraction, diagonal, curved, wavy, continuous, and dynamic) surfaces that advanced technologies have contributed to producing them according to different foundations and rules to give multiple formal configurations that departed from the usual box shape and gave multiple sensory aspects towards stability and formal balance. The study confirmed that the nature of the architectural surfaces depends on the shape of the surfaces, the building materials, the decorative details, the texture, the directivity of these surfaces, the perpendicular or superimposed relationships that connect these surfaces, and the transformations that take place on them to transfer the forces of loads to the ground according to the laws of gravity and their effect on stability and balance.

2. Knowledge framework for research

2.1. The formal composition:

The formal composition is produced by following the functional, physical, psychological, and symbolic conditions of the project. The designer is considered a scientist who collects and analyzes the facts of the design problem down to the structure of the shape. The formal composition is generated from the relationship between the elements forming the boundaries, which are represented by continuous horizontal and vertical surfaces such as ceilings, walls, columns, etc, which are organized in a way that enables the mind to perceive this formation. Sometimes the borders are continuous and immediately perceived, or some of them may disappear and the mind can perceive them, but in multiple ways. The surfaces form a closed space and unite together to form the architectural and urban forms. Architecture is one of the arts that express its producer and users, as the formal body in architecture is the product of the interaction of mental and material factors, within a specific manifestation strategy to translate this thought (Ching, 1979). Guber defines shape as something made up of parts that are perceived in two ways: Either as a whole of the elements of the form or from the interconnectedness between these elements (Al-Khafaji, 2015). Through the correlation of several architectural surfaces, whether horizontal or vertical or others with multiple structural relationships, we obtain the characteristics of the group. Mitchell proposes to study architecture as a clear approach by establishing logical rules based on specific intellectual situations and clarifying the potentials inherent in them (Mitchell, 1992), (Al-Allaf, 2014).

2.2. The Architectural Surfaces Forming The Shape:

The surface is the indication of the movement of a line in a certain direction (and it forms an area of length and width, and is surrounded by lines that represent external boundaries that create volume). And the surfaces in the architecture may be horizontal, such as floors and ceilings, or vertical, such as walls, columns, etc. The form is an indication of the movement of the flat area of the surface in the direction to be a three-dimensional shape with a length, width, and height, The surfaces forming the shape may be regular, geometric, such as the cube, pyramid, sphere, and others, or irregular, such as irregular organic shapes. And the mind can perceive space through the relationship between the elements forming its boundaries, which is represented by the regularity of architectural surfaces. Architectural surfaces can be divided into (Ching, 1979), (Almusaed, 2018).

2.2.1. regular surfaces: To clarify the regular surfaces, the horizontal and vertical surfaces must be studied in detail as follows:

2.2.1.1. vertical surfaces: These surfaces are the most specific to space and give a sense of closure and privacy to its users, in addition to their role in the formal formation and drawing the boundaries between internal and external spaces and its structural role that it plays in carrying horizontal surfaces. Sometimes vertical surfaces act as an added cover wall and affect the shapes of the interior spaces, Fig. 1. Structures can be constructed using cover wrapping systems to represent the entire facade of the building or part of it. The wall of the cover building itself may be inclined, and this affects the shapes of the internal spaces. The vertical direction of the surface is characterized by achieving balance, strength, and stability, while the transitional tilted direction is dynamic, unstable, and related to the meaning of fall (Ching, 1979), (Al-Jadri, 2010).

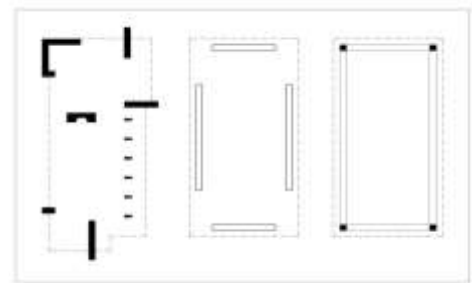


Figure 1: Vertical surfaces

2.2.1.2 Horizontal surfaces: The horizontal direction corresponds to the tension of gravity and stability, as it is static and the horizontal surfaces are often not apparent in the external shape of the building, but their effect can appear in the internal spaces. The designer's choice of the method in which he wishes to employ the horizontal surfaces depends mainly on the system's formal specifications, and his tools in this regard are what technology offer in terms of shape and, what they add to the visual impact on the facade of the building, Which are important matters for the architect, with their influence in accepting the final form of the design to represent expressive energy that moves the eye, soul, and feelings. A change in the

relationship between these surfaces produces multiple morphological configurations, (Ching, 1979), (Hefzy,2012).

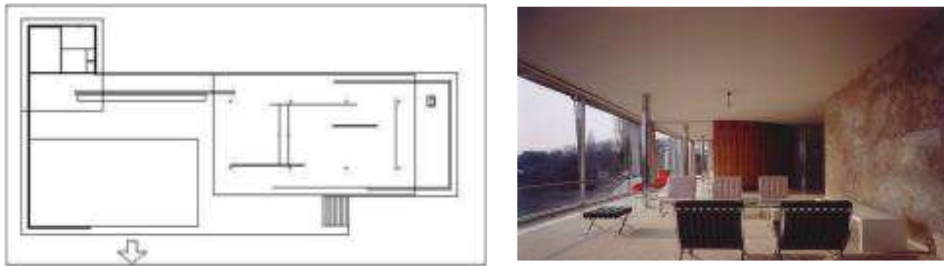


Figure 2: Mies Vandro home

2.2.2 Irregular surfaces: Advanced technology has contributed to the development of new technical and industrial systems that contribute to the design manipulation of the model, whereby changes can be made to the surface element easily as organic and geometric shapes merge with irregular relationships to generate free shapes and surfaces as well as relying on tectonic architectural elements to generate physical shapes (Yucesar, 2004) (Al-Khafaji, 2015). With the introduction of the computer into the architectural design process, architecture theories became more influenced by the capabilities of this tool. The process involved digital assistants to create a new version of digital formations, an integrated process that represented a new way of thinking in architecture to define the dynamic state of digital production of surfaces. The architect must understand the law of shape and the continuous transformation that takes place on it under the weights imposed on it. Forms that have a central axis and symmetric about a medial axis at the level of the plan or the facade are subject to the objective law in the design of shapes and compatibility with gravity. In modern buildings, the shape is out of order, to work on walls, ceilings, floors, or movement, so we see high heights and multiple bends that produce strange feelings that affect users (Marcia, 2013, p.26-28). The use of digital manufacturing methods liberated surfaces from boxy mechanical logic down to variability in product properties and flexibility in design solutions (Anne Beim, 2013, p.89), to depart from the traditional structure and reach a structural configuration with a continuous change in the trends and tendencies of floors, walls, and ceilings that merge to make space experience a new experience (Al-Khafaji, 2015, p.137).

2.3. Architectural surfaces within the different architectural trends:

Technology had direct effects on architecture during the twentieth century, whether in terms of materials or construction methods, which appeared through many architectural trends that prevailed throughout that century from modernity architecture to deconstructive architecture. The architectural form, as a sculptural volume, is a three-dimensional image and with the effects of shadow and light and the prevailing structural relations between the parts and the surrounding and the nature of the structural or raw material used on the surfaces of the mass with all its divisions and the diversity of its texture, luster, color and coded messages that affect the shape and change the psychological character when looking at it, causing a reaction receiver, Fig. 2, (Heiba,2013), (Hussein, 2017).

- Le Corbusier defines architecture as the extent of the designer's ability to achieve excitement and bring pleasure and joy to the receiver by highlighting the structural relationships that make up the architectural work and formulating it in its final form. As for Frank Lloyd Wright, he integrated, with his genius and strength of his imagination, the important elements of the surrounding nature in his deep feelings towards the place and produced from it qualities that give the building a sense of belonging to its surroundings by focusing on the extended horizontal surfaces as in the house of the waterfall (Yucesar,2004), (Almusaed, 2018).

- Since the beginning of the eighties of the twentieth century, architecture entered a new turn, where a trend of deconstruction appeared in language and philosophy, and some architects transferred the ideas of the French philosopher Jacques Derrida to architecture, which dealt with the idea of dismantling blocks and manipulating surfaces and space. These architects presented strange buildings bearing the characteristics of contradictions without a fixed formation to reach a new language, and the formal formations of these buildings turned into attractions (Abd Al-Ahad, 2018). Architecture is looking for new form fixtures, and contemporary architects have sought to employ the latest available technologies to serve architecture and its purposes, by developing their designs. At the end of the twentieth century and the beginning of the twenty-first century, modern digital technologies and their applications were adapted to serve the creative process and produce architectural formations with new structural relationships. Therefore, it was important to study the technological effects of the digital revolution and its applications in areas related to architecture, and the reflection of all of this on contemporary architectural thought (Heiba, 2013). These formations varied between the use of deconstructive, organic, hybrid, or confrontational forms, and others. Deconstructive architecture meant dismantling the architectural mass into mismatched parts and reassembling, arranging and melting them in a way that differs from all that is traditional and familiar. There are many models that Jerry implemented within the framework of this architectural orientation, such as the Hall Concert Disney Walt in Los Angeles in 2003, and the dancing building project, which is a model for deconstruction architecture and its orientation towards the production of the architecture of shapes, collision and sloping surfaces, Fig. 3, (Mumtaz, 2010). (Yucesar, 2004).



Figure 3: The dancing building- Hall Concert Disney Walt (Mumtaz, 2010)

The undulating shape architecture is one of the trends of contemporary architecture that relied in its inception on digital technologies and their applications in the fields of architecture, and it is an architecture that uses computer programs to organize the shape and make transformations in it and kinetic procedures on static shapes and modifying them to transform into a dynamic structure and devise flexible digital forms that are not It can only be obtained by standard design methods. One of the most important examples of this architectural orientation is the Music Emotion Building in USA, designed by Gehry, where the design shows his use of soft surfaces in the formation of the external building mass, (Yaqoub), (Mumtaz, 2010).

2.4. The concept of Structural Relationships for architectural surfaces:

Structural Relationships in language are the basic basis for building text of whatever type, as it is concerned with how the components of the text's structure are interconnected and organized grammatically (Al-Allaf, 2014). And in the field of architecture:

- Candelsonas tried to analyze the intellectual and practical orientation of the architects Craves and Eisenman. Kand told Sonas in general that a formal formation is a group of interconnected parts with connection and relationships that may be fixed and direct and in a systemic state the architecture declares itself, and it may be in a dynamic and continuous state.

- (Thompson) showed that the form is defined through the structural relationship and by the change of the material, the visual properties of the shape appear at a deeper perceptual level. If we understand architecture as a language, its elements are vocabulary that can be linked to form the sentence. Architectural elements, including the structural elements, the cover, the roof, and others, represent fixed rules for the apparent meaning of form and space in architecture (Abd Al-Ahad, 2018).

- Ching emphasized that the principles by which the relationship between the elements in an architectural composition can be organized are two groups, the first is called the engineering foundations of the design, and the second is called the principles of organization (Ching, 1979). Architectural surfaces represented a physical medium for transferring ideas from mental perceptions to reality in words. Architectural surfaces are not that superficial as an external veneer as much as they are a deep physical field between the interior and the outside, weaving with different relationships and organizations that end in a special image that is stored in our memory by our presence in the world and has a specific connotation and expression due to its realization of the architectural product as a whole. The physical formations of the external surfaces include a structural layer of bearing and outer skin within a bonding under relationship, colors, texture and material through certain characteristics, the shape refers to the total organization of the physical elements (surfaces) to represent the apparent part of the formal context (Mitchell, 1992). The advanced technology of construction played an important role in the relationship that determines the spatial arrangement of the supporting structure of the roof and the relationship between space and the structure. This is clearly shown in the introduction of iron as the basic structure of the building in architecture. The spatial relationships of our buildings changed dramatically, and the eye became at a loss to analyze the stability and understand the forces operating beneath the surface (Schwartz, 2017). **Conclusion: the structural relationships linking the surfaces are either direct, explicit, and strong relationships (right angles - oblique angles or others, or indirect relationships, which are relationships by which the merging of surfaces occurs without the presence of clear and explicit linking points).**

2.5. Stability and formal balance:

Balance means the stability of everything in its place, and balanced architecture responds to the necessity of human needs at all times and places, and one of the ways to achieve balance is to take into consideration the neighborhoods and the surrounding nature. The balance can be reached static, moving, or unbalanced. When paying attention to the masses and surfaces and their details, we find in it the consideration of gravity by memorizing the constants and variables and emphasizing the regular lines in the design of the shape to obtain the visual balance. Among the means of balance is to preserve the structural system of the building and its link to gravity and take into account the neighborhoods and nature. Modern architecture can be considered as a manifestation of the balance resulting from work and function. Therefore, appear static visual balance that appears in the formal formation of the building depending on the technology, skill of construction (Amidwari), the technological capabilities, and materials that this architecture possesses. Different architectural images appear across times and places to give multiple aspects of balance. Architecture interacts with different senses, hence the definition of many architects of architectural design as a perceptual perception of its components. Architecture transcends its functional role, and whatever the complexity of construction techniques, it must include providing pleasure. Architecture is considered the most visible art, as it closes our surroundings and our environment wherever our eyes are directed (Heiba, 2013). Corbusier assures me that the perception of a building is carried out according to a general reading of the elements and relationships, and this feeling is perceived by the viewer to generate the final impression of the changing physical characteristics and characteristics of the form, The human mind understands the change of those architectural surfaces, draws their deviations, and distinguishes the sensory aspects, not the purely physical or structural aspects, in an attempt to control the transformations that took place on the entire architecture and its functional and sensory multiplicities represented by the shape, its dimensions, its geometry, its texture, and surface conditions (Ching, 1979), (Almusaed, 2018). The three-dimensional shape and its properties are related to

the properties of building materials such as wood, brick, stone, steel, glass, and the jointing procedure by these elements work together so that the eye is satisfied with stability, unity, and balance. From the meeting of design elements, properties of materials, and laws of gravity, that the building can be produced, and through the relationships between these architectural elements we obtain space, construction, structure, decoration, and function (Schwartz, 2017), Diagram 1.

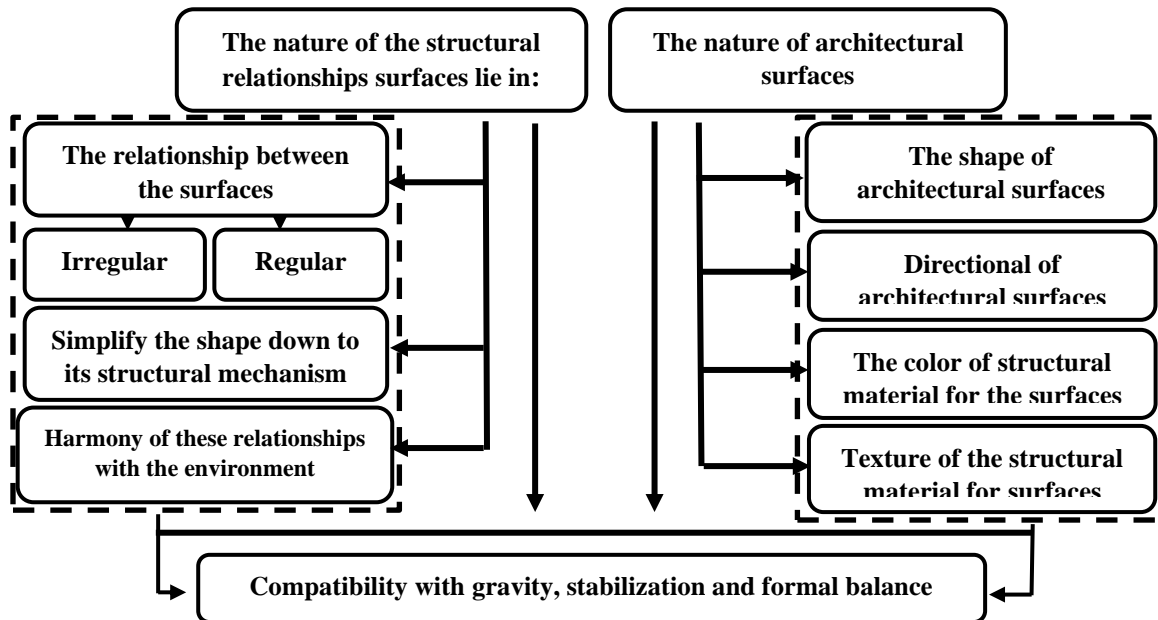


Diagram 1: illustrates the nature of architectural surfaces and structural relations (prepared by the researcher)

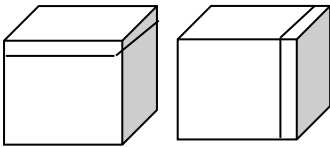
3. Practical application:

To understand the structure of the form, it is necessary to analyze the form, a descriptive and structural analysis, the research focuses on analyzing the nature of the architectural surfaces and the structural relationships on which these surfaces are organized with the technological development in both the trend of modernity and deconstruction and its impact on stability and formal balance. Therefore, workings will be analyzed for the most important modern architects who left an imprint with their creative works such as Lee Corbusier, Frank Lloyd Wright, and Hermann Hertz on the one hand, and the works of the most important architects of deconstruction such as Frank Gehry, Zaha Hadid, and Daniel on the other hand.

3.1. Criticism and analysis of examples and their architectural surfaces according to the critics (Appendix).

3.2. Structural and Descriptive Analysis:

Table 1: Nature of architectural surfaces (Prepared by the researcher)

Structural and Descriptive Analysis	Nature of architectural surfaces
- The origin of the formal structure is the direct connection between the architectural surfaces at right angles to the closed box formation. Through the multiple modulation mechanisms that the designer performs, the shape leaves the closed box configuration and the designer obtains new formal configurations, Therefore, the nature of the surfaces will be defined and clarified and what are the modification mechanisms that took place on them, leading to the simplification of the formal composition and its drawing.	 <p>The box shape</p>

The following tables illustrate the nature of architectural surfaces and structural relationships and their effect on formal stability and balance:

Table (2) Prepared by the researcher

Stability and formal balance		Structural relationships under which architectural surfaces are organized				The directivity of architectural surfaces		The nature of architectural surfaces	
Degree of balance	Balance type	Surface modulation mechanisms		Systemic structural relationship		Presence of directionality			
low		The harmony of surfaces with the environment	An illustration to simplify the modulation mechanisms	Describe the mechanics of surface modulation	Irregular structural relationship	Vertical relationship with Vertical	Vertical relationship with	Vertical relationship with horizontal (roof)	
medium									
big									
unbalanced		The harmony of surfaces with the environment	An illustration to simplify the modulation mechanisms	Describe the mechanics of surface modulation	Irregular structural relationship	Vertical relationship with Vertical	Vertical relationship with	Vertical relationship with horizontal (roof)	
Balance moving									
Steady balance									

Table (3) Prepared by the researcher





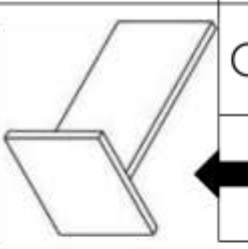
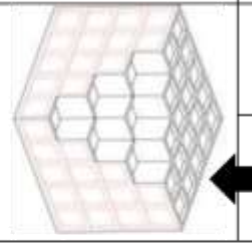
Stability and formal balance			Structural relationships under which architectural surfaces are organized			The directivity of architectural surfaces			The nature of architectural surfaces			
Degree of balance	Balance type		Surface modulation mechanisms	Describe the mechanics of surface	Irregular structural relationship	Systemic structural relationship		Presence of directionality	Surface texture or color corresponds	Subject surfaces to gravity	The shape of the horizontal surfaces	The shape of vertical surfaces
	low	medium										
	big	unbalanced										
	Balance moving	Steady balance										
	The harmony of surfaces with the environment											
An illustration to simplify the modulation		Describe the mechanics of surface		Vertical relationship with Vertical		Vertical relationship with horizontal		Vertical relationship with horizontal				
												
												
Editing surfaces and rendering the structural frame on vertical surfaces			Disassemble / release and move the horizontal and			Subtracting parts of horizontal and vertical architectural surfaces						
⊗			⊗			⊗						
Right angle link			Right angle link			Right angle link						
Right angle link			Right angle link			Right angle link						
Right angle link			Right angle link			Right angle link						
○			○			○			Lack of directivity			
⊗			⊗			⊗			Focus on the vertical direction			
⊗			⊗			⊗			Focus on the horizontal direction			
⊗			⊗			○			Surface texture or color corresponds			
⊗			○			○			Subject surfaces to gravity			
Segmented			Segmented, flat, and extended segmented			flat and segmented			The shape of the horizontal surfaces			
Segmented			Segmented, flat, and extended segmented			Flat and segmented			The shape of vertical surfaces			
Pompidou Center			Rothfield House			Office building			project name			
John Portzman			Great Rietveld			Hermann Hertz			Architect's name			
The Modernity			The Modernity			The Modernity			Architectural trend			

Table (4) Prepared by the researcher





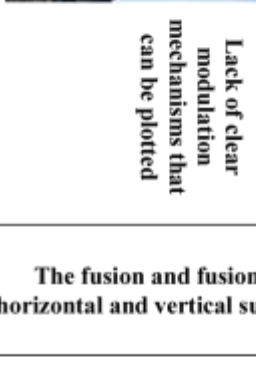
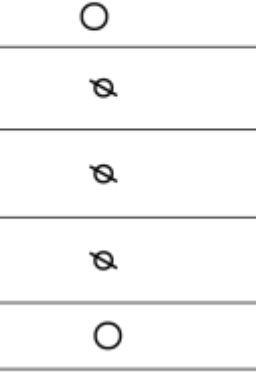
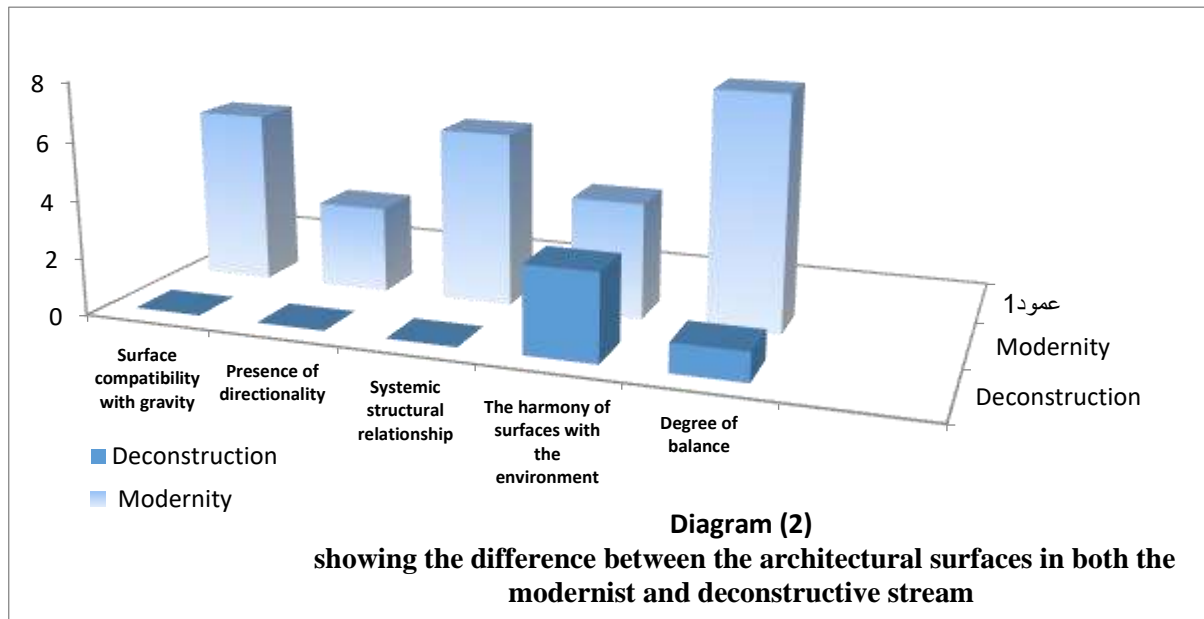
Stability and formal balance			Structural relationships under which architectural surfaces are organized			The directivity of architectural surfaces			The nature of architectural surfaces		
Degree of balance		Balance type		Surface modulation mechanisms		Systemic structural relationship		Presence of directionality			
low	medium	big	unbalanced	Balance moving	Steady balance	The harmony of surfaces with the environment		An illustration to simplify the modulation		Describe the mechanics of surface modulation	
									Lack of clear modulation mechanisms that can be plotted		
The fusion and fusion of horizontal and vertical surfaces			The fusion and fusion of the horizontal and vertical surfaces			Division of horizontal and vertical surfaces irregularly and moving them in an			Irregular structural relationship		
○			○			○			Vertical relationship with Vertical		
∅			∅			∅			Vertical relationship with horizontal		
∅			∅			∅			Vertical relationship with horizontal		
○			○			○			Lack of directivity		
∅			∅			∅			Focus on the vertical direction		Presence of directionality
∅			∅			∅			Focus on the horizontal direction		
∅			∅			∅			Surface texture or color corresponds		
○			∅			∅			Subject surfaces to gravity		
Wavy and extended			Wavy and stretchy			Curved and mated			The shape of the horizontal surfaces		
Wavy and extended			Wavy and stretchy			Break and Wavy			The shape of vertical surfaces		
Cultural center Chengdu			Cultural center Heydar Aliyev			The dancing building ¹			project name		
Zaha Hadeed			Zaha Hadeed			Frank Gehry			Architect's name		
Deconstruction			Deconstruction			Deconstruction			Architectural trend		

Table (5) Prepared by the researcher

Stability and formal balance										Structural relationships under which architectural surfaces are organized										The directivity of architectural surfaces				The nature of architectural surfaces																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
Degree of balance			Balance type			Surface modulation mechanisms				Systemic structural relationship			Presence of directionality																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
low			medium			big			unbalanced			Balance moving			Steady balance			The harmony of surfaces with the environment				illustration to simplify the modulation mechanisms		Describe the mechanics of surface modulation		Irregular structural relationship		Vertical relationship with Vertical		Vertical relationship with horizontal		Vertical relationship with horizontal (roofline)		Lack of directivity		Focus on the vertical direction		Focus on the horizontal direction		Surface texture or color corresponds to gravity		Subject surfaces to gravity		The shape of the horizontal surfaces		The shape of vertical surfaces																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
									Lack of clear modulation mechanisms that can be plotted				Lack of clear modulation mechanisms that can be plotted				Lack of clear modulation mechanisms that can be plotted				The fusion and fusion of horizontal and vertical surfaces				The fusion and fusion of the horizontal and vertical surfaces				Segmentation and overlapping blocks and their angled deflection an irregular way				The fusion and fusion of the horizontal and vertical surfaces				The fusion and fusion of the horizontal and vertical surfaces				The fusion and fusion of the horizontal and vertical surfaces				The fusion and fusion of the horizontal and vertical surfaces				The fusion and fusion of the horizontal and vertical surfaces				The fusion and fusion of the horizontal and vertical surfaces				The fusion and fusion of the horizontal and vertical surfaces				The fusion and fusion of the horizontal and vertical surfaces				The fusion and fusion of the horizontal and vertical surfaces				The fusion and 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3.3. Conclusions:

1. The design style of architectural surfaces in modern architecture is characterized by geometry and regulation that the human mind can understand and simplify into its basic box shapes. These regular shapes have a clear effect in achieving a great degree of stability and formal balance.

-The design style of architectural surfaces in deconstructive architecture was characterized by a distinguished change and revolution in the familiar box shape, perpendicular surfaces, and regular structural relationships with right angles, producing shapes that could not be simplified and drawn and required the receiver to turn around the building and see it from several angles in an attempt to understand the shape and its perception. These shapes, which are not based on the known rules of transmitting loads with the forces of gravity, produced formal deviation that does not take into account the variables and constants that lead to stability and formal balance.

2. The designer often exploited the structural material, the nature of texture and color in the design process for architectural surfaces. Despite the fragmentation and disassembly of the surfaces in some architectural works, the designer used a uniform texture and color at the level of the building as a whole. This had a great impact on achieving the stability of the building, despite its fragmentation, as in the works of Zaha Hadid. Frank Gehry used the reflective material was titanium. It produces multiple reflections segmentation of the surfaces in addition to fragmentation of real masses and surfaces, thus weakening the stability and morphological balance.

3. The compatibility direction of the architectural surfaces with the forces of gravity achieves a high degree of structural stability and balance. Architectural surfaces in modern architecture are dominated by the presence of directionality that takes consideration of the forces of gravity to achieve a static or dynamic balance. Architectural surfaces in deconstructive architecture were characterized by the absence of clear directivity, but rather the use of multiple surfaces with multiple and variable directions that do not take into consideration the forces of gravity and reduce stability and formal balance.

4. The architectural surfaces in both modernism and deconstructive architecture are largely compatible with the surrounding environment of the building, and this, in turn, had a great impact on achieving stability and formal balance.

5. The designer in modern architecture resorted to using several mechanisms and transformations on architectural surfaces to generate multiple formations and give different impressions, among these

mechanisms: dismantling vertical and horizontal surfaces and moving them in horizontal, vertical, horizontal, and vertical directions together, while maintaining the perpendicularity of the surfaces and connecting at right angles. Sometimes the designer resorted to breaking up and moving surfaces, as in the Rietveld house. The architect Piano moved the vertical surfaces represented by the structural construction forward and delayed the outer wall to the back to give a new formal composition.

- In the deconstructive architecture, the designer resorted to investing several mechanisms, including dividing the horizontal and vertical surfaces irregularly into irregular parts, moving them, collecting them irregularly, and investing them in deviated angle. To obtain configurations beyond the traditional form, the designer sometimes resorted to dissolving the standing corners and merging the horizontal and vertical architectural surfaces and fusion them together.

3.3. Recommendations:

-The research recommends getting knowledge about the nature of the architectural surfaces and the structural relationships that build the shape in all architectural trends and using this in understanding the formal structure and determination the capabilities that the surfaces possess in generating the shape.

- Digital programs have proven effective in developing design drawings and obtaining new and more flexible solutions in building surfaces according to multiple relationships, so the research recommends employing them to generate a distinguished architectural product.

- The necessity to integrate technological development, especially in the nature of the construction materials and building systems, with the design process and using them in architectural surfaces with multiple structural relationships to create a new morphological characteristics of buildings and their impact on formal stability from multiple angles.

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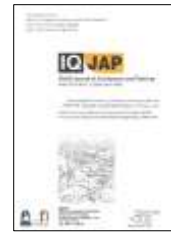
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Appendix:

6.1. Criticism and analysis of examples and their architectural surfaces according to the critics:

Table: (6) Project Villa Savoie, (Almusaed, 2018)


Building No. 1		
Project name: Villa Savoie Architect's name: Le Corbusier Architectural trend: Modernity	Vertical surfaces	Horizontal surfaces
	External walls, internal partitions, columns	Ceilings, floors
		
Building description: This work represents an essential and important stage in the development of "modern architecture" in France and in many regions of the world. Villa Savoie has a clear presence of pure geometry based on fundamental shapes such as the parallelogram and the cylinder. It consists of six precise concrete pillars supporting three horizontal surfaces, which have been linked to a free ladder. The nature of the form in this system can be changed according to the type of relationship determined by the architect, but the sense of engineering remains the basis of the formative treatments of the building and found in the regular geometric shapes an artistic language for a new architecture that responds Significantly with the age (industrialization) of the means of life, this was secured by employing the form of horizontal lines for the flat surface and simple and logical treatments of the facades with strip windows.		

Table: (7), (8) Project Waterfall ,House, Ronsham Church (Hefzy, 2012), (Almusaed, 2018)

Building No.2		
Project name: Waterfall House Architect's name: Frank Lloyd Wright Architectural trend: modernity	Vertical surfaces	Horizontal surfaces
	External walls - vertical movement points	Ceilings, Floors and extended verandas



Building description:

The Waterfall House is one of the most famous buildings designed by Wright. The building demonstrates the close relationship between nature and architecture, by merging the house with the waterfall itself, becoming part of the house and using contradiction in texture as its walls are made of limestone placed in contrast with polished blocks of white concrete, iron and shiny glass. This construction was based on the connection between the horizontal lines of the concrete with the vertical lines of the walls, the glass holes and the stems of the forest trees. Its organic architecture is represented by a harmony, a concrete block, an architecture with the stream, the rock, and the forest. It is a modern art characterized by the destruction of the idea of a boxy building and the separation of the technical construction from the rest of the defining elements of the space. There is a difference between the old box and Wright's box, in the past, buildings were formed to contain static parts and separate rooms, while the new box contains free space. Wright believes that the boundaries of the building should not stop at the least expensive supports, but are the most accessible projections in the building. And when the cables are made, the corners will disappear, and when these corners are made, the windows will disappear completely. In Wright's work, it is difficult to know the boundaries of a building from the external space surrounding it. The solid walls of the new box have vanish away.

Building No.3

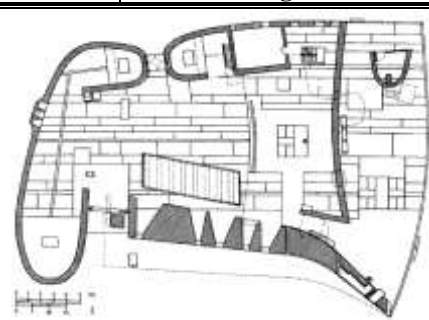
Project name: Ronsham Church
 Architect's name: Le Corbusier
 Architectural trend: modernity

Vertical surfaces

External walls - points of vertical bells

Horizontal surfaces

Floors and Ceilings, stretch ceiling



Building description:

One of the most important features of the architecture of the twentieth century is the Church of Ronsham, which has thick walls and simple curving, which represents a practical way to support concrete in the building and construction process, as well as the wide curved roof, the walls not only act as structural elements but rather formative to represent a design devoid of intricate detail, the focus on horizontal and vertical surfaces and unlike all other Le Corbusier designs that consist mainly of boxes, Runcham tends to be The shape is irregular, in terms of the walls, and the slope of the roof. The most exciting part of Ronsham is the curved roof, which appears to float on the building, because it is carried on columns within the walls. These columns leave a gap of 10 cm between the ceiling and the walls, allowing a little light to illuminate the church.

Table: (9) Insurance Company Project, (dezeen awards, 2021)

Building No.4


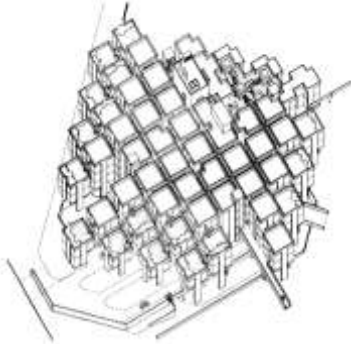

Project Name: Insurance Company Project Architectural name: Herman Hertzberger Architectural trend: Modernity	Vertical surfaces	Horizontal surfaces
	Multiple exterior walls	Ceilings, Multiple floors
  		
Building description: Design philosophy specifically referred to "structuralism" that understands this constructive arrangement in the design process. It is an arrangement of the parts of the building represented by the individual unit that is repeated to form the building as a whole. The basic project structure extends from the smallest unit to be assembled continuously in order to meet the multiple uses. The requirements were clustered together in one building space. The constructive arrangement was based on the system of columns, floor beams, and floor elements. Obviously, everything could have been prefabricated. The units used were multiples of 92 cm and the unification of the parts, the architect developed a kind of structural architecture, the insurance company project, the building was a deep spatial matrix. 56 cube-shaped elements located around the core of elevators and stairs, as a network of narrow lanes and winding paths, allowing the use of multiple surfaces for architecture, embodying raw concrete blocks, prefabricated beams and irregular floors as a model of cohesion, leaving the individual the task of completing the exposed structure in an attempt to always stimulate the user.		

Table: (10), Rietveld House, (Archdaily , AD Classics: Rietveld Schroder House)



Building No.5		
Project name: Rietveld House Architect's name: Great Rietveld Architectural trend: modernity	Vertical surfaces	Horizontal surfaces
	External walls - vertical movement points	Ceilings, Floors and verandas
 		
Building description: The house was designed according to the principles of De Stijl's architectural movement, where the horizontal plan of the house is almost devoid of any fixed inner wall, and the exterior was linked to the interior through large glass windows, and the same colors were used and abstract shapes used by the artist Mondrian (one of the founders of De Stijl) In his paintings. The designer emphasized the horizontal and vertical elements of the building. This house became a symbol of modern architecture, and in 2000 it entered the list of World Heritage Sites. The building is characterized by its innovative solutions to design issues, as the retractable walls give flexibility to the space, Almost no fixed interior wall is left in the floor plan.		

Table: (11) Georges Pompidou Center , (dezeen awards 2021)

Building No. 6		
Project name: Georges Pompidou Center	Vertical surfaces	Horizontal surfaces




Architect's name: Renzo Piano Architectural trend: modernity	External structural structure - vertical movement - services	Ceilings ,Floors and, External structural structure
		
Building description: The building is distinguished by the placement of what is found (inside) outside the structure of the building itself, meaning that the ventilation pipes, electricity, electric elevators and automatic stairs are visible on the outer surface and take their place clearly on the facades of the structural (structural) composition of the building. And each one of the service tubes is distinguished by a certain color. The Center Pompidou has six floors of large columned spaces. The building is designed so that the interior spaces can be easily rearranged. Standing out from the curtain wall is the structural steel system and a mixture of brushed and hardened metal panels that are designed to create the feeling of a transparent building envelope. Center Georges Pompidou considered a style of high-tech structural expressionism. It is unique in the way all its formal elements are formed on the outside.		

Table: (12) Rawaland Solomon Guggenheim Museum Project, (Feisal, 2010)

Building No. 7	
Project name: Rawaland Solomon Guggenheim Museum Project Architect's name: Frank Gehry Architectural trend : Deconstruction	Wavy surfaces where the horizontal and vertical merge
	
Building description: This architectural work belongs to the trend of deconstruction to generation of unusual images. the design is an irregular assembly of shapes in which the titanium-covered metal blocks contrast with the stone blocks and glass walls. The building produced unusual vocabulary, grammar and expression in unconventional forms, but this language was adopted to address the user and stimulate the sensory side through unfamiliar and unfamiliar symbols and through illogical relationships based on the existence of a prior cognitive structure and it destroys this structure, as it searches for new formal combinations, and restores Defining architecture anew. The designer used the manipulation of blocks and contradictions and dealing with different materials to show,	

where he used stone material to symbolize the past and glass to symbolize the present, while he used a new material, titanium, in cladding the main mass to express the future, and his relationship with the ocean. The building is located inside the sea in Bilbao, which is characterized by the manufacture of marine ships. This was a reflection on the process of formation and metaphor, its source and type of spatial influence.

Table: (13), Heydar Aliyev Multi-use Cultural Center (Archdaily , Heydar Aliyev Center)

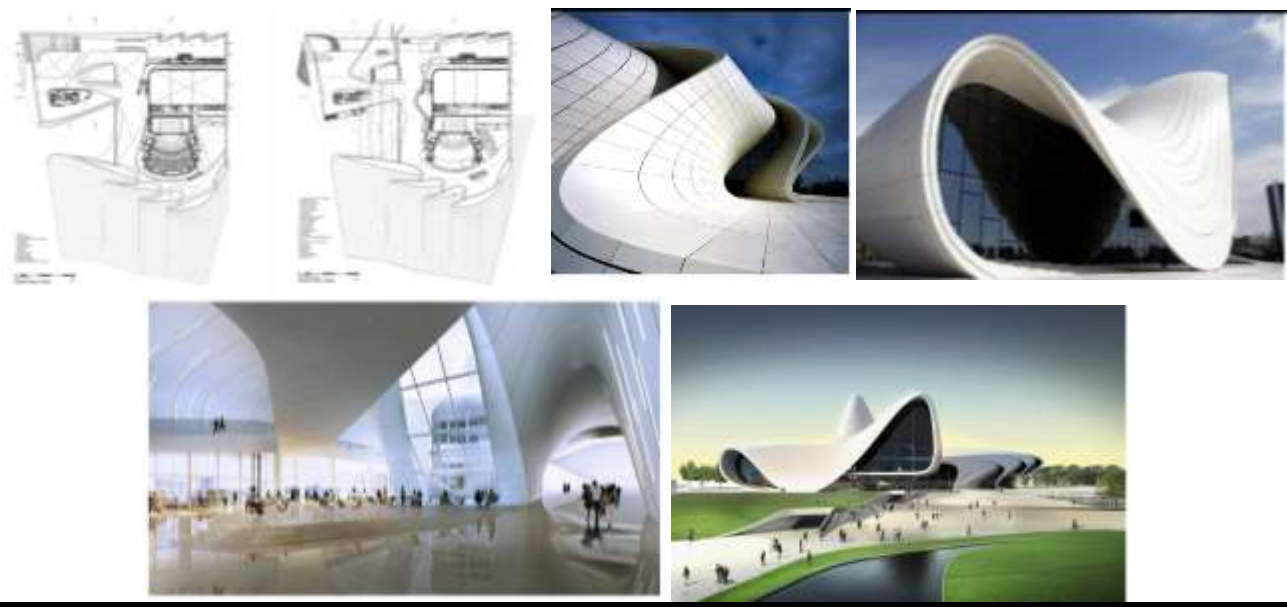
Building No.8	
Project name: Heydar Aliyev Multi-use Cultural Center Architect's name: Zaha Hadid Architectural trend: Deconstruction	Wavy surfaces where the horizontal and vertical merge
	
Building description: The project is characterized by its distinctive architectural engineering and curved style that avoids sharp corners. The project represents a landmark that plays a vital role in the center of Azerbaijan and takes the form of a liquid that comes out from the folds of the natural terrain. And it takes the shape of the liquid that comes out from the folds of the natural terrain, and these folds are represented by one continuous surface that connects the different areas of the center, so the architectural forms appear to have many ripples, bends and contortions of the surfaces. Many studies have been conducted on the geometry of surfaces that are predominantly continuous between the building and the landscape, the shape confirms the continuous transformation Movement and provides practical solutions to technical challenges.	





Table: (14), Changsha Culture and Arts Center, (Archdaily , Changsha Meixihu International Culture and Art Centre)

Building No.9	
Project name: Changsha Culture and Arts Center Architect's name: Zaha Hadid Architectural trend : Deconstruction	Wavy surfaces where the horizontal and vertical merge

**Building description:**

The behavior of the building is a free behavior that consists of ripples and air geometry, so that the building takes a wavy, elongated shape that gives the building a large flow that responds to the water and the shape of the site and contrasts with the vertical buildings surrounding it. The building defines an organic architectural language for the pedestrian paths that have woven through the site to connect with neighboring streets. The building is characterized by its high flexibility inside and outside. The multipurpose halls can be transformed into various shapes to accommodate a wide range of functions and performances by using extreme curves radiating from each of the three independent structures and connecting them to a pedestrian landscape to provide this dynamic composition and establish a strong relationship with the surroundings, giving the infinity of the group.

Table: (15), Denver Museum of Art in the United States (Feisal, 2010)

Building No.10	
Project name: Denver Museum of Art in the United States Architect's name: Daniel Libeskind Architectural trend : Deconstruction	Broken surfaces where the horizontal and vertical merge
	
	

Building description:

The building used an unfamiliar architectural language to challenge everything that is fixed from the architectural ideas. This approach is characterized by complexity and chaos by applying unfamiliar and abstract language even if it is structurally sound, and it depends on challenging everything that is fixed, as the building contradicts all expectations preserved in the viewer's memory. It is characterized by the use of pure forms to form its language, such as modernity, but its composition rules have been broken and the architecture has been transformed into reflections of instability and lack of harmony. With what looks like a huge rock to emphasize the peculiarity of local nature.

Table: (16), Bishan cultural and art center, (ARCH20, Bishan cultural and art center)

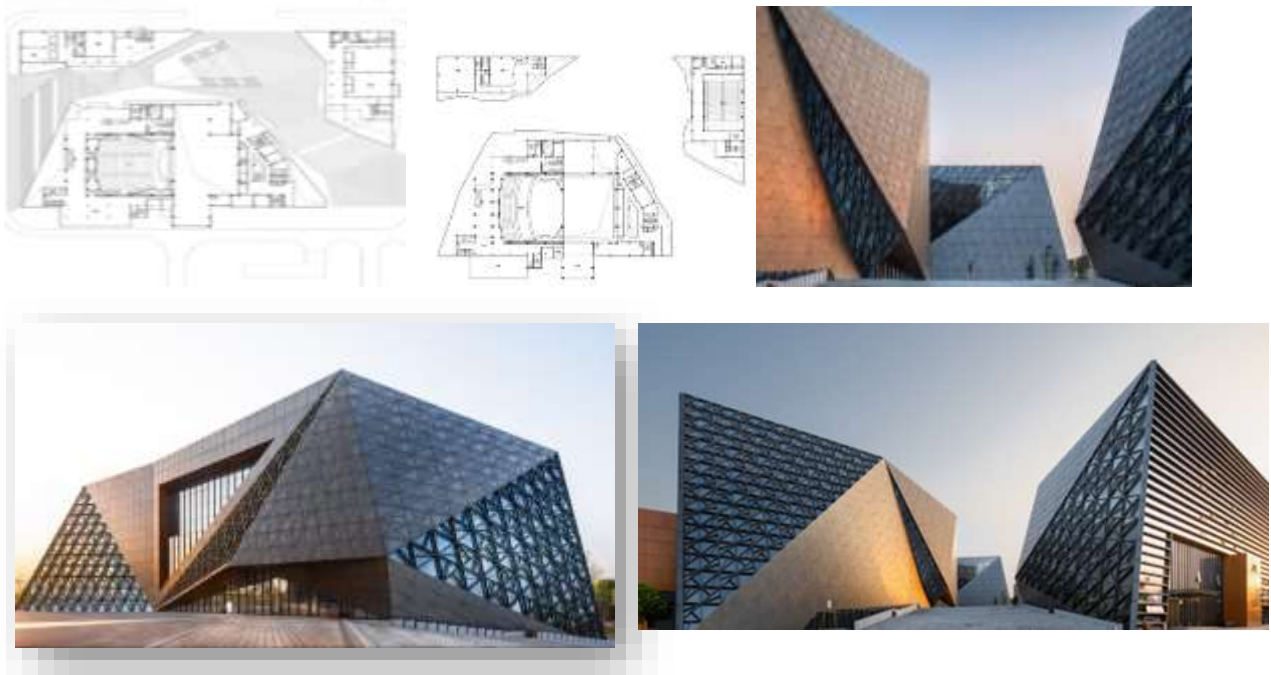
Building No. 11	
Project name: Bishan cultural and art center Architect's name: Tanghua & Associates Architectural trend : Deconstruction	Broken surfaces where the horizontal and vertical merge
	
Building description: The building consists of three conflicting stone blocks on the site, inspired by natural elements, and since the Bishan Center consists of three conflicting stone blocks on the site, it is a design that responds to nature, civilization and culture by cutting the building blocks in the form of stones available on the site (Jade Mountain stones) with The prismatic shape and its fixation along the original terrain, thus making a conversation between the size of the architecture and the surrounding public area, which made the center integrate with the site and reflect the view of the environment in which it was designed. The center is constructed of concrete with curtain walls leading to the way the building is shaped inside and out. The exterior of the main building is clad with a glass curtain wall and gray meshes that help resist sunburn and the horizontal lines formed from the organized metal sheets provide a modern look and inside the built-in glasses with Metal panels and aluminum grids in different triangle planes create a traditional Chinese pattern called ice cracking .	

Table: (17) Alberta Art Gallery

Building No. 12	
Project name: Alberta Art Gallery Architect's name: Randall Stout Architectural trend : Deconstruction	Wavy surfaces where the horizontal and vertical merge



Building description:

The shape of the building is out of the ordinary, especially the entrance block and the public spaces, inspired by the accumulation of rocks in that area, the winding steel roofs are inspired by the river. So that the wall and ceiling became one fluid surface that envelops the space, which is made of glass and steel. The glass gave a dynamic movement and linked the interior spaces with the outside, it was made of steel that flakes in some places to give views and natural light to the interior spaces. The designer was cautious with the spaces for display as they are solid boxes that rely on artificial lighting, completely contrasting with the shapes of public spaces. The entrance and the main lobby are made of glass and steel. The glass gave a dynamic movement and connected the interior spaces with the outside.