

The Design Characteristics of the Architectural Elements in the Houses of the Old Mosul City -An Analytical Study of the Iwan Element -

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ABSTRACT

Traditional architecture is characterized by specific configurations and elements, possessing design characteristics (formal and functional) that give the products of traditional architecture their character, As in the traditional architecture of the old city of Mosul. The buildings of the old Mosul city, have been subjected to damage as a result of the recent terrorist events, it was necessary to document and study these buildings by isolating the basic design elements that make up the building and studying its properties in a detailed method. The presentation of previous studies that dealt with the Mosul architecture revealed that there is a lack of knowledge specifically the Iwan element and its design characteristics, which determined (the nature of the research problem) while (the goal of the research) to discover the design characteristics (formal and functional) of the iwan in the architecture of old Mosul houses and extract the most important characteristics prevailing in it. The research Methodology builds on the structure of a theoretical framework that includes the definition of the architectural element and its design characteristics in general, and the definition of the iwan and its characteristics in the architecture of Mosul in particular. The analytical study of the Iwan was performed by two levels, depending on the database and images that were obtained and documented:

The first (general level): This level included collecting and documenting various pictures of 24 random samples from Iwans of the Mosul houses, and application of an analytical and descriptive study to discover their design characteristics. The second (detailed level): This level included collecting and documenting some pictures, information, and detailed drawings of 10 samples (For the element iwan predominant – pointed-), which were analyzed mathematically to reveal their proportions, and graphically using the AutoCAD program to reveal their detailed formal characteristics to reach a more accurate database that can be invested in restoring Construction of the old city.

Keywords: Design characteristics. ; Elements; Old city of Mosul; Traditional architecture ; Interior facades; Iwan

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1. INTRODUCTION

One of the most prominent characteristics that must be present in the traditional architecture - whether at the level of the city or a single building-, is the historical originality, thus the originality of planning, composition, elements, and building materials that qualify it to be on the list of preserving this architecture. Thus apply methods of preservation and restoration by international legislation.

The old city of Mosul, with its culture, traditional architecture and throughout history, has been a true reflection of the social organization and human behavior of the various societies, its identity which reflects its environmental, social

and artistic characteristics with its ideological and customary principles. Most of the traditional houses in the old city of Mosul, with the traditional houses prevailing in the Arab world and the Islamic East, share a set of original design elements and features, including the inner courtyard, entrances, corridors (columns and arches), iwan, mashrabiya, and others. The Mosul architecture is characterized by some details and special elements have original characteristics that must be preserved, understood, and to draw inspiration from them to create an architectural product that communicates with those architectural forms.

1.1 The Research Methodology

The research approach adopted building a comprehensive theoretical framework by:

Firstly, presenting previous studies that dealt with Mosul architecture and some of its traditional elements, and it was found that there is a lack of studies that dealt with the original traditional elements in Mosul architecture and There is no study that dealt with the iwan in particular.

Secondly: a knowledge framework was built that includes the definition of the architectural element and its design characteristics in general and the definition of the iwan component and its characteristics in Mosul architecture in particular.

Third: an analytical study of the iwan element was conducted at two levels to reveal its formal and functional design characteristics.

2. Presentation of previous studies that dealt with Mosul architecture and some of its traditional elements:

2.1 Al-Obaidi study (The architectural heritage of the city of Mosul, a starting point for reconstructing the features of the old city) (an analytical study of the old city at the planning and design levels) 2018 [1]:

The study confirmed that the ancient Mosul architecture, with all its formal components, relationships, and organizational rules governing it in its formal and functional system at the design and planning levels, gave the general appearance of its architectural models and produced features of that architecture. Because of the devastation that has greatly harmed the city of Mosul with its urban bodies, it is imperative to preserve the privacy and identity of the heritage of our local architecture and its historical originals, under what was approved by international conventions on ways to preserve the historical cities.

The study emphasized the need to preserve the design characteristics of the architectural elements in general, such as the entrances, Iwans, columns, arches, windows, decorative elements, and details. These elements and formations were analyzed in general and descriptive, and the research concluded that the characteristics of the formative, decorative, and detailed elements are (the fixed values of the architectural heritage of the old city of Mosul), which the research recommends studying and analyzing them in detail and adopting them as a starting point for the reconstruction of the city.

2.2 Al-Omari, Al-Harbi study (methods of analyzing geometric proportions, an analytical

study of interior elements (windows) in the old city of Mosul) 2016 [2]:

The study identified the geometric and numerical frameworks and proportional relations that were applied to (the window element), which is one of the architectural elements used in the internal facades of old Mosul houses. The results of the research showed that there is a proportional system that governs the dimensional relationships of the traditional Mosul windows at the whole, and detail level, the most used ratio is: $(1:\sqrt{2})$ and $(1:1)$, meaning that there is a prevailing ratio that general dimensions of the window component at all levels. The research aims to show the geometric and proportional specificity of Mosul architecture, to represent its identity in contemporary architecture, and to invest this information base in the processes of preservation and restoration. The study also showed the planning methods of Mosul architecture, by linking the main lines in the engineering analysis with parts of the basic formation without resorting to complex mathematical calculations.

2.3 Al-Ani's study (Characteristics of the architectural form of a traditional residence - the internal facades of a traditional residence in the old city of Mosul as a model) 2015 [3]:

The study focused on analyzing several compositional characteristics that make up the internal facades in the old Mosul houses, which the study considered basic lines organizing the form of the internal facades of the traditional dwelling, and these characteristics were represented in the relationships of balance, repetition, proportionality, and scale, which were adopted as main aspects, from which type, nature and form Each of the measured properties. Balance has two types, stable and not stable, as for its nature it is formal and not formal, the form of balance either symmetric or asymmetric, and the repetition has two types, complete and incomplete, with its linear stable nature or the dynamic curved nature, and the form of repetition was either stable or discontinuous, Proportionality has two types, a stable fit, a dynamic one, and finally, the single-scale one has two types, stable and unstable, and its nature is either human or monumental, and the formal analysis came through the whole, the blocks or parts represented by the elements, and the study indicated that the Iwan element is its size and shape that is distinguished by that it has the most important role In regulating the formal characteristics, as well as achieving harmony, rhythmic and formal stability, in addition to the coherent diversity of size and scale of the internal facades.

2.4 Al-Allaf Study, (Structural characteristics of traditional heritage door entrances in the old city of Mosul) 2014 [4]:

The study showed that most of the traditional houses in the old city of Mosul carry a high architectural value represented by their distinguished traditional elements. The study dealt with the main (external) entrances to these buildings with their architectural and construction details, up to the general and detailed formal characteristics and their classification, as well as the structural relationships that formed them. The study also referred to a set of relationships that show the synthetic properties of the traditional elements, such as sequence, symmetry, gradation, inconsistency, dimensional scale repetition, and visual relationship, as well as mentioning the characteristics of the position according to the horizontal plan and the vertical facade, as well as the distinct functional aspect of those elements.

The study extracted aspects including the shape of the detailed elements that make up the entrance, such as the type and number of elements and their repetition, as well as the dimensions and proportion of the materials, construction, color, and texture .

The results of the study showed great diversity in the structural and visual properties and relations of the entrances to these homes, with the presence of great harmony between these different traditional architectural elements. The study emphasized the necessity of describing and analyzing the elements at the interior level to reach the development of a digital and detailed database that can be used in the maintenance and preservation of the urban heritage of the city.

The previous studies have confirmed that traditional Mosul architecture with all its components, relationships, and organizational rules governing it in its formal and functional system, carries a historical authenticity that gave the general appearance of its architectural models and produced its identity. These studies dealt with several levels, some of them dealt with analyzing the formal structure of internal facades and some of them dealt with traditional architectural elements of Mosul houses such as main entrances, interior windows overlooking the inner courtyard. However, we did not find a study that dealt with analyzing the iwan element in detail and reached its properties, so the research came to study and analyze this element and arrive at its formal and functional characteristics.

3. Theoretical framework

Through the aforementioned, a theoretical framework will be that includes the definition of the architectural element and its design characteristics in general as first stage, Table (1), The definition of the iwan and its characteristics in old Mosul houses in particular as second stage, Because the iwan is the most distinctive element in the architecture of traditional houses in the old city of Mosul.

3.1 Architectural elements:

The architectural element is defined as a unit that is part of the architectural Configuration. Every architecture is represented by a group of elements and characteristics associated with them. These elements are dealt with through several influences and determinants of that architecture to achieve each architecture's characteristics [5].

3.2 Design characteristics of architectural elements:

The building consists of several elements that have different shapes and sizes that are related to each other to represent the general design characteristics of the building. Mitchell asserted that the rule of interpretation of architectural models depends on the physical grouping of things to give the characteristic of the group and the relationships of this group. The formal structure contains visual elements that may be vertical, horizontal, or inclined, openings, balconies, decorative elements, etc [6]. These elements are interconnected by relationships to give the general shape of the building, and this concept is what is called structure [7].

Some theories and architectural studies can be used to define and classify the design characteristics and the detailed relationships of any formal or functional element, as mathematical engineering studies are used to find proportions and dimensional engineering relations between the parts of the element or the formal composition. We can reach to know the extent of the dominance of design characteristics for a specific group of buildings, and the percentages of those characteristics in the selected models can be reached. When extracting the design characteristics of a group of buildings and arriving at a description of the structural relationship and rules of that group, which cannot be expressed by traditional means, these rules are the basis for deriving new possibilities belonging to the same architectural group[4].

3.3 Architectural elements of traditional architecture :

Theorists emphasized that the most important foundations and formative characteristics of the shape in traditional architecture are the focus on the interior in the richness of the architectural elements and treatments[8]. To-Tonna mentioned that the interior in traditional architecture invests a large number of elements, the most important of them are (arches, columns, domes, ornate surfaces, and Iwan ...), which are dealt with different methods [9]. **These represent the elements that make up the form language in traditional architecture. The old Mosul city is one of the important cities that have an ancient civilization extension.**

The old city of Mosul architecture is an extension of the previous eras in using the original architectural elements and local construction material to achieve environmental and social efficiency that reflects the thought of the Mosul community and highlighting its architectural identity [2]. Numerous studies have confirmed the potentials of the buildings of old Mosul city and the possibility of re-employing them with the need to preserve the original traditional elements present in them Fig.1. When restoring buildings and removing some elements or adding new ones, they must be in accordance with the old style, and the finishes must be using materials that express the time period of the building represents. In general, the traditional building is kept in the condition as possible to preserve the originality of the building and its functional and formal elements [10].



(Fig. 1) Architectural Elements Of Mosul
Traditional Architecture
[11]

3.4 The traditional houses for the city of Mosul:

The traditional houses in Mosul architecture date back to the 18th century and the 19th century. It is an extension of the previous period of the use of local building material and traditional architecture elements such as windows, doors, columns, arches, and Iwans have been placed in specific dimensions and materials to achieve aesthetic unity as well as environmental and social efficiency [3]. Most of the inherited traditional houses in the old city have a high architectural value, represented by their distinct structural and architectural elements. It has formal properties and structural relationships by collecting, analyzing, and classifying these elements we can provide a digital information base to be used in the work of re-representation, maintenance, and preservation of the urban heritage of the city[4].

Table (1) Theoretical framework [Prepared by the researchers]

Main characteristics		The branching aspects		
Design characteristics	The distinctive elements of traditional architecture	Entrances		
		Iwans		
		Columns		
		Arches		
		Windows		
		Frames		
		Vaults		
		Details		
		Decorations		
		Motifs		
	Forms detailed properties	Shape		
		Material		
		Texture		
		Color		
	Formal characteristics	generated characteristics by design principles	unity	dominance
Repetition				
Scale			dimensional	
			human	
			Monumental	
Balance			symmetric	
			asymmetric	
Repetition			complete	
			incomplete	
Gradation				
visual relationship				
sequence				
symmetry				
inconsistency				
Form position characteristics .	Horizontal level (plan)	In ground plan or first plan	Middle side	
			Middle side	
Vertical level (facade)	In ground facade or first façade or along two facades	Middle side		
		Middle side		
Functional characteristics	The nature of the Functional use	kinetic		
		stable		
		environmental		
		structural		
		mixed		

4. Iwan in Architecture:

The iwan is one of the basic elements in the design of Traditional housing. It is known as a hall that has only three walls and a roof over it, the fourth side is open to outside air and the attractive sunlight. The iwan may contain many columns and other elements of traditional architecture. The iwan means in architecture the vaulted and open space. It represents a room roofed with a vault, opening with arched over an open courtyard or a closed hall [12].

The iwan represents a roofed hall with only three walls, open on the front side to the courtyard to enjoy the beautiful scenery in the courtyard. It is not only used in residential buildings but also in public buildings and It may be employed in different seasons [13]. The iwan is the summer hospitality space in the old Mosul house and an essential element on the planning level of the house. It is clear in history that the word Iwan comes from Farsi origins and may go back to earlier sources such as Babylonian, Assyrian, and Aramaic. The Arabs knew the iwan before the advent of Islam, to be used later in many important Islamic buildings. The shapes and properties of an iwan can vary greatly in size, material, or decoration [10].

4.1 The design characteristics of the Iwan in the old Mosul houses:

Iwan usually has a square plan or close to that. located in the middle of two rooms on its right and left, on both sides of the iwan is determined a door for each room. The opening of the iwan is in the form of an arch towards the courtyard, This arch may be pointed, semicircular, or flat, etc.... It is usually filled with Marmar at a height of up to 3 meters and decorated with Marmar, stucco inscriptions, and sometimes paint.

The meshcat is placed in the walls in combination with the window and door openings on the side walls. The care of the decorative aspects in the Mosul house as the marble or stucco frames and may reach a point where there is no space free from the prominent or embossed ornamentation or colored with paint.

The iwan contains geometrical motifs, and it is overlain by an inscription band in thuluth script that includes Quran text. The internal facade of the Iwan contains a prominent fresco panel in thuluth script, and it may be colored and underneath it are two friezes of prominent as in the house of Amin Bey the Jalili. Often there is Kabish on either side of the Iwan arch, this tradition is widely used in old Mosul houses [12]

4.2 Select specific aspects for the practical study about the Iwan

To clarify the properties of the Iwan by documenting the shape and its placement within the plans, Emphasis will be placed within the paragraphs of the theoretical framework on the nature of the architectural element, its formal characteristics represented by the geometry of the shape, proportional properties, spatial relationships, and detailed properties such as the texture of the material, color, or decorations. As for the functional properties of the element, it was related to the type of use and the nature of the movement. As for the other aspects, it will be left to future research, as it is a brief research paper.

5. Practical application:

The practical study will be divided into two levels in analyzing samples of the Iwans of old Mosul houses, depending on the database and images that were collected and documented:

The first (general level)

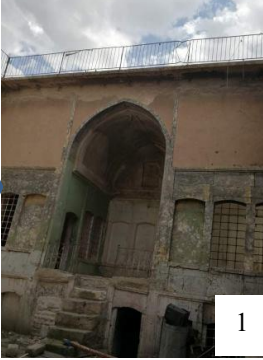
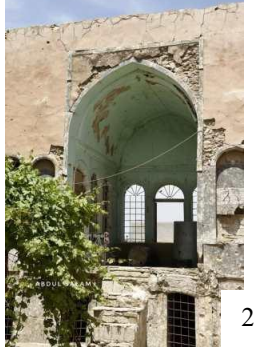














This level included collecting and documenting various pictures of 24 samples from Iwans of the Mosul houses, and apply an analytical and descriptive study to discover their design characteristics (formal and functional) and extracting the most important characteristics prevailing of these samples.

The second (detailed level)

This level included collecting and documenting some pictures, information, and detailed drawings of 10 samples from the Iwans of Mosul houses, which were analyzed mathematically to reveal their proportions, and graphically using the AutoCAD program to reveal their detailed formal characteristics to reach a more accurate database that can be invested in restoring Construction of the old city.

5.1 Practical application of The first level: (table 2) reviewing (24) random samples will be taken from the Mosul Iwans and analyzed according to the pictures illustrations, the characteristics of the formal and functional aspects of these samples will also be clarified in Table (3). In tables (4 & 5) a number of iwans pictures which they will be classified according to their formal, functional type and showing the location of the iwan on the horizontal and vertical levels. To come out with the conclusion of the prevailing and most dominant type of iwan in traditional Mosul house, in preparation for the second level.

Table (2) The different types of Iwan in terms of external shape [14] (Organization of the researchers)

Types names	Iwans photos - Each type is in a horizontal row in the table-			
<p>Iwan with a pointed arch</p>	 <p>1</p>	 <p>2</p>	 <p>3</p>	 <p>4</p>
	 <p>5</p>	 <p>6</p>	 <p>7</p>	 <p>8</p>
<p>Iwan has a half circle arch</p>	 <p>9</p>	 <p>10</p>	 <p>11</p>	 <p>12</p>
<p>Iwan with a segmental curve</p>	 <p>13</p>	 <p>14</p>	 <p>15</p>	 <p>16</p>

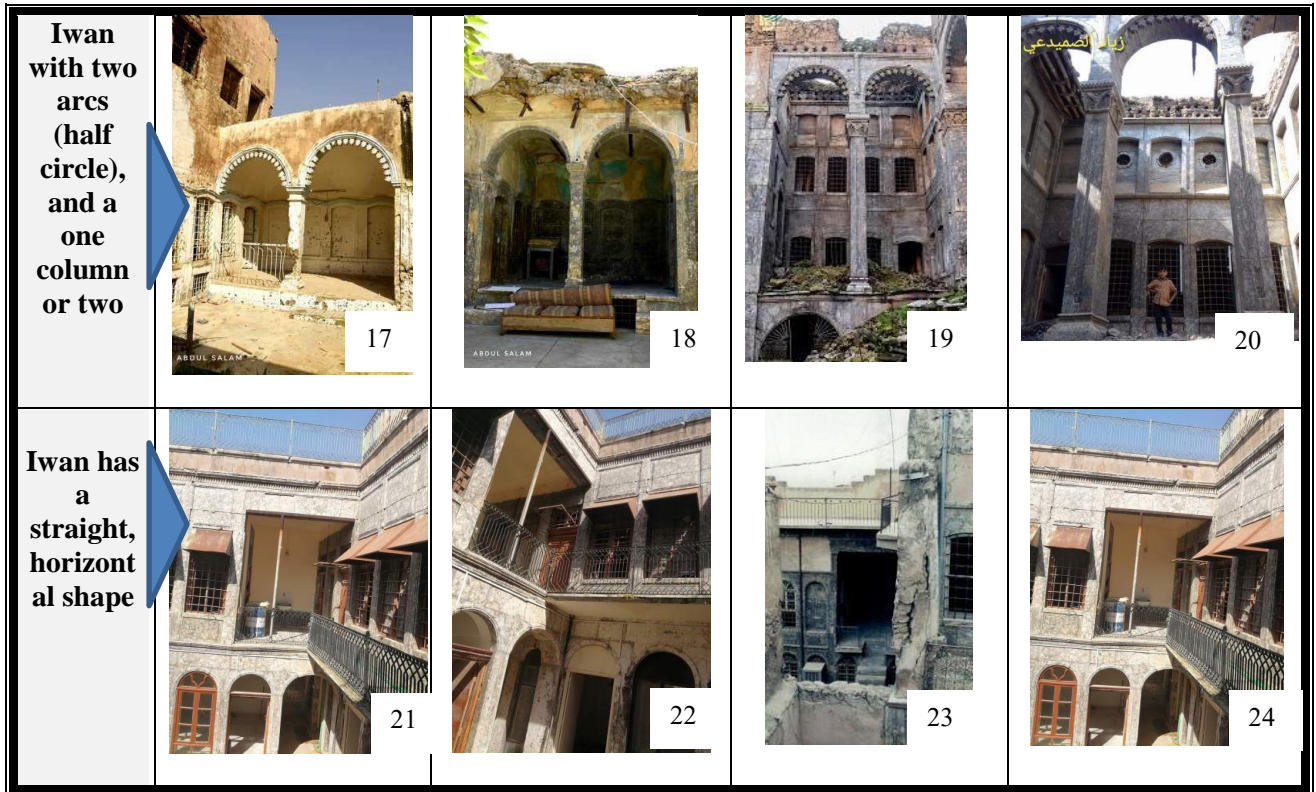


Table (3) showing the formal and functional properties of the Iwan [Prepared by the researcher]

The functional aspect										The formal aspect										The samples	
Position					movement	Function		Lack of decorative elements	The presence of decorative elements	the color		Finishin g material		Morphological configuration							
Vertical level		Horizon tal level				Transitional and crossover movement	Central and linear			Movement distributor	Seating and diffuser movement	Paint (Updated)	The color of the material	Nora-plaster	marble	Flat arch	straight	Semicircular	Semicircular		Pointed arch
Upper	Middle	grounds	Middle	side																	
0	1	0	1	0	0	1	0	1	0	1	0	1	1	0	0	0	0	0	1	1	1
0	1	0	1	0	0	1	0	1	0	1	0	1	1	0	0	0	0	0	1	1	2
0	0	1	0	1	0	1	0	1	0	1	0	1	1	0	0	0	0	0	1	0	3
0	1	0	1	0	0	1	0	1	0	1	0	1	0	1	0	0	0	0	1	1	4
0	0	1	1	0	0	1	0	1	1	0	0	1	0	1	0	0	0	0	1	1	5
0	1	0	1	0	0	1	0	1	0	1	1	0	1	0	0	0	0	0	1	1	6
0	1	0	1	0	0	1	0	1	0	1	0	1	0	1	0	0	0	0	1	1	7
0	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	0	0	0	1	1	8
1	0	0	0	1	1	0	1	0	0	1	0	1	1	0	0	0	0	1	0	1	9
1	0	0	0	1	0	1	0	1	1	0	0	1	1	0	0	0	0	1	0	0	10
0	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	0	1	0	0	0	11
1	0	0	0	1	0	1	0	1	1	0	0	1	0	1	0	0	1	0	1	0	12
0	0	1	0	1	0	1	0	1	0	1	1	0	1	0	0	0	1	0	1	0	13
1	0	0	0	1	0	1	0	1	1	0	0	1	0	1	1	0	0	0	1	0	14

0	0	1	0	1	1	0	1	0	0	1	0	1	1	0	0	0	0	1	0	1	15
0	1	0	1	0	0	1	0	1	1	0	0	1	1	1	0	0	0	0	1	1	16
0	0	1	0	1	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	0	17
0	0	1	0	1	0	1	0	1	1	0	0	1	1	1	0	0	1	0	0	1	18
0	1	0	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	0	1	19
0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	0	1	20
1	0	0	0	1	0	1	0	1	1	0	0	1	0	1	0	1	0	0	0	1	21
1	0	0	0	1	0	1	0	1	1	0	0	1	0	1	0	1	0	0	0	1	22
1	0	0	0	1	0	1	0	1	1	0	0	1	0	1	0	1	0	0	0	1	23
1	0	0	0	1	0	1	0	1	1	0	0	1	0	1	0	1	0	0	0	1	24
																				Total	
8	7	9	8	16	2	22	2	22	11	13	3	21	13	14	1	4	4	6	9	20	Total
33	30	37	33	66	8	91	8	91	45	54	12	87	54	58	4	16	16	25	37	83	average
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%

Table (4) showing the location of the iwan on the horizontal level [Prepared by the researcher]
Table (3,A)

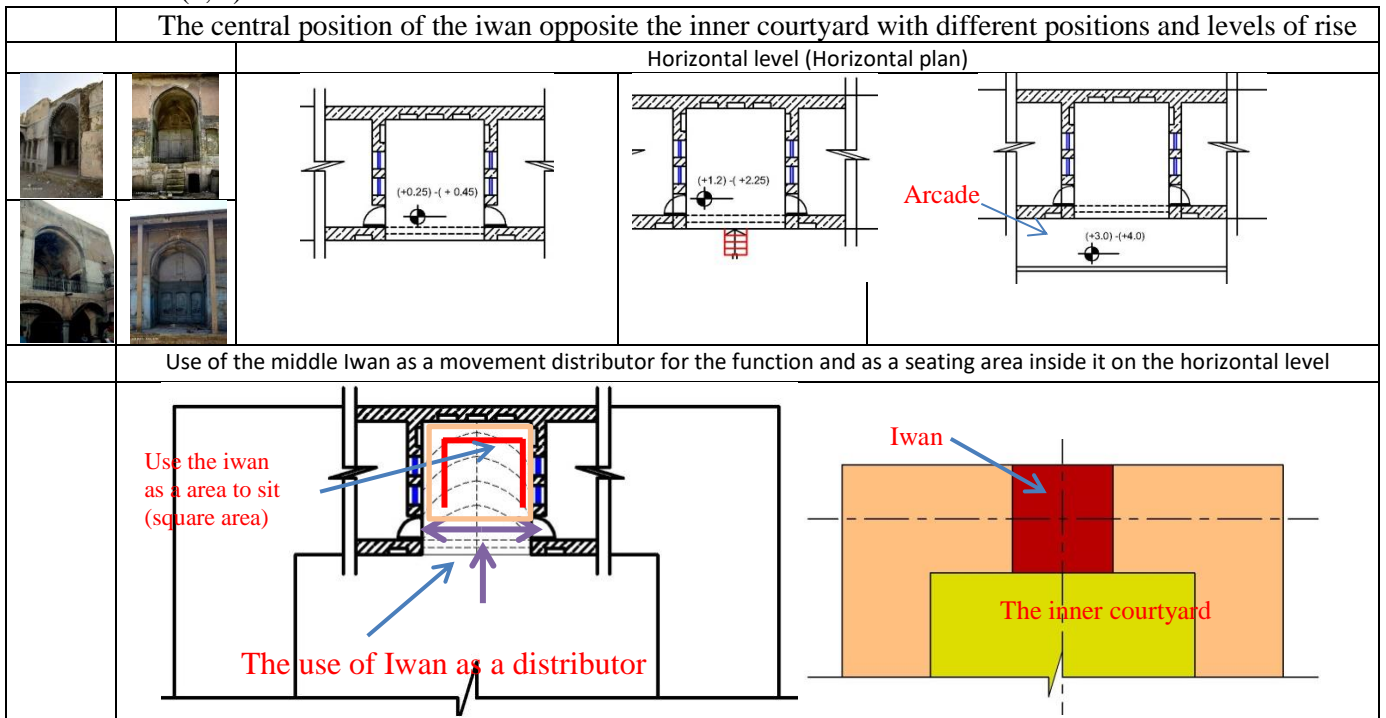


Table (4,B)

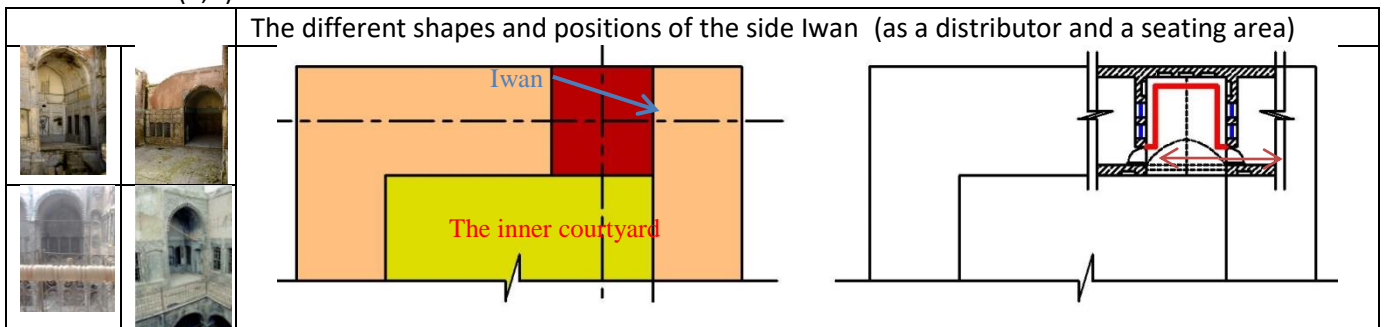


Table (4,C)

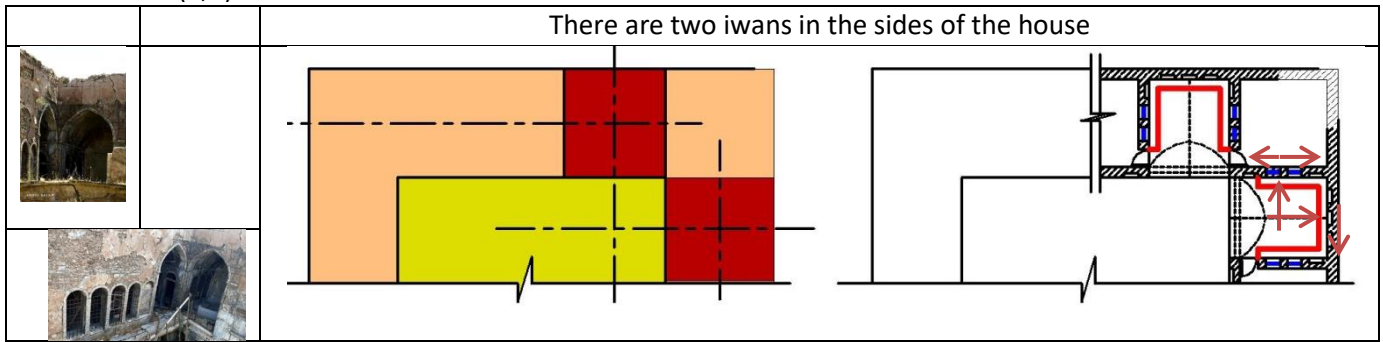
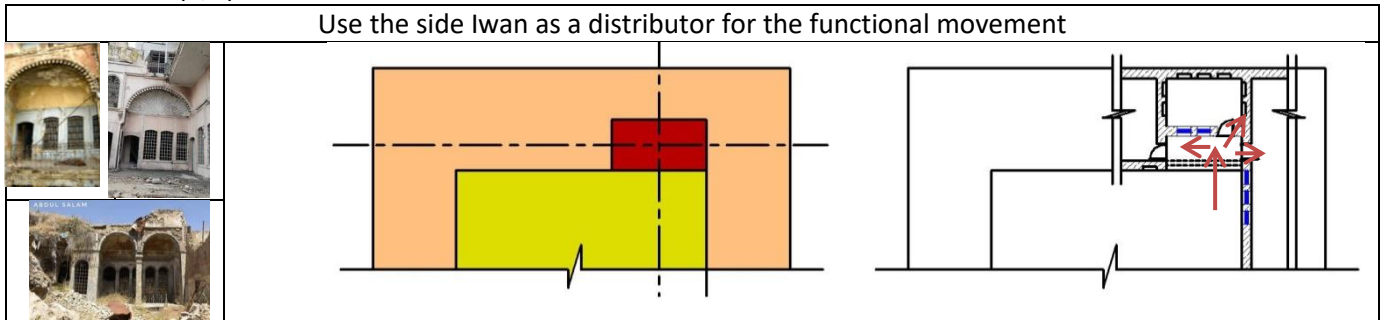


Table (4,D)



Table(4) The difference in the position of the side Iwan on the vertical level, using side Iwan as a distributor and a place to sit [Prepared by the researcher]

Table (5,A)

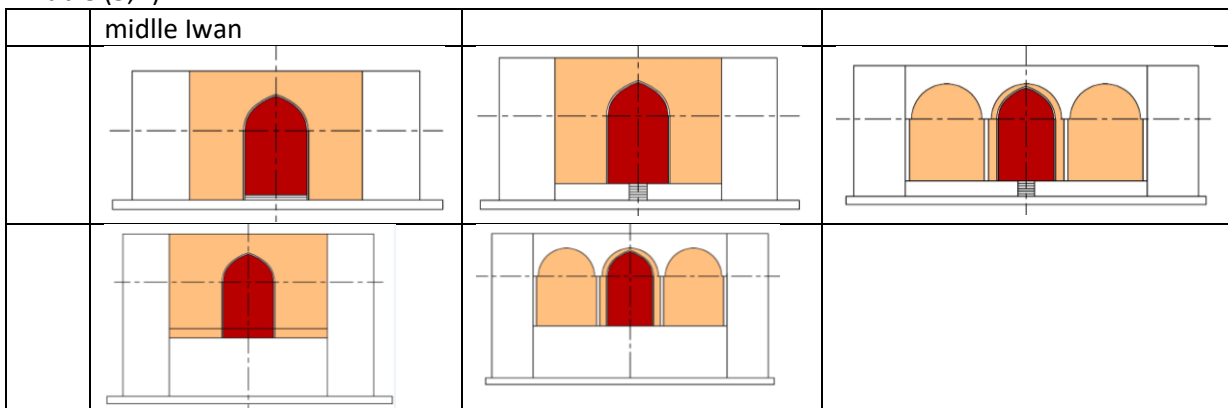
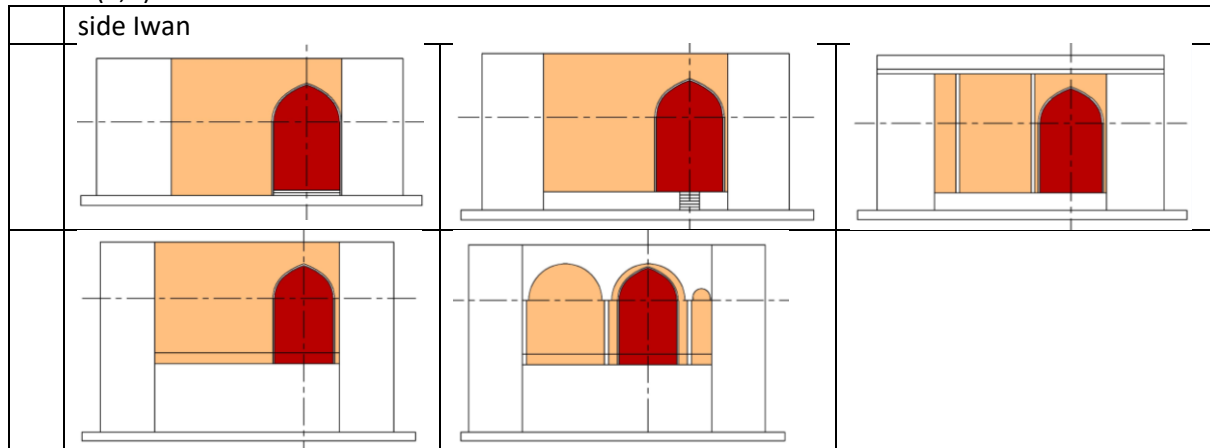


Table (5,B)



5-1-1 General conclusions:

Formal aspect:

- The shape of the Iwan was distinguished by using the rectangular shape as a frame surrounding the arch of the iwan. As for the type of arch used, the pointed arch and the semicircle are most likely to be used. The least used type is the flat arch, The results recorded only one sample out of 24 samples.

- As for the nature of the finishing materials, Nora-plaster and marble were used in close proportions, which are the local materials available in the region, and the colors used in the Iwans depended on the color nature of the materials themselves and the predominance of gray marble use. Only 12% of the samples were updated using the paint.

-The results showed a convergence in the proportions of samples that used decoration and that did not, as 13 samples used decoration and 11 samples did not use decoration, and this depended on the pension of the house owners.

Functional aspect:

- The results showed that the main functional use of most Iwans is for sitting and a movement axis, and only a very small percentage 8% of the samples were distributed for movement and were not used as sitting. Mosul Iwans overlooking the inner courtyard are used for summer seating and produce a central movement and the Iwan contain entrances to the rooms Either side, which results in linear movement.

Iwans position:

-The results showed that 66% of the samples achieved the side location at the horizontal level, and only 33% of the samples had the middle location at the horizontal level. As for the vertical level, the iwan was located on three levels, ground, upper and middle, where the level of the iwan rises due to the presence of basement openings, and the results showed a similarity in the rates of use of these sites.

5-2 Practical application of the second level:

This level included collecting and documenting some pictures, information, and detailed drawings of 10 samples from the Iwans of Mosul houses Figure (2) shows documentation of one of the samples as a horizontal section of the Iwan, which were analyzed mathematically to reveal their proportions, and graphically using the AutoCAD program to reveal their detailed formal characteristics to reach a more accurate database

that can be invested in restoring Construction of the old city.

determining the prevailing iwan in the traditional architecture of houses in the city of Mosul, and working on analyzing its characteristics and internal content as well as the main and minor elements table (7). The process of analyzing the container samples will include two levels.

The practical part will be allocated to the pointed Iwan because it is the clearest Iwan in the old Mosul residential floors in size and function. Pictures of these houses will be displayed for the remainder of them due to the recent war against terrorism. The analysis will be on the two levels, the horizontal level of the Iwan after drawing it or determining its source in terms of function and movement as well as area and proportion, as for the vertical level, the analysis will be after drawing through knowing the overall dimensions of the shape and the elements, and determining the sizes and proportions, with knowledge of the differences and similarities between the examples. Table (8), table (9) showing the results of the second level.

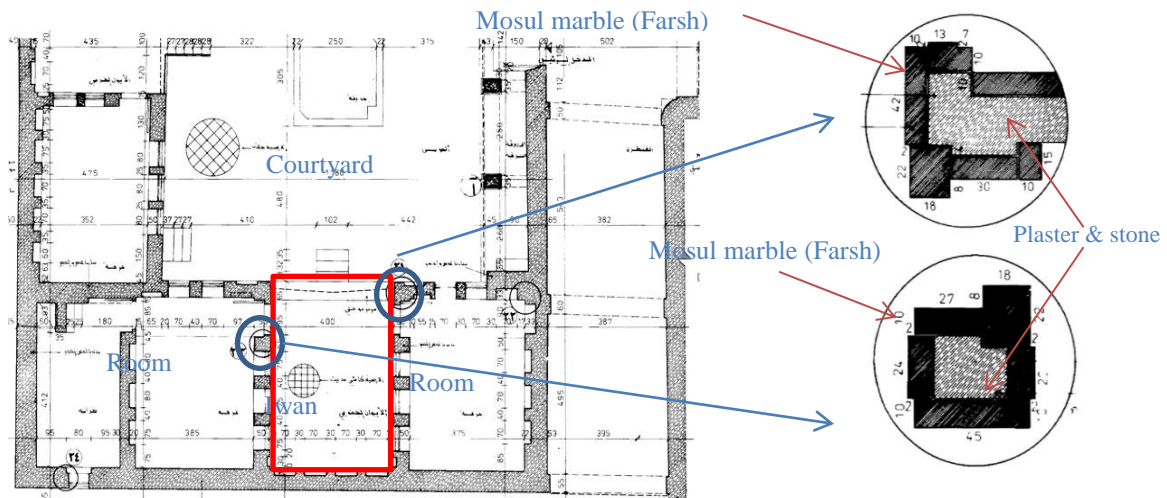
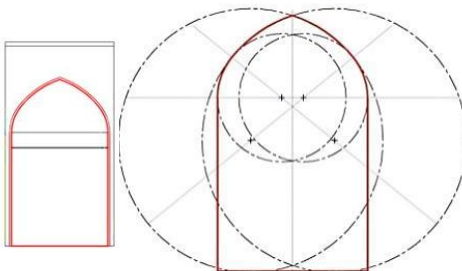
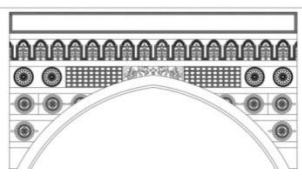
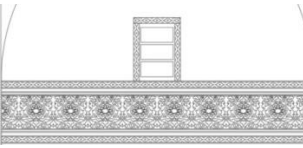
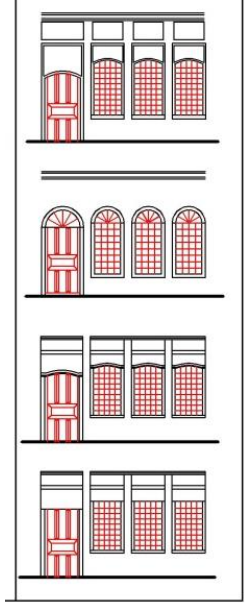
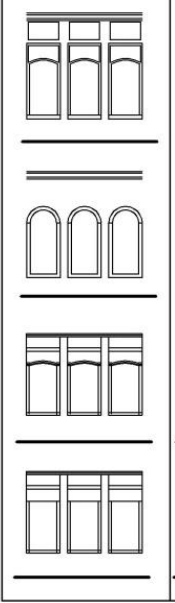
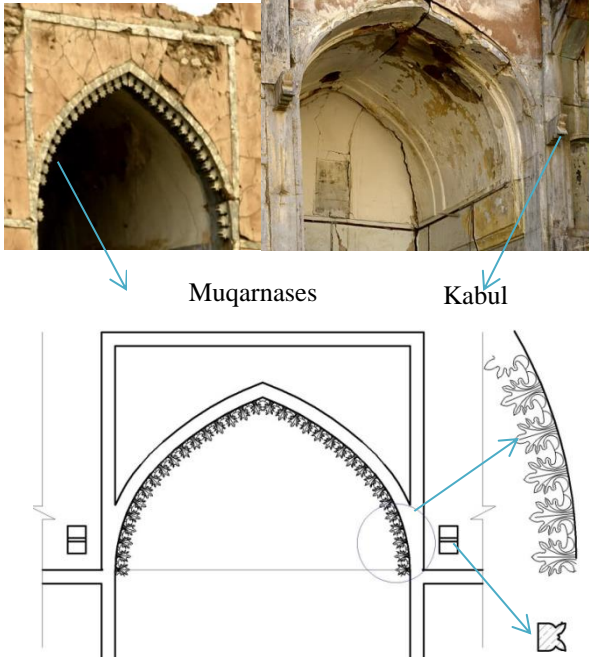
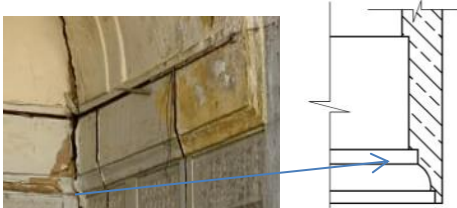


Fig 2 (Zyada house- horizontal section of ground floor plan)The central iwan opposite the inner courtyard with frame detailing around the iwan, windows, doors (main elements)[12] (Reorganizing the researchers)

Table (7) Illustrations of the main and secondary Iwan elements (Reorganizing the researchers)

main Iwan elements	secondary Iwan elements	
		
<p>Iwan engineering drawing –general shape- (researchers' drawing)</p>	<p>The ornaments used above the pointed arch of the Iwan [14](facebook.com) (Sahar M. kharrufa, 2020)</p>	<p>The ornaments used as upper belts within the Iwan space [14](facebook.com) (Sahar M. kharrufa, 2020)</p>

		 <p style="text-align: center;">Muqarnases Kabul</p>
<p>Windows and door on either side of the iwan (researchers' drawing)</p>	<p>The niches in the middle wall of the Iwan (researchers' drawing)</p>	<p>(Muqarnases and Kabuls in Iwan – researcher's drawing)</p>
		<p>Frieze- researcher's drawing</p>

5-2-1 The preliminary conclusions of the first phase of the practical study:

Building materials of Iwan

The iwan is constructed from three basic materials (plaster, stone and marble - Mosul farsh -), which are one of the materials available locally, close to the vicinity of the city. With the knowledge that Iwan paint and its interior façades has been new recently, as both the plaster and marble are left without finishing material in the traditional architecture of Mosul

classification of Iwan elements

The iwan is classified into many elements in addition to its general structure. The architectural elements of the iwan can be classified into;

- **The main elements**

- 1- The outer frame (built of marble - the Mosul farsh -) that supports the general structure of the Iwan

- 2- The doors, windows and niches on the three sides of the Iwans, built from marble as columns and thresholds that envelop the structure behind them, made of plaster and stone.
- 3- The iwan vault, built of plaster and stone.
- 4- The frieze separating the sides of the Iwan from the beginning of the Iwan's curvature.
- 5- Iron protection in front of the windows, it is like a grid of bars of circular cross section connected without welding work.
- 6- The stairs link between the inner courtyard and the Iwan.
- 7- The iron handrail and baluster in the raised Iwans is manufactured without welding, but only by forging
- 8- Wooden doors and window frames made of wood containing glass.
- 9- The floor of the iwan is mostly paved with marble (farsh) pieces

The Secondary elements:

- 1- Ornaments: It is executed on marble over the thresholds and columns of doors and windows built of marble, or it is executed on stucco over the cornices and ceilings. Only stucco ornaments can be painted. Ornaments are classified into: Geometric ornament, plant ornament, abstract ornament, epigraphic ornament - poetry, the Holy

Quran, or wisdoms - and finally, a number of household utensils.

- 2- The decorative prominent (Kabul) on the sides of the external or internal Iwan are made of marble.
- 3- Kabuls carrying torches on both sides of the Iwan are about the height of a person.
- 4- Muqarnases carved from marble to frame the arched Iwan.

Table (8) pointed Iwan analysis

Table (8,A) [Prepared by the researcher]

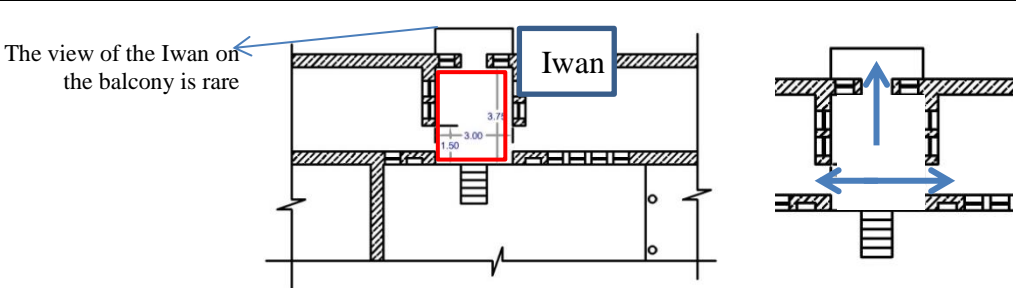
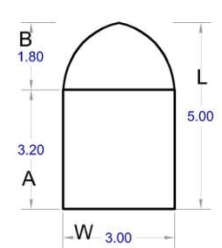
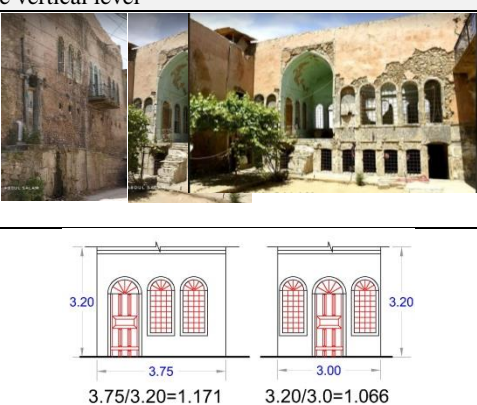
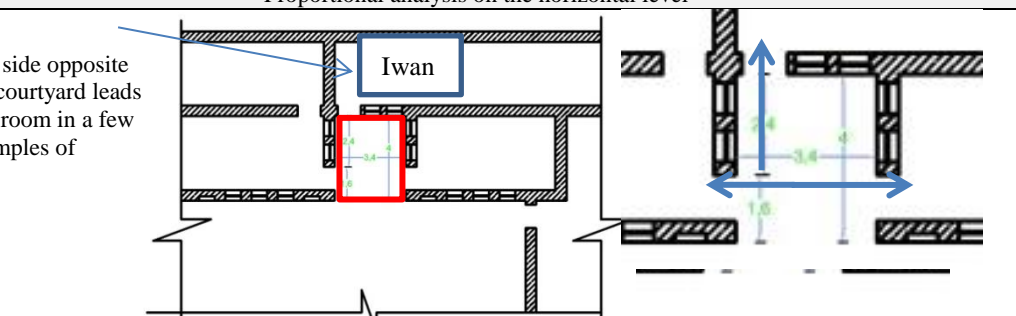
Pointed iwan analysis in terms of proportional scale	
Proportional analysis on the horizontal level	
Al- allaf house	<p>The view of the Iwan on the balcony is rare</p> 
First floor plan	
Proportion (depth to width) (Iwan) $3.75/3=1.25$	Area of sit/area of distributor $4.5/6.375=0.705$
Proportional analysis on the vertical level	
Al- allaf house	 <div style="border: 1px solid black; padding: 5px; margin: 5px;"> <p>$L(5.0)/W(3.0)=1.666$ $L(5.0)/A(3.20)=1.562$ $W(3.0)/B(1.80)=1.666$ $A(3.20)/B(1.80)=1.777$</p> </div> <p>Area = 13.5795, Perimeter = 14.4430 Size= Area of Iwan façade * Iwan depth $13.579 * 3.75 = 50.921$</p> 

Table (8,B)

Pointed iwan analysis in terms of proportional scale	
Proportional analysis on the horizontal level	
Al- haj zuhair house	<p>The side opposite the courtyard leads to a room in a few examples of</p> 
Ground floor plan	

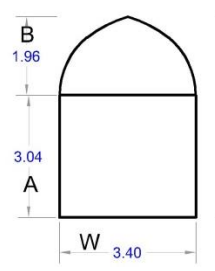

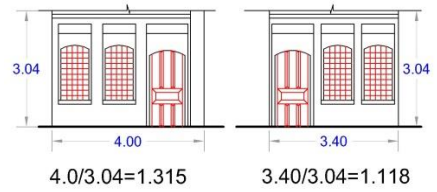
	Proportion (depth to width) $4/3.4=1.176$	Area of sit/area of distributor $5.16/7.6=0.678$
Proportional analysis on the vertical level		
Al- haj zuhair house	 <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> $L(5.0)/W(3.40)=1.47$ $L(5.0)/A(3.04)=1.644$ $W(3.40)/B(1.96)=1.734$ $A(3.04)/B(1.96)=1.551$ </div> <p>Area = 15.2534, Perimeter = 15.0774 Size= Area of Iwan façade * Iwan depth $15.2534 * 4.0 = 61.012$</p>	 <p style="text-align: center;">Newly added building</p> 

Table (8,C)

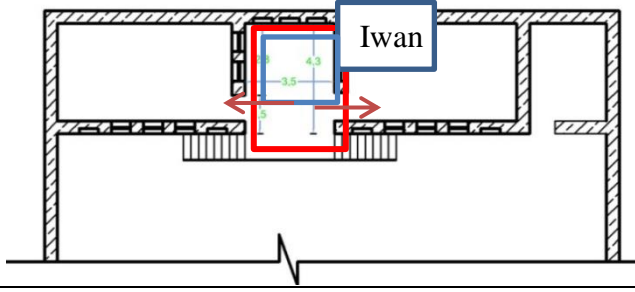
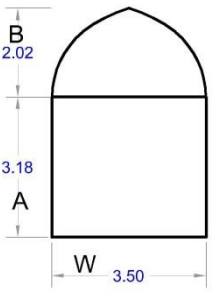
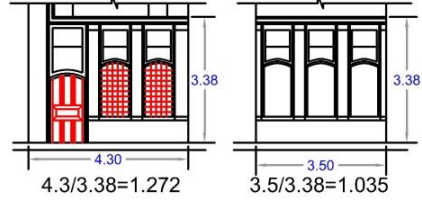
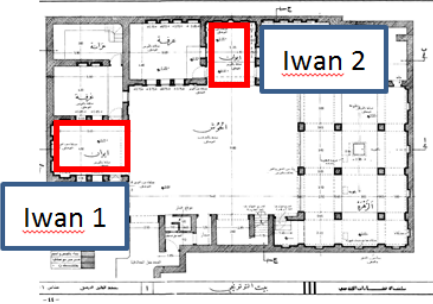
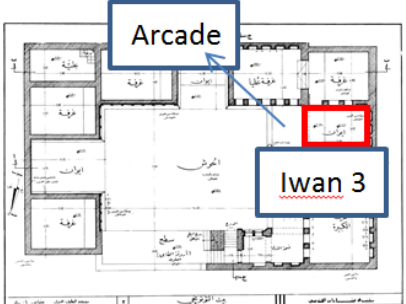
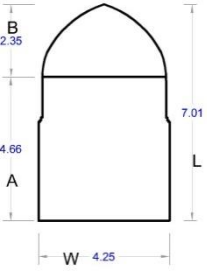




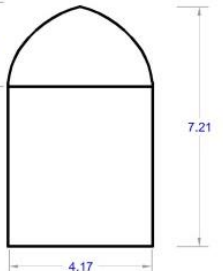


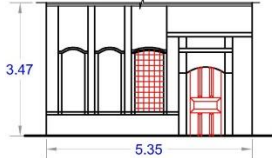
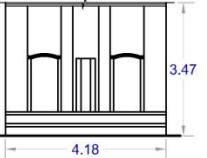
Pointed iwan analysis in terms of proportional scale		
Proportional analysis on the horizontal level		
Al- qassa b house	 <p style="text-align: center;">Middle floor plan</p>	
	Proportion (depth to width) (Iwan) $4.30/3.50=1.228$	Area of sit/area of distributor $9.8/5.25=1.866$
Proportional analysis on the vertical level		
	 <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> $L(5.20)/W(3.50)=1.485$ $L(5.20)/A(3.18)=1.635$ $W(3.50)/B(2.02)=1.732$ $A(3.18)/B(2.02)=1.574$ </div> <p>Area = 16.3440, Perimeter = 15.6237 Size= Area of Iwan façade * Iwan depth $16.3440 * 4.3 = 70.279$</p>	

Table (8,D)

Pointed iwan analysis in terms of proportional scale		
Proportional analysis on the horizontal level		

<p>Al-Totonjy House</p>				
	<p>Ground floor plan</p>		<p>First floor plan</p>	
	<p>Proportion (depth to width) (Iwan1) $6.45/4.5=1.433$</p>	<p>Proportion (depth to width) (Iwan2) $5.35/4.10=1.304$</p>	<p>Proportion (depth to width) (Iwan3) $5.80/3.60=1.611$</p>	
	<p>Area of sit/area of distributor $20.7/8.28=2.5$</p>	<p>Area of sit/area of distributor $15/7.011=2.14$</p>	<p>Area of sit/area of distributor $13.68/7.2=1.9$</p>	
<p>Proportionality between dimension (Vertical levels)</p>				
<p>Samples (Iwan)</p>	<p>Proportionality between length & width</p>	<p>Proportionality length to arch level arch height</p>	<p>Proportionality width to arch height</p>	<p>Proportionality length between straight line & arch</p>
<p>Al-Totonjy House I 1</p>	 <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>$L(7)/W(4.25)=1.647$ $L(7)/A(4.68)=1.495$ $W(4)/B(2.34)=1.709$ $A(4.68)/B(2.34)=2$</p> </div> <p>Area = 26.2492, Perimeter = 20.3973 Size= Area of Iwan façade * Iwan depth $26.2492 * 6.45 = 169.307$</p>			
			<p>After</p>	<p>Before</p>
			 <p>$6.52/4.36=1.495$</p>	 <p>$4.50/4.36=1.032$</p>
<p>Al-Totonjy House I 2</p>	 <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>$L(7.2)/W(4.17)=1.726$ $L(7.2)/A(4.84)=1.487$ $W(4.17)/B(2.52)=1.654$ $A(4.83)/B(2.52)=1.916$</p> </div> <p>Area = 28.3637, Perimeter = 20.8730 Size= Area of Iwan façade * Iwan depth $28.3637 * 5.35 = 151.745$</p>			
			<p>After</p>	<p>Before</p>
			 <p>$5.35/3.47=1.541$</p>	 <p>$4.18/4.47=1.204$</p>

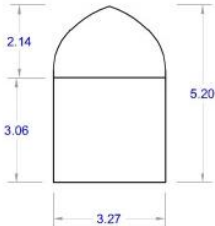
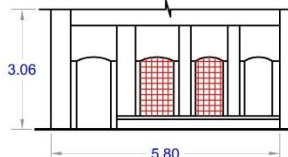
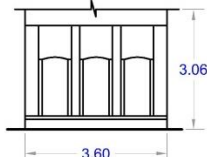
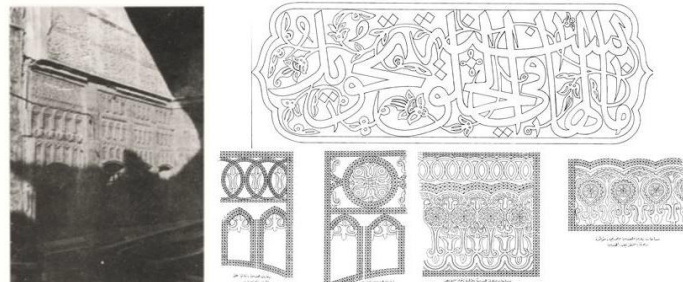
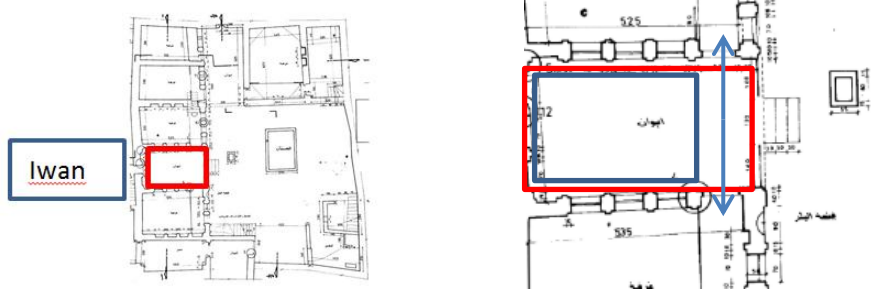
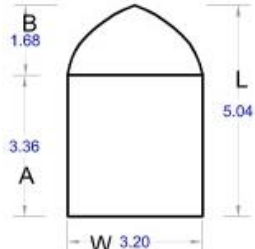
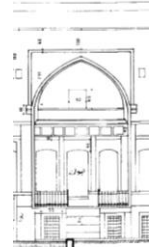

Al-Totonjy House I3	 <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> $L(5.2)/W(3.27)=1.59$ $L(5.2)/A(3.06)=1.699$ $W(3.27)/B(2.14)=1.528$ $A(3.06)/B(2.14)=1.429$ </div> <p>Area = 15.1803, Perimeter = 15.1672 Size= Area of Iwan façade * Iwan depth 15.1803 * 5.8 = 88.045</p>		
		After	Before
		 <p style="text-align: center;">$5.80/3.06=1.895$</p>	 <p style="text-align: center;">$3.60/3.06=1.176$</p>
			
Calligraphy and ornaments (geometric and botanical) in one of the walls of the Iwans in (Al-Totonjy house) (shareef, 1982, p40, p52-54)			

Table (8,E)

Pointed iwan analysis in terms of proportional scale				
Abdony House				
Ground floor plan				
Proportion (depth to width) (Iwan) $5.64/3.2=1.76$ Area of sit/area of distributor $13.088/4.96=2.638$				
Samples	Proportionality length & width between	Proportionality length to arch level arch height	Proportionality width to arch height	Proportionality length between straight line & arch
Abdony house	 <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> $L(5.02)/W(3.20)=1.569$ $L(5.02)/A(3.36)=1.49$ $W(3.20)/B(1.66)=1.93$ $A(3.36)/B(1.66)=2.03$ </div>			

<p>Size= Area of Iwan façade * Iwan depth $14.4648 * 5.64 = 81.581$</p>	
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Table (8,F)

<p>Ground floor plan</p>	<p>Ground floor plan</p>
<p>Proportion (depth to width) (Iwan1) $5.8/4=1.45$</p>	<p>Proportion (depth to width) (Iwan2) $4.35/3.2=1.359$</p>
<p>Proportion (Area of sit/area of distributor) $16.4/6.4=2.562$</p>	<p>Proportion (Area of sit/area of distributor) $8.64/5.28=1.636$</p>
<p>Zyada House I 1</p> <p> $L(6.24)/W(4.0)=1.585$ $L(6.24)/A(4.16)=1.524$ $W(4.0)/B(2.10)=1.834$ $A(4.16)/B(2.10)=1.9$ </p> <p>Area=22.7908, Perimeter = 18.5545 Size= Area of Iwan façade * Iwan depth $22.7908 * 5.8 = 132.186$</p>	<p> $5.70/4.24=1.344$ $4.0/4.24=0.943$ </p>
<p>Zyada House I 2</p> <p> $L(5.5)/W(3.34)=1.646$ $L(5.5)/A(3.68)=1.494$ $W(3.34)/B(1.88)=1.776$ $A(3.68)/B(1.88)=1.957$ </p> <p>Area = 16.8086, Perimeter = 16.0446 Size= Area of Iwan façade * Iwan depth $16.8086 * 4.35 = 73.117$</p>	<p> $4.35/3.69=1.178$ $3.38/3.69=0.915$ </p>
<p>ornaments (geometric and botanical) in one of the walls of the Iwans in (Zyada house) (shareef, 1982, p83-84, p101)</p>	

Table (8,G)

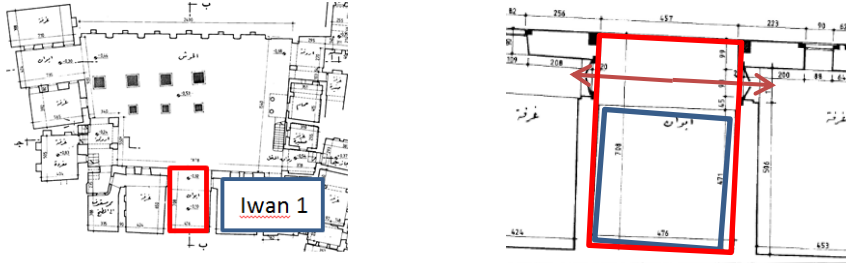
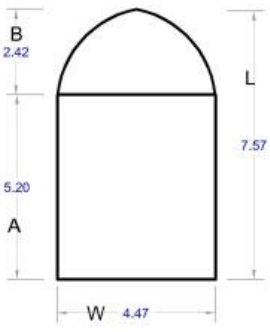
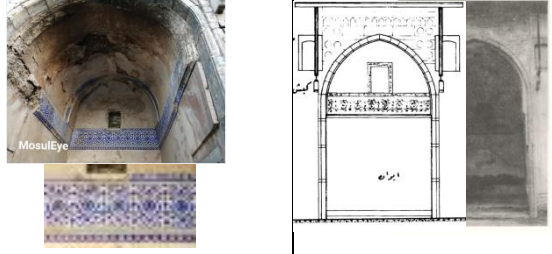
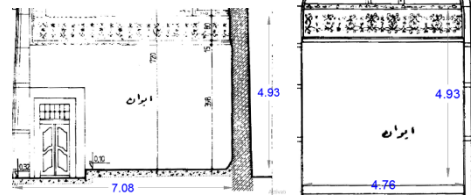
Pointed iwan analysis in terms of proportional scale	
Proportional analysis on the horizontal level	
Al-jalily House	
Ground floor plan	
Proportion (depth to width) (Iwan1) $7.08/4.47=1.583$	
Proportion (Area of sit/area of distributor) $21.195/10.593=2.0$	
Al-jalily House	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">  <p> $L(7.57)/W(4.47)=1.684$ $L(7.57)/A(5.20)=1.453$ $W(4.47)/B(2.42)=1.865$ $A(4.20)/B(2.42)=2.174$ </p> <p> Area = 31.0618, Perimeter = 21.9180 Size= Area of Iwan façade * Iwan depth $31.0618 * 7.08 = 219.917$ </p> </div> <div style="width: 50%;">  <p style="text-align: center;">After Before</p>  <p style="text-align: center;">$7.08/4.93=1.436$ $4.76/4.93=0.965$</p> </div> </div>

Table (9) the results of second phase [Prepared by the researcher]

Design elements (form, function)		Details of design elements	Detailed aspects of the items with their presence shown on samples		
Form	Formal Elements	Main Elements	outer frame	Rectangular frame with a pointed end	4
				A rectangular frame with a pointed arch	6
		floor of the iwan	square		
			Closer to the square	1	
			rectangle	9	
		iwan vault	With frieze	10	
			With ornaments	geometric	4
				Botanical	5
				written	2
			With upper niche	5	
windows frames	formal types (upper thresholds)	Prone arc	6		
niches		Prone arc with protruding ends	2		
	Doors frames				

					Semicircle arc	1
					Straight	1
			frieze			
			Iron bars	Iron grid of window		9
				Iron handrail and baluster		5
			stairs	One or two steps Along the front of the iwan		5
				middle stairs		5
				Side stairs		
			Wooden doors			10
			Wooden window frames			9
			Glass sheets of windows			9
		Secondary Elements	Ornaments	geometric		4
				Botanical		5
				written		2
			decorative prominent (Kabul)			7
			Kabuls carrying torches			
			Muqarnases			
Formal Proportions	Vertical level	Frame	Height to width	types	Golden ratio (about)	8
					Islamic ratio (about)	
					other	2
			Height to rise of frieze	types	Golden ratio (about)	4
					Islamic ratio (about)	1
					Other	5 about 1.5
			Width to arch height	types	Golden ratio (about)	5
					Islamic ratio (about)	
					Other	5 about 1.8
			The height to the frieze to the height of the arch	types	Golden ratio (about)	1
					Islamic ratio (about)	1
					Other	8 about 2
		Windows	types	Golden ratio (about)		
				Islamic ratio (about)		
				Other	5 about 1.25	
					3 about 1.5	
					2 about 1.8	
Niches	types	Golden ratio (about)				
		Islamic ratio (about)				
		Other	10 The ratio is very close to 1			
Horizontal level	Proportion (depth to width)	types	Golden ratio (about)	3		
			Islamic ratio (about)	3		
			Other	4 about 1.25		
	Area of sit/area of distributor	types	Golden ratio (about)	1		
			Islamic ratio (about)			
			Other	2 about 0.7		
				7 about from 2-2.5		
sizes	types	Small	From 50 – 80	6		
		Medium	From 130 -170	3		
		larg	220	1		
Function	Purpose to function	Position of sit	types	U shape	8	
				U & L shapes	1	
				L & L shapes	1	
	disputer	types	Vertical disputer			
			Horizontal disputer	8		
			Vertical & horizontal disputer	2		

5-2-2 Detailed Conclusions:

The results showed on the detailed level that the pointed Iwan has many fixed properties and few of them are variable

- The prevailing form of the floor of the Iwan is rectangular, and its walls most often contain doors and windows on its sides, often with pron archs, protected by an iron grid, while the opposite side of the courtyard covers the iwan with niches to ensure the formal continuity of the windows.

- The Iwans rise from the floor of the courtyard if they are on the ground floor, they rise by one step or two steps, or they rise above the basements with a middle staircase, as they might be on the upper floor.

- In most of the specimens of pointed Iwans, no building is constructed on top of them, as they symbolize the end of construction.

- The Iwans follow many fixed ratios, on the vertical plane, such as the ratio of length to width and the ratio of the width of the iwan to the height of the tapered arch close to the golden ratio, or the ratio of the height Iwan frieze to the height of the pointed arch close to (2), and the ratio is also close to (1) for all Iwans between the height niches to be displayed.

- The pointed Iwans are considered a place to sit, as well as being horizontal to the rooms it contains. It may also contain a vertical distributor in many samples.

6- Future research

- Carrying out research on the features of other elements in traditional architecture, especially the basic elements of houses in the old city of Mosul.

- Carrying out research on the traditional elements in other buildings, such as religious and service buildings.

- Carrying out research at the level of the urban facades of the traditional city of the old city of Mosul, especially the detailed level of these facades.

7- Recommendations

- Adopting the results of such research in the process of rebuilding the Old City of Mosul.

- Investing documentary drawings of the traditional elements of such research as an information base, with directing it to the concerned authorities in the rehabilitation of buildings at the detailed level.

References:

- [1] Al-Obaidi, Maysa Mowaffaq, Al- Sharif, Anwar Mishaal, "Architectural legacy of the city of Mosul out of the custom of building features of the old city" , International Journal of: Architecture, Engineering and Technology, 2018.
- [2] Alomari1, Hafsa R., Alharbi, Raad S. "Analysis Styles of Geometric Proportions An analytical study of internal elements (windows) in the old city

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الخصائص التصميمية للعناصر المعمارية في بيوت مدينة الموصل القديمة - دراسة تحليلية لعنصر الايوان -

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المستخلص:

تتميز العمارة التقليدية بتكوينات وعناصر معمارية محددة، تمتلك خصائص تصميمية (شكلية ووظيفية) اعطت لنتائج العمارة التقليدية طابعها الخاص كما هو الحال في عمارة مدينة الموصل القديمة. لقد تعرض النسيج العمراني والمباني التقليدية لهذه المدينة لأضرار كبيرة نتيجة الأحداث الإرهابية الأخيرة التي مرت بها المدينة، لذا كان لا بد من توثيق ودراسة هذه المباني من خلال عزل العناصر المعمارية الأساسية التي يتكون منها المبنى ودراسة خصائصها التصميمية بطريقة مفصلة. كشفت الدراسات والأدبيات السابقة التي تناولت عمارة الموصل القديمة، أن هناك نقصاً معرفياً وتحديداً لعنصر الإيوان وخصائصه التصميمية، لذا (تحددت طبيعة المشكلة البحثية في عدم وجود دراسة تناولت الإيوان الموصل) وجاء هدف البحث في الكشف عن الخصائص التصميمية للإيوان في عمارة البيوت التقليدية لمدينة الموصل القديمة واستخراج أهم الخصائص السائدة فيها. اعتمدت منهجية البحث على بناء إطار نظري يتضمن تعريف العنصر المعماري وخصائصه التصميمية بشكل عام، وتعريف الإيوان وخصائصه في عمارة البيوت الموصلية بشكل خاص، ومن ثم تم إجراء الدراسة العملية والتحليلية للإيوان على مستويين، وذلك اعتماداً على قاعدة البيانات والصور التي تم الحصول عليها وتوثيقها:

الأول (المستوى العام): تضمن هذا المستوى جمع وتوثيق 24 عينة عشوائية للإيوان الموصلية، وتطبيق دراسة تحليلية وصفية لاكتشاف خصائصه التصميمية.

الثاني (المستوى التفصيلي): تضمن هذا المستوى جمع وتوثيق بعض الصور والمخططات والرسومات التفصيلية لعشرة عينات (للإيوان المديب) والتي تم تحليلها رياضياً للكشف عن نسبها، واستخدام برنامج (AutoCAD) بيانياً للكشف عن خصائصها الشكلية التفصيلية، والوصول إلى قاعدة بيانات أكثر دقة يمكن استثمارها في إعادة بناء وعمار المدينة القديمة.

الكلمات المفتاحية: العنصر المعماري، مدينة الموصل القديمة، العمارة التقليدية، الخصائص التصميمية، الإيوان.