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Research Article:

Comparative Study of the Main Courtyard-Facing Facade A Case Study of Two Traditional Houses in Sulaymaniyah and Sanandaj

Sakar Sardar Mohammed Salih [1,a,*]
Amjad Muhammad Ali Qaradaghi [2,a]
[a] University of Sulaimani , College of Engineering , Arctechure Eng. Dept. , KR, Iraq

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About the Authors:
Corresponding author:
Sakar Sardar Mohammed Salih
E-mail: sakar.mohammed@univsul.edu.iq
Researcher Involved:
Prof. Dr. Amjad Mohammed Ali Qaradaghi
E-mail: amjad.ali@univsul.edu.iq

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Abstract

Traditional Kurdish architecture in the cities of Sulaymaniyah and Sanandaj represents a living mirror of social and cultural identity, with houses with main courtyards forming the heart of residential life, and the facades overlooking them becoming the most prominent symbolic and aesthetic elements.This research seeks to bridge this gap through an authentic analytical framework. The first phase relied on a descriptive analysis of the formative elements across the three levels (lower, middle, and upper), and led to the discovery of architectural elements without previous names, and the formulation of authentic Kurdish names for them for the first time. The second phase focused on transforming the elements of composition and facade materials from traditional descriptions to measurable quantitative-compositional indicators, within an analytical system developed in the Python/Jupyter Notebook environment. This framework made it possible to encode formative elements in a digital "interface language" through automated mechanisms to recognize arcs, rhythms, and style consistency, while incorporating artificial intelligence as a supporting tool for both formative and cognitive reading of the interface. The results showed a structural and physical convergence between the interfaces, while the perceptual-visual reading revealed a gap between the computational and the perceptual, which led to the formulation of the concept of "false similarity" to explain the ambiguous relationship between the physical and the visual in traditional architecture.

1-Introduction

Traditional Kurdish architecture is a living reflection of cultural, social, and political identity (Omari, 2023, p. 181). As it is not reduced to its aesthetic or functional dimension, but rather embodies a living document of the cultural transformation paths that the region has undergone. Cities such as Sulaymaniyah and Sanandaj have emerged as pivotal urban centers, as their Natural, economic, social and political conditions have contributed to the formation of a distinctive architectural path for their traditional homes (Alizadeh, 2021, pp. 5-14) . The inner courtyard is the beating heart of this residential style, while the façade overlooking it embodies its most prominent visual and symbolic elements, carrying clear social and cultural connotations (Waiqan & Dabdbe, 2020, pp. 39-54) . Despite their importance, most previous studies have been limited to general description or partial analysis, without engaging in quantitative methodologies or the use of precise numerical tools capable of transforming architectural features from descriptive concepts into measurable and verifiable indicators, leaving a gap in understanding the compositional structure of these facades and their relationship to the local context. Hence the need for a rigorous scientific approach that combines traditional morphological analysis with modern digital tools. In this context, the research adopts a customized digital analytical framework that

has created an entirely new code within Python, not as a replacement for existing tools, but as an integrated system that connects multiple levels of analysis specifically designed for this mission and presented for the first time in architecture studies. This code provides an integrated analytical framework that combines DXF, CSV, XLSX data. Extracted from engineering drawings and photographic analysis (JPG) via advanced perceptual indicators such as SSIM, MS-SSIM, Grid-SSIM, DSSIM, and LPIPS. The originality of this research lies not in the use of these indicators per se, but in their repurposing within a unified architectural framework that links geometric structure, physical properties, and visual perception؛This framework has made it possible to extract accurate indicators of architectural structure such as: unity, symmetry, rhythm, balance, hierarchy, contrast, size, and transparency, and link them to perceptual indicators. It also revealed the phenomenon of "false similarity" that shows the contrast between numerical similarity and visual perception. This work is an authentic scientific addition that enhances the understanding of traditional architecture and opens the way for the development of new approaches to documentation and digital preservation. The research is also based on highlighting the local architectural characteristics of Sulaymaniyah and Sanandaj, by tracing the way in which the architectural elements are organized within the façade, and how they are physically and decoratively expressed, as the most important entry point to understanding the architectural identity of each city within a single regional framework. This research is part of the researcher's master's thesis entitled A comparative study of the architecture of traditional houses, between Sanandaj and Sulaymaniyah cities, and it has been converted into an independent study.

- **Research problem:**

General: There is a lot of speculation that the traditional houses in the city of Sulaymaniyah are similar to the houses in the city of Sanandaj, but this proposition has not yet been subjected to any systematic academic study to prove its validity or denial. Hence, the problem of research lies in the absence of reliable scientific evidence that determines whether this similarity reflects a real relationship and a direct extension, or is it just a common saying that lacks academic proof.

Specific: The extent to which the architectural characteristics of the main facades of traditional houses overlooking the inner courtyard of the two cities differ and resemble is still not scientifically precisely defined.

Research objective:

- **General**: This research aims to analyze and interpret the nature of the architectural relationship between the facades of traditional houses in the cities of Sulaymaniyah and Sanandaj, by identifying and measuring the levels of similarity and difference in their formative, physical and perceptual characteristics, based on a systematic analytical framework that combines descriptive formal analysis, and quantitative analysis that can be measured and repeated, in a way that contributes to bridging the knowledge gap related to the understanding of local architectural characteristics in a regional comparative context.
- **Specific:**

1- Analysis of morphological characteristics of the facades of traditional houses in the cities of Sulaymaniyah and Sanandaj.

2-Transform the elements of architectural composition from qualitative descriptions to quantitative indicators that can be measured and repeated, including indicators such as: unity, symmetry, rhythm, balance, hierarchy, contrast, scale, transparency, and distribution of materials, using a customized digital analytical framework.

3-Conduct a systematic comparison between the results of the morphological and quantitative analysis of the facades of the selected houses in the two cities, with the aim of identifying the patterns of intersection and architectural difference, and interpreting them in the light of the local characteristics and cultural and urban contexts of each city.

- **Research Hypothesis:**

This study assumes that the main facades overlooking the main courtyard of the traditional houses in the cities of Sulaymaniyah and Sanandaj intersect in their general architectural structure and a number of their basic elements, as a result of belonging to a convergent regional context, but this intersection coincides with a qualitative distinction in the characteristics of organization and proportions, and physical and perceptual expression, which makes the relationship between the facades a structural architectural intersection that does not reach a complete formal or perceptual compatibility

- **Scope of the Study:**

This research focuses exclusively on the analysis of the main interior façade overlooking the central courtyard in the selected traditional houses in the cities of Sulaymaniyah and Sanandaj, as the densest part in terms of formal composition, spatial organization and social significance. The research does not deal with the exterior facades or the general visual landscape of the buildings, as the scope of the analysis has been deliberately confined to this specific part to ensure measurement accuracy, comparability, and uniformity of the unit of analysis between the two study cases.

Accordingly, all indicators related to materials and architectural formations, Cognitive/visual readings are directly related to this façade alone, and are not intended to be generalized to the entire building or to the broader urban context.

2-Research Background:

Despite the remarkable increase in architectural studies on traditional architecture in the Islamic world and the Middle East, Kurdish cities, especially the city of Sulaymaniyah, still suffer from a clear lack of academic research that documents and analyzes their residential architecture in a comparative framework. Most of the literature has focused on models of square architecture, and although there have been many studies on Kurdish architecture, most of them have focused on a single city or on a general description without a comparative study In-depth. Some researchers also addressed the formal characteristics of the houses of Sanandaj, as well as the great and first efforts made at the level of Iraq and Sulaymaniyah by Qaradaghi in documenting the traditional houses in the city of Sulaymaniyah. However, these studies, despite their importance, often concentrated on defining individual models or specific architectural contexts within Sulaymaniyah houses and were not analyzed in this regard. This study places the subject within an extensive regional comparison, seeking to rectify the inadequacies of current research through meticulous cultural and architectural analysis. Mohammad Ebrahim Zarei's book **"Old Mansions of Sanandaj"** (Zarei, 2015). the book places a great deal of emphasis on the mansions and historical houses of Sanandaj is a significant factor in assisting Kurdish people in developing a sense of belonging. The iwan, the courtyard, and the stucco and wooden decorations represent traditional elements that are not limited to decoration only, but also play a clear practical role, so they combine aesthetic value and daily use. The book is meaningful not only to researchers and specialists, but also to anyone drawn to Kurdish culture and design. By exploring the traditional houses of Sanandaj in depth, it paints a clear picture of how people once built their homes in ways that reflected social customs, family ties, and community values. The study shows that architecture here was more than construction; it was a form of cultural expression, binding material space with identity and memory. These houses can therefore be seen as historical evidence and renewed social symbols, as they concretely translate the deep overlap between the logic of architectural design and the dynamism of social life. Understanding the exact characteristics of traditional architectural facades in Sanandaj also allows for a systematic comparison with the facades of traditional houses in Sulaymaniyah on the basis of their compositional form, which is essential in comparative studies. Hooshmand Alizadeh's book **" Building a traditional Kurdish City the Urban Morphology of Sanandaj"** (Alizadeh, 2021) focuses on and looks at traditional houses in Sanandaj as more than just buildings—it views them as reflections of the people and culture that shaped them. The compositions of the courtyard, iwan, and rooms illustrate the social structure and daily lifestyles of the Kurds. This research aims to study the traditional residences of both the common people and wealthy and prestigious families, in order to show how architecture has become a means of expressing status, identity, and values. These traditional houses were not only built in the way of providing shelter or coping with the weather, but they told interesting stories about the roles, lives and beliefs of the people who lived in them. It is an important reference in understanding the architectural specificity of traditional Kurdish houses, as it profoundly reveals the relationship between architectural space and social structure. This source is useful in supporting the spatial analysis of Kurdish dwelling as the result of an interaction between culture and place. Therefore, it is relied upon to frame the morphological characteristics of houses within the local context. The importance of this study in understanding the morphological and social characteristics of the traditional house in Sanandaj, which helps to determine the impact of culture, class, and spatial field on the formation of Kurdish residential architecture. In the same vein, the study will later move on to provide a comprehensive systematic review of the literature on the city of Sulaymaniyah, in preparation for building an integrated comparative framework. Rasha's book **"The City of Sulaymaniyah"** (Rasha, 1987) The author wants to show how the city of Sulaymaniyah has changed over time, focusing on how political and social factors have shaped the way people live, work, and pray. The book also provides documentary material It is rich in historical and architectural facts about traditional houses and buildings, making it an important reference for researchers and those interested in studying Kurdish urban heritage. Through a methodology based on a combination of historical description, the book makes a scholarly contribution to understanding the city's past, and provides a knowledge base that can be used for academic research on urban heritage conservation and the development of historic cities. Although its focus is on the general context rather than on the comparative analysis of facades, the book provides a historical and architectural background on the city of Sulaymaniyah, forming an important theoretical basis for the study of traditional facades. Qaradaghi book's **"DOCUMENTATION OF OLD NEIGHBORHOODS AND BUILDINGS IN KURDISTAN SULAYMANIYAH CITY"** (Qaradaghi, 2022) .There are a lot of interesting facts

about more than 100 old buildings in the old neighborhoods of Sulaymaniyah. These buildings have mosques, houses, and public baths in them. These places are an essential element of the city's identity and cultural value, and this work highlights the cultural significance of these urban centers and the pathways that shape them, and the book clearly contributes to the conservation efforts of historical buildings in Sulaimaneyah through its reliance on in-depth research and rigorous scientific methodology. This means that people will be able to use it later. It shows how important these places are to the city's history and how important it is to keep them as part of the city's cultural and architectural heritage. Through a robust, research-based approach, the book makes a meaningful contribution to the documentation and understanding of local architectural heritage The book's importance in linking the cultural and social conditions of a city with its urban features has led to new ideas on how to protect ancient buildings and make cities more sustainable. This study conducts a comprehensive examination of the various architectural elements in the residences and their methods of employ, and contributes to building a broad knowledge base about the common architectural features in the city of Sulaimaneyah. It provided a reliable knowledge base for comparing the facades overlooking the interior courtyards with their counterparts in the city of Sanandaj. Abdullaah's book "**The Impact of Rebuilding Process on Changing Architectural Genotype: Traditional Houses in Sulaymaniyah City as a Case Study"** (ABDULLAH, 2023) This study investigates the alterations in traditional houses in Sulaymaniyah city due to unplanned reconstructions, emphasizing the effects of these modifications on the architectural genotype and the deterioration of authentic elements that have defined the identity of local architecture. This study is significant as it elucidates the threats to urban heritage and demonstrates the influence of contemporary socio-economic factors on the morphological and spatial configuration of traditional houses. The thesis also seeks to establish an analytical framework utilizing quantitative methodologies, including Space Syntax, to demonstrate the extent of the transformations that have impacted traditional architecture. This research offers a significant database and documentary resources applicable in scientific discussions regarding the conservation of urban heritage and sustainable development**.** Although its direct scope is different from the subject of comparison between the facades of traditional houses in Sulaymaniyah and Sanandaj, it constitutes an auxiliary reference in understanding the urban and social context that has influenced the development of the facades of houses in Sulaymaniyah. That study argues that previous studies have documented the architecture of Sanandaj and Sulaymaniyah separately, but they lack the comprehensive comparative framework that this study seeks to establish.

3- Kurdish Traditional House:

Traditional houses are one of the most important and best landmarks to show and embody the lifestyle of the past. Traditional houses offer peace, comfort, and protection. Kurdish architecture initially reflected the climate, terrain, economic resources of the population, and available materials, but since the remaining historic houses are limited to those houses that mainly belong to the rich and powerful segments of society, the general public has much simpler houses (TAHERI & Aeinifar, 2019, pp. 149-168). In the design of traditional houses, it is the integration of spaces so that the residents feel comfortable and relaxed. The diversity and decorations executed in the buildings do not cause fatigue and monotony. The traditional Kurdish house by facing inwards (a central courtyard) partially or completely. The house block in both cities is made up of a courtyard house. The courtyard house is the main building unit, and constitutes its most important economic, social and climatic assets. It is usually part of a shared apartment building for the same family. It is often irregularly shaped, i.e. the main rooms are arranged around a central courtyard with very few external openings (EDWARDS, 2006, p. 58). The entire design is based on a triangular pyramidal system, where first there is a public reception space consisting of an entrance called a "sand terrace", then a semi-private area, and finally the private family part of the house. This transition from one part of the house to another represents a great aesthetic experience, which includes an appreciation of open and covered spaces, the succession of light and shadow, and the continuity of size that gives a deeper sense of interior design. The house usually consists of one or two floors, with a balcony dedicated to women's activities, and another area used for sleeping on summer night. (Omed Shatari Faiqan, 2018, pp. 148-164) (Zarei, 2024, pp. 556,557). Fig (1) and Fig (2) show more explanation

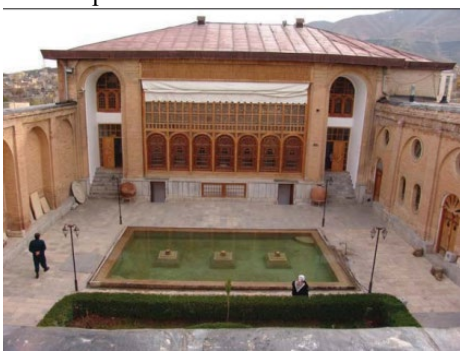

Figure1: View of the southern facade of the external courtyard of Moltafollah Sheikholeslam's Mansion (Aghlatifi & Kaliaei , 2018, pp. 111-131)

4-Sulaymaniyah City:

The city of Sulaymaniyah was founded by Mahmood Pasha in 1781, and the completion of the city was completed by Prince Ibrahim Pasha, his nephew, and the land of the Babanis "Sulaymaniyah Empire" expanded a lot during the reign of Prince Ibrahim Pasha. RICH sets the date of the second construction of the city of Sulaymaniyah in 1785. Sulaymaniyah city is in the northeast of Iraq, 40,000 meters from the Iranian border. The city of Sulaymaniyah is located in the foothills of the Goizha and Azmar mountains. The land in this region is stretches from the northeast to the southwest. On the eastern side lies Qalachwalan, once the capital of the province, along with the area known as Mergpan. The nucleus of the city belongs to the village of Malkande located nowadays. The city consists of seven main neighborhoods and contributed to the formation of traditional areas, including:" Malkandi, Sabunkaran, Sheikhan, Dargazen, Bazrgani, Sarshaqam, and julakan. Many historic areas have kept their original intended uses ". These major neighborhoods, or parts thereof, are sometimes known under several names. (VASILYEVA, 1991, p. 55) (MajorSon, 1971, p. 9) (Qaradaghi, 2021, p. 22) .

4-1 The Traditional Houses in Sulaymaniyah:

The best traditional houses in Sulaymaniyah were square-shaped, one-story and topped with cellars about three feet high or not exceeding two to three meters above the ground. The bricks were dried in the sun and then covered on the outside with a layer of clay mixed with chopped straw. The tiles in one or two rooms were also coated with white lime.(RICH, 1836, pp. 83,85). The flat roof is made of reeds, rafters, and a gabion. People say that traditional Kurdish houses are simple and made from materials that are easy to find in the area. Megerson says that Kurdish houses are often not square or rectangular and only have a few basic rooms. The inside design usually follows a square or rectangular shape, but it can change over time based on how the people who live there use the space. The main part of the house is the central courtyard, which has rooms around it. Some area like service areas, have been changed to better meet the needs of the people who live there. Not doing things the way they usually are (Qaradaghi & Nawzad, 2019, pp. 108-124). Fig (3) show more explanation

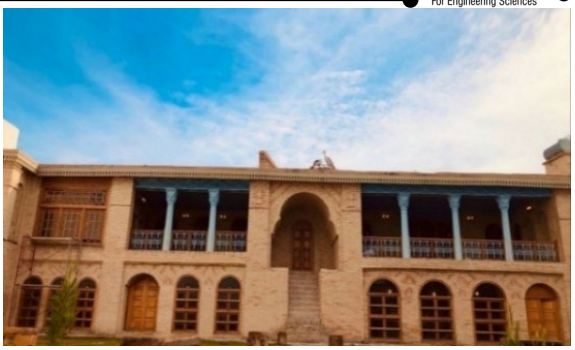

Figure 2: View of the south western facade of House of Haji Rashid Wasman Chawash in Sabunkarani neighborhood of Sulaimani.

4-2- Typology:

Traditional houses in Sulaymaniyah are often characterized by square or rectangular shapes, influenced by rural housing styles. These changes in old neighborhoods and buildings in Kurdistan. The style evolved from I Shape, H-shape, U-shaped, and L Shape, which were originally found in the region.

4-3- Spatial Organization:

The spaces begin with sand in a simple design and do not have much depth, in their simplest form, as they are separated from the street and the entrance door and used as a parking point for guests and strangers, to receive people or use the place for women to gather. In some houses (Khagenshin) there is, and then the journey of entering the house begins. Often the presence of a single heavy door and in some houses was the only indication of living inside. But the entrance did not allow, under any circumstances, a direct view of the residents. House. Therefore, their location is accurately calculated, and the outer entrance of those houses is located on the transverse wall of that courtyard, and this usually leads to a corner of the courtyard, where there are no household activities. The layout of the entrance was carefully considered as the layout of the courtyard itself and the beginning of the sequence of spaces within the house after the doorstep begins with a straight passage called the Dalan that may have an arched roof that enhances the architectural form of this space, the Dalan was also an important part of the entry sequence. Then to the central courtyard. Some of these houses have a sink in a front courtyard. There is a roofed porch with rooms and bathrooms in the courtyard. There is a bakery or oven on the other side of the open courtyard. Some houses consist of two floors, the Radi floor for the stables and the first floors for the bedrooms and living rooms . (Qaradaghi, 2020, pp. 158-183) (Lee & Park, 2015, pp. 65-74) (Qaradaghi, 2022)

Figure 3: Northern facade of Sofi Karim house (experience.slemani, 2020)

5- Sanandaj City:

Sanandaj is the capital of the Kurdistan Region, with a majority Kurdish population and the third largest Kurdish city by number. The city of (kaykhosravi & farshchian, 2017, p. 207)Sanandaj was founded during the reign of Suleiman Khan Ardalan around **1636–1637 AD**, on a hill overlooking the region, turning it into houses and urban life. The location and Kurdish culture give it a unique character. Sanandaj, in northwestern Iran, is surrounded by the magnificent Zagros Mountains and rolling hills. The city is surrounded by mountains, and to get anywhere, you have to cross huge mountain passes. The Zagros mountain range has had the greatest impact on the formation of Kurdish culture, traditions, history, and the structure of its society, and it extends along the western border of the Iranian plateau(Izady, 1992, pp. 1,2) (Qasri, 1961, p. 6).The mountains have long divided the Hanafi (Sunni) Ottoman Empire (1299-1922) from the Shiite Safavid Empire (1501-1722) (Alizadeh, 2021, p. 4).

5-1- Mahallaha (Neighborhood):

The neighborhoods mentioned are: Meyan-Qala - the inner city centered on the seat of power and ruling house. Gore-Awa - the servant quarter of the outer city, located to the north. Aqa Zaman - the area for merchants, which is to the east. Qatar-Chyan Neighborhood. where mules transport goods, located to the south (Alizadeh, 2021, pp. 61,62,97).

5-2- Sanandaj Houses:

To establish and build houses in Sanandaj for the first time, architects from the central parts of Iran were invited to build their mansions during the Medina period, and thus this aspect was included in the Sanandaj architecture of the central regions (Alizadeh, 2021, p. 27).Traditional residential houses and standing buildings that make up the traditional neighborhood, in Sanandaj, old buildings usually have a simple and clean appearance, but the doors are very beautiful and the interior decoration is elaborate. The valuable and cultural aspects that were taken into account when constructing these buildings. Interior details of the building include mirrors, plastering, bricking, carving and painting. The largest historical houses in Sanandaj are the Qajar and Pahlavi houses (Kasri, 2011, p. 15). The closed architectural style is characterized by its focus on the interior spaces and the avoidance of highlighting them outwards, an approach that is mainly a response to climatic requirements, but it may gradually establish a closed behavioral and ethical pattern. In contrast, the open style was one of the common spatial styles in public housing, and was borrowed from the original architecture of neighboring cities, as this type of house allows a clear reading of the style of the courtyard, the architectural elements surrounding it, and the spaces it organizes.(Malekizadeh & Soroush, 2021, pp. 946-966). Fig (4) show more explanation.

5-3- Overall Design and Strategy:

Spatial organization related to local migration occurred in different seasons. Sun-facing sections are used during the winter, while the part exposed sun-facing sections are used in the summer (kaykhosravi & farshchian, 2017, pp. 207-214). The same principle is also seen in traditional houses in Baghdad, where spaces are arranged between summer and winter uses regardless of their orientation (Warren & Fethi, 1982, p. 105).On one side of the yard is called I shape, with H shape having areas on both sides of the yard and facing each other, and L-shaped spaces on the side of the yard, it is characterized by spaces on three sides of the yard called U and O shape in this type (Dalir & Kashavar , 2018, pp. 33-38).

Figure 4: Northern facade and main façade of Asif Vaziri mansion (visitiran.ir, 2020)

5-4- The Overall Structure and Arrangement:

The house begins with sand and two seating platforms (Khajinishin) are designed on either side of the entrance to the house and in another space. The entrance doors of the houses have latches, locks and keys, sometimes in special sizes. The Glagherre was used in the facades of a number of buildings in Sanandaj. There is a transitional space between the exterior and interior of the house and a semi-polygon, as a transitional space between the two areas, a station for directions, or a **"temporary reception room for**

those who do not need to enter the house that was not suitable for socializing, but was used as resting places for visitors ", A driveway or walkway known as Dalan is used to access the courtyard from Hashti (Memarian & Brown, 2003, p. 189), (Habib & Alborzi, 2013, pp. 11-20).This is followed by a corner walkway that is connected to other parts of the house, especially the corner of the yard. Depending on the owner's health, this walkway also goes to the stable (Alizadeh, 2021, p. 161)**.**Traditional Kurdish houses are similar in the organization of the, entrance, dalan, corridor, Iwan and courtyard, as well as other functional areas that are connected to the courtyard. This is because they are based on the idea of a parallel system. The residential house is physically and visually connected to the central courtyard or garden on four sides. In this style, the courtyard is the beating heart of a residential house. Entrance to the courtyard including the main courtyard of the house, backyard and courtyard. Upper terrace and garden, balcony with columns, veranda and moonlit balcony, rooms around the courtyards: Shahnshin Hall, earring room, five doors, three, two doors for the dining room,

cistern and cellar, basement hall, kitchen, bathroom, bathroom, shoe rack, stairs. The houses are mostly built of brick, clay, and wood, and the building materials contain limestone mortar. In some houses, straw is also used. Inspired by houses in central Iran. (Azizzadeh & Molanai , 2022, pp. 1-20) (Zahra & Ali, 2011, pp. 43-56).

6- Analysis of Façade Elements:

6-1- Facade Elements in Traditional Houses:

An architects have a different way of dealing with interior facades, they are interested in them and they used a wide range of elements, however, builders used a combination of elements and the design of traditional house facades in both cities consists of:

6-1-1- The bottom level: includes the stone dado.

6-1-2- The middle level: comprises columns, Tavangan, Orsi window, oriel window, taq_e_chubi.

6-1-3- The uppermost level: Comprising both the eaves and the "Shirsari" (timber eaves), Rokhbam (brick eaves), Afriz, Afriz, Kolaf Farang- roof top) along with the roof covering But at Traditional houses, and there is no Frangi, but there is roof top curtain) For social reason (MEMARIAN, 2021, p. 90) , (Ekhlassi & Rafati, 2015, pp. 01-11) . Due to the large number of drawings, it was not possible to include them all in this place, so all the architectural elements of the façade were systematically listed and defined in Table (3,4,5,6 and 7).

6-2- Architectural Composition Elements:

Elements of architectural composition are essential pillars of architectural studies, as they are the tools that allow for understanding how facades are formed and their visual and functional integration. Through concepts such as unity, symmetry, rhythm, balance, hierarchy, contrast, scale, proportionality, and transparency, the logic of the internal organization of the elements can be interpreted, revealing the aesthetic and structural values that give architecture its distinctive character.

6-2-1- Unity:

It means the relationship that makes the components of an architectural composition work together as one cohesive entity, so that the design achieves harmony and wholeness rather than disintegration.

6-2-2- Symmetry:

It is the visual balance resulting from the repetition or reflection of architectural elements around a specific axis or center, creating a sense of stability and organization.

6-2-3- Rhythm:

Using rhythm in architecture lets the built solution respond in a musical way. Architecture and music have some things in common, such as their focus on rhythm, which is an important part of both. Architecture rhythm is when the same effects happen over and over again. Movement (line, shape, sequence, and patterns) can give design solutions a sense of rhythm.

6-2-4- Balance:

The principle of balance is a key design principle relative to the architectural design process. Balance occurs when opposing forces or visual weights appear to be equal and harmonious.

6-2-5- Hierarchy:

indicates the relative importance of the parts of a composition and is dependent on number, geometry, and proportion, since each of these contributes to the identity of each part and its position relative to others.

6-2-6- Contrast:

Contrast is a design principle used to provide specific emphasis to a particular piece or section of the solution. Its purpose is to create a greater sense of the element in relation to its surroundings.

6-2-7- Scale:

Scale in architecture has a lot to do with proportional development. Scale refers to the size of an element in relation to a known or established standard, while proportion refers to the size of the relationships between elements.

6-2-8- Transparency:

It is the degree of clarity or permeability of elements (like glass or openings) that lets light through and be seen, making connections between the inside and outside (Unwin, 2009, p. 4).

6-3- Materials in Traditional Facades:

The climate and geography of the area determine and decide what materials are used there. Materials that are used for façades in the traditional houses in general,

consisting of wood, brick, glass, stone, plaster, metal, rammed earth (MEMARIAN, 2021, p. 57).

7- Methodology:

7-1- Case Study House Selection:

The case study in this research comes to embody the applied dimension of the analytical method that was based on it, where two architectural models were selected that represent two central cities in Kurdish architecture: the house of Ali Mam Sheikh in the Sabunkaran neighborhood of Sulaymaniyah city and the mansion of Moshir Diwan in the Sartabul area of Sanandaj city. The choice of these two models was not arbitrary, but was based on clear scientific criteria:

- The first represents an authentic model of the traditional Kurdish house in Sulaymaniyah.
- The second was later turned into a public museum, and is considered one of the most important examples rich in formative and decorative elements in the facades of houses in Sanandaj, and reflects the influences of the Qajar era through its patron Mirza Yusuf, one of the ministers of the Emirate of Ardalan.
- These models were chosen because of their completeness and high representation of the main interior façade elements overlooking the main courtyard, providing a valid methodological basis for an in-depth architectural comparison, without pretending to generalize the results. From table (1) and (2).

7-2- Phase I Descriptive Analysis:

7-2-1- Comparison of the Architectural Elements of the Façade:

In this axis, we analyze the visible and constituent elements of the façade, and divide the façade into three levels according to. From table (3-7)

7-2-1-1- Bottom Level:

١-Stone Dado:

Stone Dado is used as a prominent part of the façade of traditional houses in Moshir Diwan with a height ranging from 90-100 cm, and it usually consists of polished and decorative stone which gives the base of the façade durability and decoration, while in the traditional house of Sabunkaran Dado stones were not used at the base of the wall.

7-2-1-2- The middle level:

1- Iwan:

The element of the iwan, which is not found in the traditional houses of Sulaymaniyah in general, and this house in Sabunkaran. As for the facades of the traditional houses of the city of Sanandaj, the spatial element that appears in the façade is the Iwan, which is always present in the façade of the courtyard, often in the center, with three openings or arches, and is supported by columns and decorations of brick, wood or plaster.

2- Iwan-Chah:

In the traditional house of Sulaymanyah Sabunkaran, there is no Iwan-Cha, but in the traditional house of Moshir Diwan in Sanandaj on the sides of the main iwan, there are two smaller arched spaces, namely the Iwan-cha, which serve for architectural purposes such as achieving visual balance, or light use. In the Moshir Diwan is a complementary element to the Iwan symmetry.

3- Stairs (Pilekan):

There are no external stairs as a basic element in the facades in the Qajar period in general, and that in the main façade overlooking the main courtyard of the house, Moshir Diwan, there are stairs on two sides of the building in front of the Iwan-Cha for the visual balance and rhythm in the façade, and in contrast, in the main façade there is the house of Ali Mam Sheikh in the traditional Sabunkaran in Sulaymaniyah, which appears as a structural element integrated into the visual configuration of the façade on both floors.

4- Wooden Doors with A Wooden Transom (Dargay Dar Ba Sarwana Dar):

In the traditional house of Sabunkaran in Sulaymaniyah, the door is functional, often singular, expressing the simplicity of the lifestyle and the realism of use. But in the traditional house of Moshir Diwan, the door is decorated, double, with symbolic patterns, designed to highlight authority and status.

5- Pacholaghi:

It is a wooden door that contains a Goljam element and is found in the central façade of the house of the Moshir Diwan, especially in the openings within Iwan-cha. In the center of the façade, there are anchored doors of stained glass, some of which extend from the ground upwards, and some are fixed vertically (closed wooden bottom, glass top and open). There is one in the main façade of the traditional house Ali Mam Sheikh in a simple way without complications.

6-Ordinary Wall Windows:

Ordinary wall windows are common in traditional Sulaymaniyah houses and are located in the main façade of Ali Mam Sheikh's house, they are placed on walls to ensure natural air flow, better light distribution and interior comfort. But this type of window does not have the main façade of the traditional house of Moshir Diwan in Sanandaj.

7- Wrought Iron Railing (Shashbandi Asni):

It is a metal architectural element mounted on windows, doors, or balconies and is usually cast or forged an iron (Qaradaghi, 2022, pp. 337-344). It is found in the main interior façade of the house of Ali Mam sheikh, while in the house of the Moshir Diwan there is no such element in covering openings.

8-Orosi: In Moshir Diwan, the Orosi is considered the most prominent and largest element in terms of space, and in the façade of the main house of the Moshir Diwan, there are usually panjdri it has colored glass and is characterized by a lot of decorations and

ventilation, and in the traditional house in Sabunkaran in the city of Sulaymaniyah, it can be said that it is used in a small and simple way in which many decorations, decorations or colors were not used.

9- Goljam (Shusha Rangi):

There are stained windows above the Arusi or Pacholaghi known as Goljam, which have used for lighting in the houses of Moshir Diwan in Sanandaj in a complex form of decorations and inscriptions, and in the house of Ali Mam Sheikh in the city of Sulaymaniyah it is present but in a simple form.

10-Oriel Window (Panjareh Pish-Âmadeh):

The architectural element that appears in the façade of the courtyard is the traditional Kurdish architecture of the house of Ali Mam Sheikh, and contributed to enriching the composition of the façade with a clear wooden distinction, and this element allowed to increase the space of the interior, introduce more natural light, and create a panoramic view of the courtyard. This element is not found in the traditional house of Moshir Diwan in Sanandaj.

11- Arches (Taq):

In the Main Courtyard-Facing Facade of traditional houses Moshir Diwan, a group of arches appears, often semi-circular arch, and are used above the three large openings, above large entrances and windows to the Iwan. While in Firangi's element have used multifoil/cusped arch, (composite arch), The traditional Ali Mam Sheikh's house in Sulaymaniyah is often seen above the windows and doors, and is in the form of Segmental Arch Above ordinary wall windows and wooden door, Semi-circular Arch above orosi window and Pacholaghi, and Cusped/Multifoil Arches which Made entirely of wood, it is fastened as a front cladding (decorative façade).

12-Column (stun):

In most of the houses of traditional houses, columns were used a lot, and in the traditional house of Moshir Diwan was used in the Iwan and decorated and made of wood covered with plaster, and in the city of Sulaymaniyah, columns are not commonly used in the façade and appear only in some iwans or facades, but in the house of Ali Mam Sheikh, there are wooden columns in a simple way.

13- Tavangan:

The Tavangan element in the façade uses the main of the traditional house of MOSHIR's Diwan above the column element and carries the decorations and adds a visual rhythm to the façade, but in the city of Sulaymaniyah in the house of Ali Mam Sheikh is absent. Fig (5) show more explanation

14- Wooden Arch (Tāq-e-Chubi -Taqi Dar):

In the traditional Ali Mam Sheikh's house there is a Taqe-Chubi element that performs a partial aesthetic and structural function, supporting the transition between the arch and the columns or forming a visual end to the space. In the house of Moshir Diwan that was used as a visual and decorative transition element between the column and the arch. It is made of carved or decorative wood that helps to accentuate the architectural symmetry and covers the intersection between the arch and the column. It contains floral decoration patterns.

Figure 5: Plaster molding of the western Iwan's column and Tavangan (freecadadmin, 2021)

15- Wood Carving (Monabbat -Kari):

The Monabbat -kari for the traditional house of Ali Mam Sheikh in Sulaymaniyah, this element was made in a simple way Only in how to divide the timber. in the other hand the Monabbat -kari is found in the Moshir Diwan's mansion, and it indicates craftsmanship. It is a method of hand engraving or decorative emptiness, executed on the surfaces of the wooden arch.

16-Raraw:

In the main façade of the traditional house of ALI Mam Sheikh in Sulaymaniyah there is an element of Raraw that is not used as a seating element because it is only a narrow area for movement and connecting the rooms at the top with some or standing in which you see a visual scene, and it is surrounded from the front by low walls or Wrought Iron Railing, which is separate from the façade configuration. In the traditional house of the Diwan MOSHIR, there is no such element in the main façade facing the main courtyard. Fig (6) show more explanation

Figure 6: View of West view facade of Ali Mam Sheikh's house (Researcher, 2025)

7-2-1-3- Upper Level:

1-Afzir:

Element, delicately decorated, used in the main façade overlooking the inner courtyard of the main courtyard of the Mosher Diwan which is a horizontal bar at the top of the façade. Used for decorative, structural, and final purposes. It may hide or contain a wooden beam. In the house of Ali Mam Sheikh, there is no such element.

2-Afriz:

Horizontal elements in the façade, used for decorative or structural separation. They are often flat and filled with decoration or writing. In the traditional house of Ali Mam Sheikh, this element is found where a line has formed a seal for the façade that can be used for aesthetic and practical purposes, and in the traditional house of the Moshir Diwan, there is no such element in the main façade.

3- Timber Eaves (Shirsari):

In the traditional houses of Moshir Diwan, a Shirsari is used, which is a prominent lower wooden eave, decorated, used as a high aesthetic visual finish and used to protect the facades, and it is present in the house of the traditional house Sabunkaran is prominent and undecorated.

4- Brick Eaves (Rokhbam):

In the house of the Moshir Diwan was used Rokhbam element in the final part of a flat roof on the western façade on both sides, but there is no Rokhbam element in the house of Ali Mam Sheikh in the city of Sulaymaniyah.

5-Frangi:

In some traditional houses of Sanandaj, there is a decorative element such as an upper strip or a balustrade decorated with the name of a Frangi and made of wood, but it is not found at all in the traditional houses of the city of Sulaymaniyah. Fig (7) show more explanation

Figure 7: This building was built in the Qajar period by Mirza Yusuf Moshir Diwan (Mahinpoo, 2018)

7-3- Phase II (Separate Analysis):

7-3-1- Overall Analytical Framework of Phase II:

- This research is based on building an integrated digital analytical framework, specifically designed to transform traditional interfaces from a descriptive subject into a measurable and retestable system. This framework was based on the integration of three layers of data: the architecture extracted from AutoCAD drawings, machine-converted digital tables (DXF/CSV/XLSX), and realistic images that represent the true visual experience of the interface.
- This framework was developed within the Python/Jupyter Notebook environment through a centralized, reusable code, which is launched via text commands and runs within the browser, so that interface files are automatically received and deconstructed into standard indicators without any manual intervention. Independent units of analysis have been incorporated into this system, so that concepts that were traditionally read as "impressions"—such as symmetry, rhythm, transparency, hierarchy—are transformed into numerical values that are comparable and comparable between the interfaces studied.
- However, the methodology did not stop at the limits of geometric measurement, but moved to a deeper level of cognition by integrating AI algorithms and deep computer vision models into the analysis track itself. Advanced indicators (SSIM, MS-SSIM, Grid-SSIM, DSSIM, LPIPS) were used. To measure similarity as human cognitive mechanisms "see," not just as the numbers calculate. This combination of geometric and cognitive results has made it possible to reveal subtle gaps — what the research called the phenomenon of spurious -similarity — where the shape is numerically similar while visually fundamentally different.
- In the final phase, the outputs were standardized into a final comparative code that calculates the difference between morphological and perceptual similarity, producing a composite reading that combines engineering precision with the power of AI-based

analysis. In doing so, this framework not only provides a technical tool, but also a new analytical approach to preunderstanding traditional architecture through a computational system that can be scaled and reapplied to other states.

7-3-2- Stage one: Separate Analysis (Data Extraction and Software Integration):

7-3-2-1- Data Preparation and Software Integration:

1-The study started from the preparation of the complete plans in AutoCAD, where an accurate architectural classification (windows, doors, arches, columns, ceilings, decorations) was carried out in independent layers. Subsequently, the data was issued in various formats.

2-DXF (Drawing Exchange Format) to maintain engineering precision, from them, CSV (Comma-Separated Values)/XLSX (Excel Sheet) files were extracted via a special code to generate live digital measurements without any manual intervention.JPG is taken directly from AutoCAD for visual documentation, optionally use BBOX (Bounding Box) when needed to adjust dimensions.

3- Software Integration Mechanism and Automated Analysis Implementation:

- The methodological originality of this research is based on building a unified analytical system that regulates the transfer of data between its different sources within a single coherent path. The work begins with the identification of the formative elements of the interface from the DXF files, where indicators of an engineering and organizational nature (such as unit, symmetry, rhythm, and balance) are extracted and converted directly into quantitatively manipulable tables. When indicators require a perceptual-visual dimension, or some numerical features are absent, analysis based on images extracted from AutoCAD, based on Bounding Box technology, is used to locate and proportion objects and convert them into comparable digital indicators. With this approach, the consistency and stability of the analysis is achieved, while ensuring that its results can be reproduced within a single, integrated software environment.

4- Python Language and its Role in Research Methodology:

Python is one of the high-level programming languages widely used in contemporary scientific research, particularly in the fields of engineering, data analysis, and computer vision, due to its structural clarity, flexibility, and high ability to process digital and image data in a reproducible and verifiable manner.

7-3-2-2-Analysis of Architectural Composition Elements:

Independent software modules are designed for each element of the architectural composition (Unity, Symmetry, Rhythm, Balance, Hierarchy, Contrast, Scale, Transparency). Each module directly integrates the extracted data (DXF, CSV, XLSX, JPG, BBOX) and converts it into accurate quantitative indicators. These units were applied to the façade of Ali Mam Sheikh's house in Sulaymaniyah, and then to the façade of Moshir Diwan's Mansion in Sanandaj, producing a separate quantitative output for each house. Then, a custom comparison code was used that took these results and automatically calculated the similarity and difference indices for each individual element, and then combined them to produce the final result (Overall Similarity & Difference) between the two interfaces.

- An illustrative example of the mechanism of aggregation of results and final calculation:

After the analysis of all elements of the architectural composition was completed independently, the final quantitative values of each element (unit, symmetry, rhythm, balance, hierarchy, contrast, scale, and transparency) were compiled into a single CSV file. This unified file was then re-entered into custom comparison code within the Python environment, where the code read and processed the input values to extract the similarity and divergence indicators for each individual element, and then combined these results to produce the overall similarity and overall difference indicators between the two interfaces. The results of the code run were adopted as the final values, as all calculations within the program were conducted based on the CSV file without any external accounts. Shown in Table (8).

- **Illustrative examples of how unity indicator components are calculated:**

A-Repetition–Rhythm:

It is illustrated by the repetition of window openings or arches on the façade with the regularity of the horizontal spaces between them, where the relative convergence and evenness of the distances indicate a uniform rhythm.

B-Proportion–Scale:

It is illustrated by the similarity of the relative relationships between the width and height of architectural elements (such as windows or arches), so that the convergence of these ratios indicates a uniform proportional system.

C- Material–Color Harmony:

Illustrated by the repeated use of the same material and color (such as bricks or plaster) throughout the façade, with limited color contrast, reflecting a clear visual harmony.

D-Alignment–Axis:

Illustrated by the regularity of the positioning of architectural elements on either side of a central visual axis, such as the alignment of windows or arches around a clear vertical axis.

E- Stylistic consistency and the language of architecture (Consistency / Style/Language):

It is illustrated by the repetition of the same type of arch or the same shape of the openings, with the similarity of their formal and relative characteristics, and the continuity of the same modulation rules across the entire façade, which shows the consistency and consistency of the architectural language.

- **Illustrative examples of how symmetry components are calculated:**

A-Axis of Symmetry:

Illustrated by testing a possible set of axes within the courtyard façade, and then selecting the axis that achieves the highest match between the left half of the façade after being mirrored and the right half, based on Visual Structural Similarity Measurement (SSIM) with support from the balance distribution of the elements extracted from the DXF around the chosen axis.

B- Element Count Symmetry:

It is illustrated by comparing the number of architectural elements on both sides of the axis (windows, arches, doors/columns/decorations...) and then converting the difference of the number to a numerical degree, so that the closer the number of elements on the two sides (within the same category), the higher the degree of numerical symmetry, calculating the percentage of elements for which a "pair" was found on the opposite side.

C- Size & Proportion Symmetry:

This is illustrated by matching symmetrical elements to the right and left (after inflecting around the axis) and then measuring the convergence of their standard properties such as area, width, height, and aspect ratios, where a decrease in relative differences between the measurements of each symmetrical pair indicates a higher symmetry in size and proportion.

D- Shape Matching Symmetry:

This is illustrated by comparing the actual "shape" of each symmetrical pair of elements by describing the edges and descriptors of the element within a uniform patch around each element; the lower the distance of difference between the shape descriptions of the symmetrical pair, the higher the degree of shape matching.

E- Hierarchy Symmetry:

It is illustrated by comparing the balance of the "Dominant Elements" on both sides, by arranging the elements according to their volumetric/spatial importance and their location near the axis, and then measuring the similarity of the distribution of ranks between the left and the right, so that the convergence of the position and balance of the major elements around the axis indicates a higher hierarchical symmetry.

- **Illustrative examples of how the components of the rhythm indicator are calculated:**

A-Repetition of Elements:

Calculated by extracting "anchor elements" from the façade (windows/doors/arches/columns) from the DXF or from the image in the absence of the DXF, and then automatically grouping the elements into horizontal rows based on the proximity of their vertical positions (row clustering). The regularity of repetition within each row was then measured via:

1-Regularity of horizontal intervals between the centers of elements (gaps between cx) using the CV dispersion coefficient of the intervals; the lower the CV, the more regular the repetition.

2-Frequency periodicity Via a simple spectroscopy of distribution intervals (FFT) to detect a "cyclic pattern" of intervals; the more one frequency dominates the spectrum, the higher the degree of rhythmic regularity. The results of the rows were then combined with a weighted average of the number of commas in each row to produce the degree of repetition.

B-Variation within Repetition:

Calculated in order to measure "controlled variation" that does not disturb the rhythmic system. Therefore, it is measured within each row:

1-Item sizes vary using Coefficient of Variation (CV) for the sum (width + height) of the items within the row.

2-Horizontal breaks variation between items within a row using CV for commas. These two variances were then converted into a degree via a Bell-shaped function that targets a perfect variance value (Target), i.e., too little variance means monotony, too large variance means chaos, while mean variance close to the target gives the highest score. Weighted average is taken according to the number of class items.

C-Progression:

Calculated to capture the presence of an "intentional sequence/gradient" in the rhythm rather than the repetition being completely constant. Within each row, it was checked whether it:

Element sizes (w+h) gradually change in one direction across the interface, and/or. Gaps change gradually (get bigger/smaller) on a regular basis. This was measured by a Kendall-like rank association between the order of the items on the horizontal axis and the values (volume or intervals), and then the absolute value was taken: the stronger the order relationship, the clearer the gradient.

D- Spatial Intervals:

Calculated at the level of all grades by aggregating all horizontal intervals between elements and then statistically analyzing the "distribution of intervals":

1-The bin width of the boxes was automatically determined by the Freedman–Diaconis method to avoid arbitrary selection.

2-The extent of the control of the two most common separations (Top-2 coverage) was then calculated: if

most of the separators fall within two dominant values, this indicates a fixed separation system.

3-The dispersion of the intervals around the dominant values (local spread) was also measured; the lower the dispersion, the more accurate the rhythm. “Interval control" and "dispersion discipline" were then combined to produce the degree of spatial separations.

- **Illustrative examples of how the components of the Balance indicator are calculated:**

A-Axis Distribution:

It was illustrated by testing a possible set of optical axes within the courtyard façade, and then selecting the axis that achieves the highest degree of convergence in the distribution of the visual mass of the architectural elements on both sides, based on a comparison of the spread of the elements and their relative centers of gravity to the right and left, reflecting a general visual stability around the chosen axis.

B- Solid vs. Void Balance:

It is illustrated by comparing the distribution of architectural openings (windows, doors, glass openings) on both sides of the façade, where the convergence of the spread of the spaces and their presence on both sides indicates a visual balance between solid blocks and voids, without requiring direct formal symmetry.

C- Proportion Balance:

It is illustrated by comparing the relative properties of opposite elements around the axis, such as the general relations between width, height, and area, so that the convergence of these relationships between the two sides indicates a relative equilibrium in composition, even in the case of partial morphological differences.

D- Material –Color Balance:

It is illustrated by comparing the physical and visual character of the two sides of the façade, including the type of material used and its chromatic and optical properties, where the convergence of physical and chromatic properties between the two sides reflects a higher degree of visual balance.

E- Ornament Balance:

It was illustrated by comparing the density and spread of decorative elements on both sides of the axis, both in terms of area and spatial distribution, so that the proximity of the presence of the decoration and its lack of concentration in one side indicates a decorative balance within the façade.

- **Illustrative examples of how to calculate the components of a hierarchy index:**

A-Scale component:

It is illustrated by identifying the prominent elements in the interface based on the "relative size" of each element compared to the rest of the elements within the same interface. Larger elements of space (such as a iwan, main entrance, large central window, or a wide decorative block) are treated as visually dominant, while smaller elements (such as secondary openings or limited details) are less hierarchical. Thus, "dominance" is interpreted here as volumetric/mass dominance within the visual system of the interface.

B- Location Component:

This is illustrated by evaluating the "position" of the element within the overall configuration of the interface, not just its size. Elements located in areas of higher perceptual sensitivity—such as the center of the façade, near the axes of organization, or locations that correspond to visual focus points—are given higher hierarchical significance than elements of similar size but located at the edges or in areas that are less impactful to visual reading. That is, the location translates into a perceptual value that is related to the centrality of the element within the interface.

C-Contrast component:

It is illustrated by comparing the "distinctiveness" of the element from its immediate surroundings in terms of visual differences (color/brightness/texture). When an item is more different from the surrounding background (such as a glossy glass window in the middle of a brick wall, or a light gypsum decoration within a dark surface), it becomes more attention-grabbing, and thus its position in the hierarchy rises. Contrast here is understood as a visual separation force that makes an element "read first" compared to its surroundings.

D- Ornamentations component:

It is illustrated by measuring the "density of detail" within the item compared to its surroundings. Elements with patterns, decorative repetitions, wooden details (carry-manbat), or higher tactile complexity are considered more hierarchical because they produce a stronger "perceptual focus" and capture visual attention within the façade. In doing so, the decoration is treated as a factor that elevates the hierarchy by increasing visual richness and complexity.

- **Illustrative examples of how to calculate the components of the Contrast Index:**

A-Material Contrast:

Illustrates by comparing the "composition of materials" between parts of the façade using DXF layers and linking them to the table of materials (CSV/XLSX), and the difference in material distribution (stone/brick/wood/gypsum/glass...) translates into a higher degree of variation as the material differences increase.

B- Color Contrast:

It is illustrated by comparing the color properties within the element/interface against its immediate surroundings after excluding the background, as the greater the color difference (in

brightness/gradient/saturation), the higher the color contrast value.

C-Scale/Size Contrast:

Illustrates by measuring the extent to which specific elements are "dominant" compared to the average sizes of other items; the presence of an element/group that is clearly larger than the overall context raises the scale variability.

D-Texture/Ornamentation Contrast:

Illustrates by comparing the density of surface details within an element with the surrounding ring (Edge density/texture descriptors), with a "physical correction" based on the properties of real materials (roughness of stone, softness of gypsum, wood modularity, etc.) to distinguish the real decoration from the visual noise.

E- Transparency Contrast:

Illustrates by estimating the presence of transparent/semi-transparent elements (glass/Orosi) and how they are visually different from the surrounding dark masses, as the increased presence of transparency or the intensity of its distinction from the background increases this dimension.

- **Illustrative examples of how to calculate the components of the Scale Index:**

A-Human Scale

Measured by how close the dimensions of the openings (especially doors/windows) are and the height of the façade from the human measurement references; the closer the approach, the greater the value of the Human Scale.

B-Hierarchy via Scale

Measured by the presence of clear volumetric differences that produce a visual hierarchy (dominant element vs. secondary elements) at the interface/aperture level; the more pronounced the differences, the higher the hierarchy.

- **Illustrative examples of how to calculate the components of the Transparency Index:**

A-SVR_DXF: The ratio of spaces/slots extracted from DXF to reference interface area, representing the geometry as actually built based on the layers.

B-SVR_IMG: The visually estimated proportion of spaces/apertures from the interface image within the boundaries of the dominant element; represents image-based transparency.

C-SVR_FUSED: A balanced fusion of SVR_DXF and SVR_IMG to produce more consistent transparency, combining geometric precision with visual sense.

7-3-2-3-Architectural Materials Analysis:

On the physical level, the same methodology was used to analyze the proportions of the materials used (wood, bricks, stone, plaster, glass, metal, tamped soil). However, the process was not limited to the data drawings (DXF), as the latter often did not have the exact physical qualities. Therefore, the realistic specifications of the buildings were entered directly into the code, so that the results translated the actual physical properties of the materials in reality, not just the symbols. Another special code was designed to extract the material ratios for each interface, and then an additional code to compare the two bits, so that Similarity and Difference were automatically calculated, with the final result of the material level being produced.

7-3-3- Stage Two: Parallel Analysis Using Realistic Images:

After completing the separate analysis (Phase 1), the study moved to a new, more realistic level by adopting direct photographs of the facades of Ali Mam Sheikh's house (Sulaymaniyah) and Moshir Diwan's mansion (Sanandaj). Herein lies the methodological originality: an entirely new code system was developed in the Python environment, designed from scratch and never before used in the field, to perform automatic image analysis without any manual intervention.

7-3-3-1- Spurious Similarity Code:

Initially, a special code was created that compared the two images via a set of visual morphological indicators:

• Aspect ratio (AR_NORM)
• Symmetry
• Solid/ Void
• Rhythm
• Color Harmony

7-3-3-2- Perceptual Similarity Code:

After the completeness of the formal-numerical analysis, a move was made to a more advanced level based on measuring similarity as visually perceived, by employing a set of digital perceptual indicators originally developed in the field of computer vision, with the aim of simulating the mechanisms of human visual perception when comparing architectural facades. The following indicators were adopted:

• SSIM (Structural Similarity Index)
• MS-SSIM (Multi-Scale SSIM)
• Grid-SSIM (Evaluation via Splitting the Image into Small Grids)
• DSSIM (Converting Similarity to Scale of Difference)
• LPIPS (Deep Neural Networks Based Indicator to Simulate Human Cognition)

The perceptual-visual analysis phase is based on a set of advanced numerical indicators, originally developed in the field of computer vision, to measure similarity as perceived by the human eye, and not just as calculated by geometric dimensions.

• The SSIM index is used to compare the overall structure of an image across three basic

components: lighting, contrast, and spatial structure, allowing the formal relationships to be represented as visually perceived.

- MS-SSIM extends this principle by analyzing the image at multiple levels of measurement, combining the reading of the whole and the detailed level at the same time, which is closer to the nature of human vision that integrates the overall landscape with fine details.
- Grid-SSIM works the interface is divided into a network of small cells and analyzed by each cell individually, reducing the effect of the overall average of the image and showing the subtle positional differences in the distribution of elements on the interface.
- SSIM is reformulated as an indicator of difference through DSSIM, which transforms similarity into a measure of cognitive gap that is easy to read when comparing the two interfaces.
- In contrast, LPIPS is based on pre-trained deep neural models, evaluates similarity approximates human perceptual judgments, not just at the level of color or direct geometric values.
- All of these indicators are automatically computed within the Python/Jupyter Notebook environment through a unified code designed specifically for this research, which reads the images of the interfaces and extracts the perceptual values without any manual intervention, ensuring the objectivity of the measurement and the possibility of accurate retesting. The detailed numerical values of each index, and the differences between the two interfaces at the level of visual perception, are presented and interpreted in the Results, Tables, and Subsequent Figures section

7-3-3-3- Gap Analysis:

Analysis of the Gap Between Numerical Similarity and Perceptual Similarity, In the final stage, the results of formal-numerical similarity were combined with the results of cognitive similarity within a single code, whose task is to calculate the methodological gap between the two types of measurement. This fusion made it possible to reveal the distance between what digital accounts produce and what is actually visually perceived. This led to the formulation of the concept of "spurious similarity" as a framework for explaining cases in which similarity appears computationally high, while visually manifesting differently. At this stage, the software tools developed by the research have become an organizational framework for the measurement process, so that the input, processing, and extraction steps are standardized within a single digital path, ensuring the stability of the procedures and the possibility of future re-application to other interfaces. The binary approach, which combines quantitative analysis and visual perceptual reading, has also made it possible to build a measurement system that does not rely on abstract numbers alone, but links them to how the interface is visually perceived within its architectural context. Finally, the integration of "gap analysis" at the end of the program path made it possible to aggregate all the outputs into a single comparative framework, transforming the multiple findings into an integrated reading that could later be used for interpretation and scientific discussion.

8-Result and Discussion:

8-1-Result:

8-1-1-The Elements of Architectural Composition of the Facades of Traditional Houses:

Formative and organizational elements are essential analytical tools in understanding the architectural approach through which interior courtyard facades have been shaped in traditional architecture. These elements include. From table (8) and (9)

1- Unity:

In the traditional houses of the cities of Sanandaj and Sulaymaniyah, especially the facades of the two houses of Moshir Diwan and Ali Mam Sheikh, unity is achieved in the main facades on the main central courtyard through the repetition of rhythm, proportion and proportion, the use of materials, the harmony of color and the style of linguistic consistency in a homogeneous way, so that unity can be seen. In the traditional houses of the city of Sulaymaniyah, the unit is 39.8% and the house of Ali Moshir Diwan is 30.1%.

2- Symmetry:

The symmetry in the facades of traditional houses consists of the axis, the number of elements, the measurement and proportion of the elements on both sides, the shapes and the hierarchy. In the house of Ali Mam Sheikh, it is unclear and is present in 70.96% where the elements are distributed according to the needs of the rooms, without taking into account the symmetry., and in the traditional house, Moshir Diwan is present at 89.86%.

3-Rhythm:

In the traditional house of Sulaymaniyah Ali Mam Sheikh, the rhythm is 60.7%, and in the house of Moshir Diwan, the rhythm is found in the inner façade that overlooks the main façade, which is equal to

65.40%, where the rhythm is made up of repetition, the elements, the types within the repetition, Progression, spatial interval.

4- Balance:

The balance in the facades of the two traditional houses in both cities was achieved through axis distribution, solid vs void _ balance, proportion_ balance, material color _ balance, ornament _ balance, where the balance in the traditional house in Ali Mam Sheikh is 67.0% was partially achieved through the functional distribution of the elements without visual organization. And the traditional house of Sanandaj achieved a balance of 88.2%.

5- Hierarchy:

In the traditional facades of houses in Sulaymaniyah, the gradient is 53.27%, and in the traditional house, the gradient in the facades is equal to 44.72%, and the gradient consists of calculating scale, location, contrast, ornamentation.

6- Contrast:

The contrast is present in the facades of traditional houses, in the façade of the house of Ali Mam Sheikh is present in the ratio of 34.82%, while in the interior façade of the house of Musher Diwan, it is present in the percentage of 40.63% and the contrast in terms of material, color, scale/size, texture/ ornamentation, and transparency.

7- Scale:

The scale is located in the main façade of the two traditional houses Ali Mam Sheikh and Moshir Diwan for different ratios, the house of Ali Mam Sheikh is 68.45% and in the house of Moshir Diwan the scale is 63.40%.

8-Transparency:

There is transparency in the two main facades inside the main courtyard, Ali Mam Sheikh and Kosher Diwan with a different percentage, where in the house of Ali Mam Al-Sikh with a percentage of 17.75% and the House of Musher Diwan with a percentage of 32.69%. Fig (8) and (9) show more explanation.

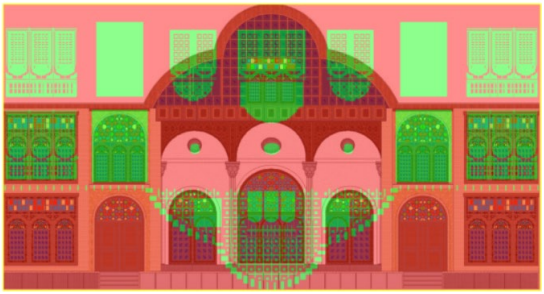

Figure 8: Transparency in Moshir Diwan show Solid=67.31, Void: Solid =0.486 (by Researcher).

Figure 9: Transparency in Ali Mam Sheikh's show Solid =82.25, Void: Solid = 0.216 (By Researcher).

8-1-2- **Comparison of Materials Used in the Facades of Traditional Houses in Sulaymaniyah and Sanandaj Cities:**

In the interior facades overlooking the main courtyard in the Houses of Ali Mam Sheikh and the Moshir Diwan, materials not only as structural elements but also as cultural and aesthetic connotations, reflecting the identity of each city. The contrast in secondary materials reflects environmental, climatic and social responses**.** Fig (10) and (11) show more explanation.

1-Wood:

In the house of Ali Mam Sheikh in Sulaymaniyah, the percentage of wood reached 53.6%, making it the most dominant material on the façade. Wood was used in doors, windows (Orsi), columns, and ceilings, where it was primarily a functional and structural element. In the house of Moshir Diwan in Sanandaj, the percentage reached 44.64%, which is relatively lower, but wood was used in a richer decorative way, especially in the colorful Orsi and wood carvings (Monbat kari), which reflects a tendency towards Qajar luxury.

2- Brick:

In Sulaymaniyah, the percentage of bricks reached 34.65%, as it was mainly used in load-bearing walls in a practical way without a clear decorative appearance. While in Sanandaj, it reached 36.68%, which is close but with a clearer decorative employment in arches, arches, and the large iwan, where it combined the structural and aesthetic role.

3-Glass:

The presence of glass in the house of Ali Mam Sheikh was limited to 6.26%, and was limited to Ordinary wall windows or simple Orosi. In the house of Moshir Diwan, the percentage was 9.90%, reflecting a greater reliance on stained glass and decorative in the large Eurasian windows, and we see the highlight of transparency and visual openness.

4- Stone:

The stone comprised solely 1.83% of the main façade material of Ali's house to um Sheikh, as its use was limited to the staircase. While in Moshir Diwan's house, the percentage reached 5.85%, which is a clear difference that indicates Sanandaj's reliance on stone

in the lower layer of the façade (Dado) as a durable and decorative element that adds a sense of strength and solidity.

5- Plaster:

The percentage of plaster in Sulaymaniyah was only 1.72%, and its role as a simple covering layer was limited. Conversely, data from Sanandaj shows a rate of 2.92%, where plaster was employed as a decorative material in walls and some architectural additions, in a clear extension of the decorative spirit in the Qajar tradition.

6- Metals:

The house of Ali Mam El Sheikh recorded a percentage of 1.49% for metals, which were mostly used in simple iron windows. While minerals were completely absent in Moshir Diwan's house (0.0%), reflecting the difference in technical and functional orientations between the two cities.

7- Rammed Earth:

- In the house of Ali in Mam el-Sheikh, it appeared by a small percentage of 0.43%, which is an indication of the continuation of the tradition of popular building related to local resources. In Moshir Diwan's house, soil was completely absent (0.0%), indicating a tendency towards the use of more luxurious and solid materials.
- In this way, the second phase represented a fully automated analytical system, combining graphical data (DXF, JPG), digital (CSV, XLSX), and adjustment tools (BBOX) in original code designed from scratch. This system was not limited to formative elements only, but also extended to structural materials, and allowed for a comprehensive, quantitative and objective comparison between the facades of Sulaymaniyah and Sanandaj without any manual intervention, which is an unprecedented systematic contribution to the analysis of traditional Kurdish architecture.

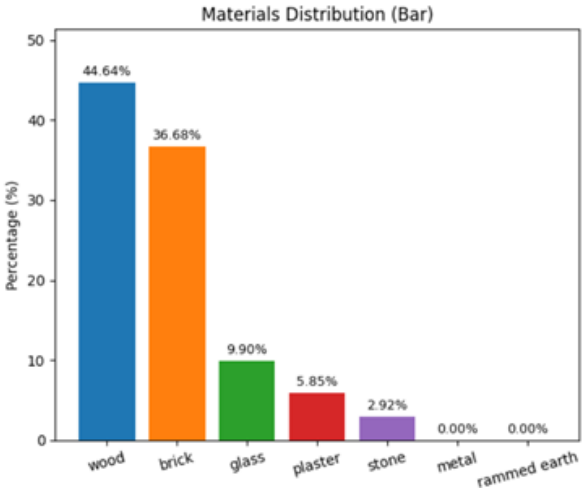

Figure 10: The percentage of materials used in the Main interior façade that overlooks the courtyard of the Moshir Diwan's mansion

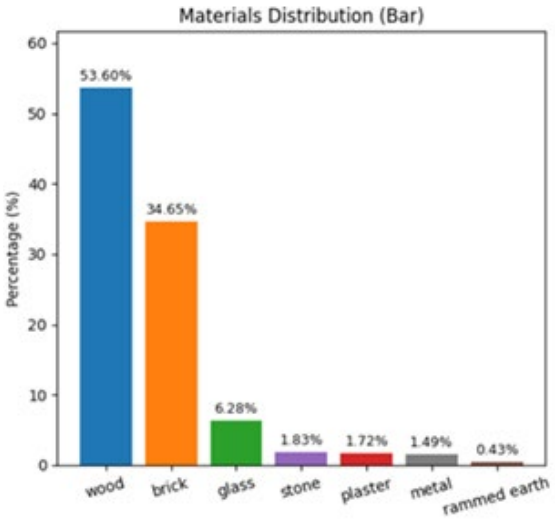

Figure 11: The percentage of materials used in the main interior façade that faces the main courtyard of Ali Mam Sheikh's house

8-1-3-Stage Two: Parallel Analysis Using Realistic Images;

8-1-3-1- Spurious Similarity Code:

The results (Table 10) showed a very high average ≈ 95.82%, suggesting a near-perfect numerical symmetry between the two interfaces. However, this symmetry is considered "false" because it does not necessarily reflect the actual visual impression.

8-1-3-2- Perceptual Similarity Code:

The results showed a sharp decline in the similarity values, as the average of ≈ perception reached only 41.18%, which confirmed that visual perception does not see the two interfaces in the same way as reflected in the numerical calculations. Fig (12) and Table (11) show more explanation.

8-1-3-3 — Gap Analysis

- Spurious Similarity: ≈ 95.8%
- Perceptual Similarity: ≈ 41.2%
- Gap: ≈ 54.6%

This large gap provided empirical evidence of a disconnect between numerical calculations and human visual perception, which led to the formulation of the concept of the Spurious Similarity Phenomenon for the first time in this paper.

The last code (Gap Analysis) made it possible for the first time to unify the different results into a single frame, giving the overall final result about the similarity and difference between the two beta interfaces.

8-1-3-4-The Final Comparison of the Two Interfaces: From Morphological Similarity to Cognitive Gap:

A comparison between the façade of the Ali Mam Sheikh's House in Sulaymaniyah and the façade of Moshir Diwan's mansion in Sanandaj showed a

remarkable convergence in the use of basic materials such as wood and bricks, with a high similarity (≈83–94%), reflecting a radical unity in the traditional building practices in the two environments. This convergence extended to the rhythm and hierarchical organization of the elements, suggesting that the two facades belonged to a single architectural language based on the style of the house with the inner courtyard. However, the quantitative analysis revealed fundamental differences that express the stylistic nature of the two cities differed, with Sanandaj recording higher rates of symmetry (≈89.9% vs. 70.9%), balance (≈88.2% vs. 67.0%), and visual transparency, in line with the Qajar trend towards highlighting symmetry and exaggeration of decoration as symbols of power and dominance. In contrast, Sulaymaniyah was characterized by achieving a full humanitarian scale (≈100% vs. 92%) and the results show a higher organizational diversification that reflects a functional-practical orientation linked to the local socio-economic structure. but express two different paths of expression, revealing the resilience of traditional Kurdish architecture and its influence on climate, politics, and cultural factors. The results show that the two facades are rooted in the same origin, but embody different modes of expression, confirming that traditional Kurdish architecture is highly flexible and influenced by climate, politics, and cultural factors. In the perceptual analysis of realistic images, a glaring gap between numerical similarity and visual perception was revealed: the perceptual similarity indices recorded moderate to low ratios (SSIM ≈ 53.4%, MS-SSIM ≈ 52.24%, Grid-SSIM ≈ 53.44% ±1.83%, DSSIM ≈ 46.6%, LPIPS ≈ 17.9%), while the dimensional index (AR) recorded a perfect match ≈100%, and gave an average of unweighted numerical similarity (Spurious Similarity) High Value ≈95.82%. This variation, as shown in (Tables 11 and 12), revealed a gap of ≈54.63%, leading to the formulation of a new concept called the " Spurious -similarity phenomenon", which highlights the amplification of numerical indicators of geometric similarity at the expense of true visual perception that reflects subtle stylistic and aesthetic differences. Finally Phase II showed that numerical similarity (≈ 96%) is radically different from perceptual similarity (≈ 41%), and that the gap (≈ 55%) is key to understanding architectural duality: a common morphological coherence offset by a profound perceptual-aesthetic difference. . Fig (13) and Table (12) show Spurious-Similarity phenomenon.

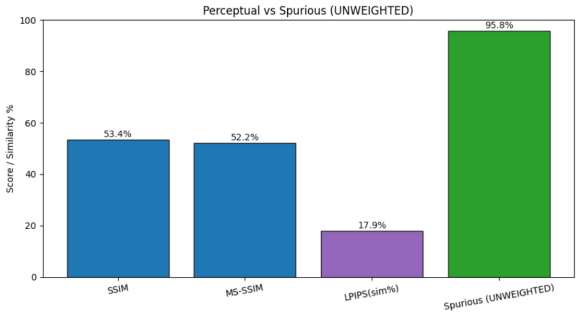

Figure 12: Perceptual Vs Spurious (unweighted)

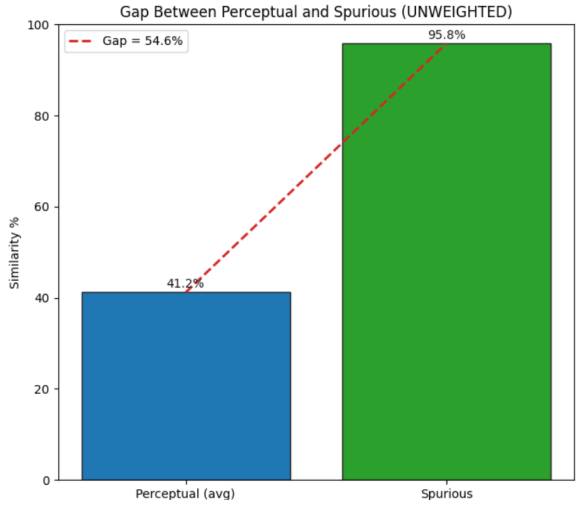

Figure 13: Spurious-Similarity phenomenon.

8-2-Discussion:

This discussion illustrates how digital results are interpreted within a socio-cultural architectural framework, how they support or modify the research hypothesis, and reveal the relationship between form, function, and perception in traditional home facades

8-2-1 First Stage: Interpretation of the Results of the First Analysis:

8-2-1-1- (Architectural composition elements):

This stage of the discussion focuses on the interpretation of the quantitative results associated with the elements of architectural composition in the facades of the Ali House of Mam Sheikh and the House of Moshir Diwan, as derived from the engineering codes based on the DXF files and digital tables. Here the indicators for unity, symmetry, rhythm, balance, hierarchy, variance, scale, and transparency are reorganized as an interconnected system that reveals the logic of building the façade, not just separate values. By reading these indicators in the light of the function and the nature of daily use, the social and political background of each city makes it possible to distinguish between the general formal similarity and the different modes of organization and expression.

1-Unity;

- **Sulaymaniyah**

1.The unit consists of functional repetition linked to the paths of daily living, where the interface is held

together according to the logic of use rather than the logic of presentation.
2. The physical and chromatic homogeneity reveals a conscious practice of the visual economy, in which the showmanship of the façade is reduced, and its presence is subjected to considerations of function and the demands of daily life.

- **Sanandaj**

1.Unity is achieved through a centralized representative organization in which motifs and stained glass contribute to the construction of an "interface language" directed at visual reading.
2.Unity becomes a symbolic function as much as it is formative, as it is used to produce a coherent image that declares and consolidates social status.

- **Significance**

The comparison shows that unity moves from being an engineering feature to a cultural strategy for managing meaning:
a façade that serves life in Sulaymaniyah, as opposed to a façade that tells the narrative of status and prestige in Sanandaj—which partly explains the contrast of meaning despite the convergence of formal values.

2-Symmetry:

- **Sulaymaniyah**

1-Symmetry is shown here as a flexible symmetry, in which elements are reworked according to the requirements of the interior space rather than to a rigid visual center.
2- This pattern allows the distribution of openings and services to be redirected in a functional-social way, maximizing practical utility even at the expense of the formal image.

- **Sanandaj**

1-Symmetry is very clear and is managed as a conscious visual project that establishes order and discipline.
2-The axes of symmetry are integrated with the iwan and decorations to form a "staged" façade with a clear center.

- **Significance**

The comparison shows that in Sulaymaniyah, symmetry moves from being a tool for organizing the function, to becoming in Sanandaj a representative discourse of an authoritarian nature, and thus symmetry becomes an indicator of the nature of the authority that produces space and shapes its relations.

3-Rhythm:

- **Sulaymaniyah**

1. The architectural rhythm is adaptive, changing according to the distribution of spaces and housing requirements.
2. Frequency is managed to a limit that allows for daily movement without imposing a rigid system on the interface.

- **Sanandaj**

1. The rhythm is disciplined and centered, organized by sequential units that surround the iwan and support it as a leading element.
2. Repetitions are used to create a sedentary festive sensation.

- **Significance**

The rhythm here is not a decoration, but a technique for controlling behavior within the space: a rhythm that accommodates life in Sulaymaniyah, as opposed to a rhythm that regulates the viewing in Sanandaj.

4-Balance:

- **Sulaymaniyah**

1. Balance is achieved through a rational distribution of blocks and slots without committing to perfection.
2. The relationship between solidity and vacuum is governed by functional needs.

- **Sanandaj**

1. The balance is visually created via precise control of the axes, trim and vents.
2. The goal is to produce a stable image that reads as a ceremonial façade.

- **Significance**

The balance here is not a fixed criterion, but rather a different cognitive choice:
functional-practical balance in Sulaymaniyah versus a representational-incidental balance in Sanandaj.

5-Hierarchy:

- **Sulaymaniyah**

1-No single element appears to be absolute dominant; the dominant elements are shared according to usage.
2-Paths and movement play a crucial role in shaping the focus points.

- **Sanandaj**

1-The hierarchy is built around clear leadership elements (iwan/Orosi/ornament).
2- This results in a carefully designed visual system that focuses the gaze on a specific focal point.

- **Significance**

The element of hierarchy reveals that the reading of the interface is not linear: in Sulaimaneyah, we are faced with a multi-signal system, as opposed to an overstated and dominant visual center in Sanandaj.

6-Contrast:

- **Sulaymaniyah**

1. The contrast is limited and controlled, and works mainly to serve visual clarity and practicality.
2. The materials used with their Spartan character reduce the showmanship of the façade.

- **Sanandaj**

1. Contrast is higher, driven by stained glass, motifs and patterns.
2. Contrast is invested as a means of intensifying symbolism and highlighting centers.

- **Significance**

Contrast is transformed from a tool for improving functional reading
to a tool for producing a declarative visual identity — which explains the cognitive difference despite the similarity of structure.

7-Scale:

- **Sulaymaniyah**

1-A human scale close to the body, giving a sense of containment.
2-The big elements are not showy but rather related to use.

- **Sanandaj:**

1-Relative amplification of specific elements enhances a sense of prestige.
2-The scale is employed to produce a representative effect.

- **The connotation**

of the scale turns into a social language:
everyday comfort versus authoritarian symbolism.

8-Transparency:

- **Sulaymaniyah**

Transparency is limited, and is used as a medium for controlling privacy more than revealing inside.

- **Sanandaj**

Transparency is higher, and is employed to create a festive and colorful feel, while keeping the look in control.

- **Significance**

Transparency here oscillates between a tool for social control and a tool for expanding visual discourse.

8-1-2-2-Material Comparison:

• A comparison of materials in the two interfaces reveals that quantitative similarity does not imply functional or symbolic match. Wood, despite its dominance in both cases (≈53% vs. ≈45%), played different roles: in Sulaymaniyah it emerged as a utilitarian element associated with the living space, while in Sanandaj it became a decorative-representative medium influenced by Qajar taste. Similarly, brick maintained its carrier role in the two cities (≈35–37%), but its re-use in the arches and iwan in Sanandaj moved it from a structural level to a visual discourse.

• The height of the glass in Sanandaj (≈10% vs. ≈6%) reveals a difference in the concept of visual openness: the façade there shows the interior as part of the representation, while Sulaymaniyah maintains an economy of vision that protects the domestic sphere. Stone and plaster also contributed to higher percentages in Sanandaj in formulating a language of prestige and durability, in contrast to a limited and functional presence in Sulaymaniyah. The persistence of tamped soil in Sulaymaniyah and its absence in Sanandaj reflects a transition from the logic of the local resource to the logic of the prestigious material.

• Thus, the materials here function as a semantic system as much as they are structural elements: unity in roots, and diversity in modes of expression, reflecting the socio-political differences between the two environments.

8-2-1-3 Second Stage: Discussion of the results of the second phase (realistic images):

1-Spurious -Similarity:

High values (≈96%) reveal that purely geometric indicators amplify similarity because they measure what is constant: proportions, the concentration of masses, and the conformity of the overall framework. But these indicators ignore what works architecturally at the level of experience: the precise rhythm, the distribution of light, and the nature of the decoration. Thus, a "perfect similarity on paper" is produced, but not visually achieved.

2- Perceptual Similarity — Similarity as Perceived:

The decrease in the average of cognition to ≈41% shows that the eye rearranges the façade according to a different logic:
They capture contrasts of visual dominance, breaking rhythm, transparency gradation, and overlapping intensity of decoration. The SSIM, MS-SSIM, Grid-SSIM, and LPIPS indicators show that the differences are not in "dimensions", but in stylistic language: Sanandaj proposes a transverse-representative interface, while Sulaymaniyah remains relevant to everyday human use.

3-Perception Gap:

The large gap (≈55%) is not just a mathematical phenomenon, but epistemological evidence that architecture cannot be reduced to a mathematical calculation. Figures capture common structure, while perception reveals stylistic and cultural differences. Hence the concept of " spurious similarity": a high geometric consistency matched by a clear perceptual difference, because what is seen does not necessarily match what is calculated. The results reveal that the two facades share formal coherence, but differ in the economy of decoration, the rhythms of space, and degrees of transparency — i.e. In its aesthetic-cultural dimension. This shift, as shown in Tables 11 and 12, revealed a convergence gap (≈54.63%), which led to the formulation of a new concept of the " spurious similarity phenomenon", which highlights the amplification of digital indicators of geometric similarity at the expense of true visual perception that captures subtle stylistic and aesthetic differences. This finding confirms that sufficiency with computational analysis alone leads to misleading readings, while the integration of quantitative analysis with cognitive indicators is an essential step to a deeper understanding of architectural identity. Thus, it is clear that traditional Kurdish facades share a formal structure, but differ markedly in their cognitive-aesthetic style: Sanandaj represents the ornate elitist façade associated with Qajar power, while

Sulaymaniyah reflects the human-functional character most associated with social reality. Accordingly, the second phase highlighted that relying on numbers alone is misleading, and that the combination of quantitative analysis and visual perception is a critical condition for achieving a deep understanding of traditional architecture.

9- Conclusion:

This research represents an advanced scientific attempt to re-read traditional architecture in Sulaymaniyah and Sanandaj, by moving from historical and impressionistic description to building a digital-cognitive analytical framework capable of testing architectural hypotheses with measurable accuracy and reproducibility.

- The study was based on a dual system that combines quantitative morphological analysis and simulation of visual perception of realistic images, which made it possible to convert a number of descriptive concepts (unity, symmetry, rhythm, balance, hierarchy, transparency and contrast) into comparable quantitative indicators
- A comparison between the two studies shows that a large number of formative elements are repeated in both the Ali Mam Sheikh's house in Sulaymaniyah and Moshir Diwan's mansion in Sanandaj, reflecting their affiliation with a common architectural tradition based on the house with an inner courtyard. However, a comparative reading reveals that the same elements—arches, iwans, openings, and wooden windows—have been reorganized within radically different contexts.
- In Moshir Diwan mansion, these elements were integrated into an explicitly representational compositional system that gave the façade an authoritarian-ceremonial character, as they were incorporated into a disciplined arrangement that works in harmony with its original functions and traditional architectural connotations, becoming part of an integrated façade logic.
- In the façade of Ali Mam Sheikh's House in Sulaymaniyah, the elements themselves appear as "movable or adapted elements", which have been repurposed outside their traditional functional framework to serve aesthetic, structural, or organizational purposes, indicating the transition of the façade from a clear functional logic to a more flexible and selective style of composition.

Thus, the function of the façade shifts from a mere "formal surface" to a cultural system that simultaneously reflects the relationship of power, privacy, and social life, and shows that similarity in elements does not necessarily imply a congruence in meaning or architectural role.

- In the façade of Moshir Diwan's mansion in Sanandaj, architectural elements are transformed into a functional language that reveals the nature of the interior spaces, such as the iwan, the sedari, the panjdari. The façade becomes a reading tool for the spatial and social system. As for the façade of the house of Ali Mam Sheikh in Sulaymaniyah, it is more oriented towards symbolic beautification and the borrowing of elements, which makes the relationship between the façade and the interior less transparent, and transforms the façade into a visual discourse independent of its spatial structure.
- The results of this research show that the two studied facades, despite belonging to the same cultural environment, operate according to two radically different architectural logics. Morphological comparison has shown that there is a recurring common structure in the elements of composition and materials (≈80–82%) that is associated with the residential model with an inner courtyard, reflecting a single historical root in spatial organization and mass distribution.
- However, the analysis of realistic images revealed that this similarity is not reflected perceptually, as the indicators of geometric similarity increased to ≈96%, while the indicators of perceptual similarity did not exceed ≈41%, which produced a cognitive gap of ≈55%, which was formulated in this research within the concept of "false similarity": any structural congruence that is digitally convincing, but differs visually due to different rhythm patterns, the logic of the visual gradient, and the degree of decorative work.
- This study not only recharacterizes two facades, but also proposes a cognitive framework that can be expanded to include broader samples of traditional architecture in the region, while at the same time serving as a digital platform for documentation, comparison, and reappraisal. In this way, the similarity between the two facades becomes roots, while the difference remains the language of expression — revealing that Kurdish architecture is not a unified model, but a living system capable of reproducing itself according to the social and cultural context over time.
- This research contributed to the transfer of a number of architectural concepts from the level of theoretical description to the level of digital measurement, while developing an analysis system that can be generalized to other interfaces. Advanced perceptual indicators (LPIPS, SSIM...) were also employed. Within the architectural context for the first time in this integrated form, which allowed the difference between numerical similarity and visually perceived similarity to be revealed, and the concept of "false similarity" was formulated as a new interpretive tool.

Recommendations:

- The importance of integrating quantitative and cognitive methodologies into heritage studies.

- Adopt this methodology in restoration and digital simulation to avoid only misleading numbers.
- Do not rely on geometric indicators alone in restoration decisions, as numerical similarity may mask deep cognitive-aesthetic differences. Applying include residential, religious and public facades in multiple cities, to produce a comparative map of the architectural identity in the region.
- Develop additional perceptual indicators (light, decorative intensity, transparency gradation, human interaction with the interface) to deepen the reading of the relationship between form and experience.
- Investing the curriculum in architectural education to train students to distinguish between what is "digitally similar" and what is "visually different", and linking heritage to contemporary digital tools.

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دراسة مقارنة للواجهة الرئيسية المواجهة للفناء حالة الدراسية لمنزلين تقليديين في السليمانية وسنندج

المستخلص:

تمثل العمارة الكردية التقليدية في مدينتي السليمانية وسنندج مرآة حية للهوية الاجتماعية والثقافية، حيث شكّلت المنازل ذات الساحات الداخلية قلب الحياة السكنية، وأصبحت الواجهات المطلة عليها أبرز العناصر الرمزية والجمالية. وعلى الرغم من الادعاء بوجود تشابه جوهري بين واجهات المدينتين، فإن هذا الادعاء بقي دون اختبارات علمية دقيقة، مما خلق فجوة معرفية أعاقت تحديد طبيعة العلاقة. ويسعى هذا البحث إلى سد هذه الفجوة من خلال إطار تحليلي أصيل.اعتمدت المرحلة الأولى على تحليل وصفي للعناصر التكوينية عبر المستويات الثلاثة (السفلي–الوسطي–العلوي)، وأدّت إلى اكتشاف عناصر معمارية بلا تسميات سابقة، وصياغة أسماء كردية أصيلة لها لأول مرة. أمّا المرحلة الثانية فتركّزت على تحويل عناصر التكوين ومواد الواجهة من توصيفات تقليدية إلى مؤشرات تركيبية–كمّية قابلة للقياس، ضمن منظومة تحليلية طُوِّرت في بيئة Python/Jupyter Notebook. وقد أتاح هذا الإطار تشفير العناصر التكوينية في «لغة واجهة» رقمية عبر آليات تلقائية للتعرّف على الأقواس والإيقاعات واتساق الأسلوب، مع إدماج الذكاء الاصطناعي بوصفه أداة داعمة لقراءة الواجهة تكوينيًا وإدراكيًا معًا. وأظهرت النتائج تقاربًا بنيويًا وماديًا بين الواجهات، فيما كشفت القراءة الإدراكية–البصرية عن فجوة بين الحسابي والمدرَك، الأمر الذي قاد إلى صياغة مفهوم «التشابه الزائف» لتفسير العلاقة الملتبسة بين المادي والمرئي في العمارة التقليدية.

الكلمات المفتاحية:

العمارة السكنية, بيت تقليدي, منزل الفناء، تحليل الواجهة الرئيسية ، مقارنة شكلية / إدراكية

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Table 1: Description of Moshir Diwan's mansion (by researcher)

Description	Name of the house
Owner Name: Mirza Yusuf Moshir Diwan Number of floors:3 Height:15.150m Total Area: 3659m2 Number of Courtyards :5 Façade: Façade facing the main courtyard	Geographical Location: Iran, Sanandaj City House belongs to Qajar era It is located in the city of Sanandaj in the old Sartpuleh quarter. This building with architectural elements considered the most important building in the Sarbatul district between the past and the present. The building has 5 courtyards and, in a central courtyard the buildings are formed on four fronts. This building is an introvert and dual buildings; the western side of the building consists of 3 stories. This space contains a hall - a colonnaded iwan on which Frangi is built. The façade of this building includes brickwork with bridal frames Wooden windows have flat arches that have arches, openings, and brick frames.

Plans	Façad	View
		
Figure 14: Ground floor plan	Figure 15: Facade that faces to the main courtyard (West Side)	Figure 16: View of the western façade and main terrace of the mansion of Moshir Diwan (Prince, 2017)
		
Figure 17: First floor plan	Figure 18: Facades that face to the main courtyard (East Side)	Figure 19: view of the East _façade a Moshir Diwan
		
Figure 20: Second floor plan	Figure 21: Facades that face to the main courtyard (North Side)	Figure 22: View of the North-Eastern _façade and main terrace of the mansion of Moshir Diwan (Zarei, 2014, p. 95)
		
	Figure 23: Facade that faces to the main courtyard (South Side)	Figure 24: View of South Side of Moshir Diwan Mansion

Table 2: Description of Ali Mam Sheikh's house (by researcher)

Description	Name of the house
Owner Name: Ali Mam Sheikh Number of floors:2 Height:11.42 m Total Area:216.6 m2 Number of Courtyards: 1 Façade: Facade facing the main courtyard	Geographical Location: Iraq, Sulaymaniyah City The house from 1910-1920 is located in the city of Sulaymaniyah in the old neighborhood of Sabunkaran. This building is rich in architectural elements. The building has 1 courtyard; the buildings consist of two fronts. The west side of the building consists of 2 stories. This space contains two hallways, rooms, and a colonnaded Iwan. The façade of this building includes brickwork, and there is a clear variety in the use of arches according to function and architectural level: broken arches, semicircular arches, lobed arches with three curves dedicated to the Sulaymaniyah houses.

Plans	Façade	View
		
Figure 25: Ground floor plan	Figure 26: Facade that faces to the main courtyard (West Side)	Figure 27: main façade Ali Mam Sheikh

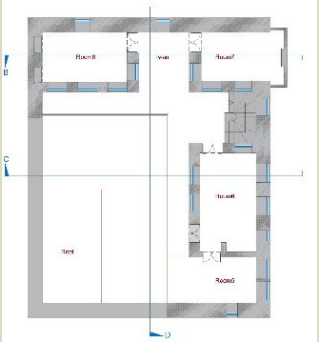
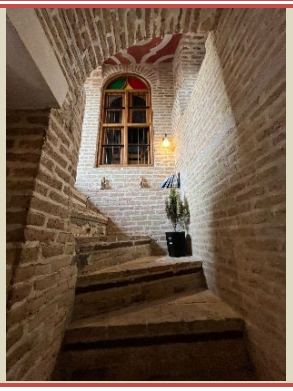



Figure 26: First floor plan	Figure 27: Facades that face to the main courtyard (North Side)	Figure 28: View of Ali Mam Sheikh's courtyard house

Table 3: Architectural elements of Ali Mam Shekh's main courtyard-facing facade _ the middle level comprises (by researcher)

Elements	Description	View
Gate Darwaza	• **The first element in the front of the house from framing the protrusion of the wall surface.** • **a click of a corridor .** (Tazarj, et al., 2016, pp. 1-14)	 Figure 28: view of main gate of Ali Mam Sheikh. (Qaradaghi, 2022, pp. 337-344)
Wooden doors with a wooden transom Dargay dar ba sarwana dar	• **Traditional architectural element** • **crafted from wood and often decorated with carvings or paneling** • **horizontal wooden panel placed above the door,** • **It has symbolic roles.**	 Figure 29: View of wooden door with wooden transom (Directorate of heritage of Sulaymaniyah, Archives)
Ordinary wall windows	• Common In Traditional Houses, especially in Kurdish Rural Areas • placed above ground, under the roof. • provide cool visibility and airflow, • often placed on multiple walls • enhancement, natural air flow and better light distribution and indoor comfort. (Tahbaz & Moosavi, 2009, pp. 273-278)	 Figure 30: view of ordinary wall windows (Directorate of heritage of Sulaymaniyah, Archives)

Shashbandi Asni (WroughtIron Railing)	• **It is a metal architectural element.** • **mounted on windows, doors, or balconies** • **usually cast or forged iron.** (Qaradaghi, 2022, pp. 337-344)	 Figure 31: View of orosi window (Qaradaghi, 2022, p. 343)
Window Sill Paya-Y_Panjara (Sako-Y-Panjara) , (Aso-Y-Panjara)	• **It is the horizontal lower part of the window opening.** • **Make of stone, brick or wood,** • **structural and decorative element** • **Occasionally decorated with glazed bricks or wood carvings to reflect the local taste.**	 Figure 32: View of Paya-Y_Panjara (Researcher, 2025)
Arches (Taq)	• the arch is one of the oldest basic architectural elements of traditional architecture. • It is a façade element for traditional houses. • Used in wall and ceilings. • Form wall arches without space. • Wrapped in carved bricks. • Types include. Semicircular Arch ,pointed Arch , Persian arch ,flat arch , . (Mogaveera & Sarangapani, 2016, pp. 01-08) (Memarian, 2021, p. 95) (Zomorshidi, 2017, pp. 9-11)	 Figure 33: view of Taq (Researcher, 2025)
IronBeam_ Brick Console (Konsoli_E_Kheshtin ba Tira Asn)	**Consist of (Iron Beam+ Brick Console)**	 Figure 34: View of Konsoli_E_Kheshtin ba Tira Asn. (Qaradaghi, 2022, p. 343)

Stairs Pile -Pilekan	**"Stairs are crucial components of architectural composition in terms of both aesthetics and spatial arrangement"**	 Figure 35: View of Interior Pilekan (Researcher, 2025)
Orsi window	• Vertical lattice windows with various function. • Decorated with various knot styles and stained glass. (Yekta, 2015, pp. 281-291) • The main parts of Orosi are curved wooden pieces called Kala and Vadar. (Ekhlassi & Rafati, 2015, pp. 01-11)	 Figure 36: View of orosi window (Qaradaghi, 2022, p. 343)
Goljam Shusha rangi	• It is a traditional architectural element, • allowing light to reach the furthest part of the room. (MEMARIAN, 2021, p. 94) • Stained-Glass Panels in Rich Buildings • Used in mansions due to precision. • Small panels placed on top. • Calves used as window capitals. • •Shapes mainly roses and vases. (Tahbaz & Moosavi, 2009, pp. 273-278)	 Figure 37: View of Orosi window (Qaradaghi, 2022, p. 343)
Pacholaghi	• A combination of door and window with the door opening at the bottom and the window at the upper part. (Tahbaz & Moosavi, 2009, pp. 273-278)	 Figure 17: View of Pacholaghi with Goljam (Directorate of heritage of Sulaymaniyah, Archives)

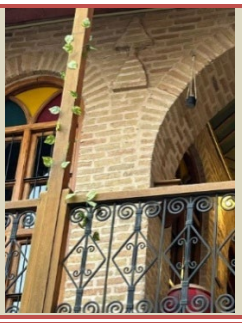
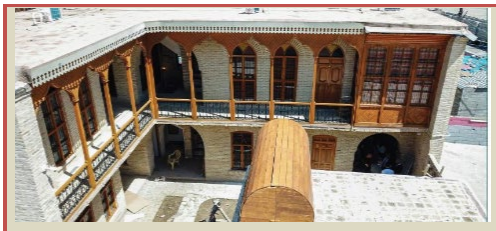
Columns Stûn	• Columns are common in iwans and halls. • Common materials: wooden, stone, brick. (Memarian, 2021, p. 162)	 Figure 38: View of repetition of Stun. (Qaradaghi, 2022, p. 343)
Wooden Arch Taqi Chubi	The wooden arch, a structural and decorative element that connects the columns, is used to create spacious openings with floral decoration. (Maniekhi, et al., 2015, pp. 1-19)	 Figure 39: View of Taqi Dar (Researcher, 2025)
WroughtIron Railing Shashbandi Asni	• Hand Machined Iron, • These are geometric patterns with a high contrast between iron and wood • 90-100 cm high. • a safety barrier on the upper floor porch (EBRAHIMIPOOR, 2008, pp. 10,690)	 Figure 40: View of Shashbandi Asni (Researcher, 2025)
Oriel Window Panjareh Pish-Âmadeh	• **Architectural Elements in Courtyard Façade** • **Breaks flat façade for seating and side views.** • **Reinforces wooden frame with light bricks.** • **Adds protrusion for aesthetic appeal. (Researcher)** • Capture sun movement. • Bring fresh air. (Zulfiqar, 2018, pp. 70-76)	 Figure 41: View of Panjareh pish-âmadeh (Qaradaghi, 2022, p. 341)
Raraw	• It is usually located on the first floor • Interior courtyard view	 Figure 42: View of Raraw in Ali Mam Sheikh's house (Researcher, 2025)

Table 4: Architectural Elements of Ali Mam Shekh's main courtyard-facing facade _The upper level (by researcher)

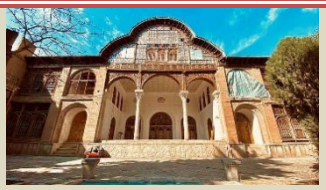
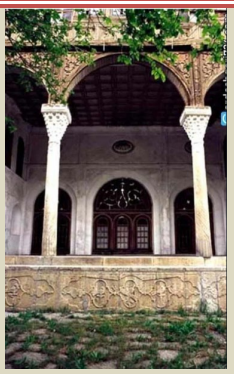
Elements	Description	View
Afriz	• Horizontal Elements in Façade • Used for decorative or structural separation. • Often flat, filled with decoration or writing. (Pirnia, 2007, p. 355)	
		Figure 43: View of Panjareh pish-âmadeh (Researcher, 2025)

Table 5: Architectural Elements of Moshir Diwan's main courtyard-facing facade_ THE bottom level (by researcher)

Elements	Description	View
Stone Dado Azhara SangI	• Lower Façade Stone Strip Cutting • Horizontal rectangular strip. • Method depends on location. • Vertical and horizontal cuts. . (Memarian, 2021, pp. 61,90)	
		Figuer 44:View of main Iwan In Moshir Diwan's mansion (Mahinpoo, 2018)

Table 6: Architectural Elements of Moshir Diwan's main courtyard-facing facade The Middle Level (by researcher)

Elements	Description	View
Iwan	• An important Persian architectural space in houses. • Usually, the highest level of the courtyard, • It was a semi-open area spanning three-sided walls that linked the courtyard to the closed space of the house. • Fronting a three- or five-door room, a long rectangle "Ivan" links it to other areas. (Tazarj, et al., 2016, pp. 1-14)	
		Figure 45: View of the western façade and main terrace of the mansion of Moshir Diwan (TISHINEH, 2018)

Iwan _Cha	• Small Iwan called Iwan Cha, • Adds visual balance to façade • Serves as transitional spaces between inner courtyard and enclosed space. (Pirnia, 2008, p. 102)	 Figure 46: view of North facade and Main façade of Asef Vaziri Mansion (Nazari, 2023)
Pacholaghi	Table 3: Architectural elements of Ali Mam Shekh's main interior façade _ the middle level comprises	
Columns	Table 3: Architectural elements of Ali Mam Shekh's main interior façade _ the middle level comprises	
Tavangan	• It is a local term used in traditional Kurdish architecture, • Crowns of decorative columns, often take the form of Muqarnas • Often made of Wood or stone, and in Every other Often covered by A layer of plaster. (Ekhlassi & Rafati, 2015, pp. 01-11)	 Figure 47: view of north facade and Main façade of Moshir Diwan capital with plaster muqarnas.
Tāq-e Chubi	Table 3: Architectural elements of Ali Mam Shekh's main interior façade _ the middle level comprises	
Monabbat-kāri	• Wood Carving Art • Floral and Islamic Motifs • Adds sophisticated artistic character to façade. (Shamari, 1989, p. 8)	 View 48: North facade and main façade of Moshir Diwan Monabbat-kāri on Tāq-e Chubi (Prince, 2017)

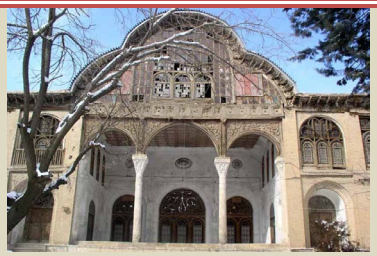
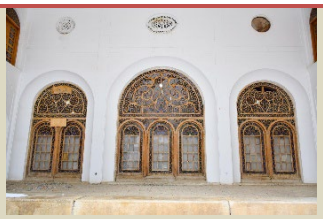
Door-Windows Sadar_ Pangdar	• Tall windows allowing light into house and connecting inside to yard. • Can have three, five, or seven doors. • Used in main and secondary areas, facade, ground floor, or upper floors. • Made from wood and glass (Tahbaz & Moosavi, 2009, pp. 273-278)	 Figure 49: View of west facade and main façade of Moshir Diwan explain Orosi door window (MrBilit, 2022)
Goljam	Table 3: Architectural elements of Ali Mam Shekh's main interior façade _ the middle level comprises	
Orsi window	• Vertical lattice windows with various functions. • Decorated with various knot styles and stained glass. (Yekta, 2015, pp. 281-291) • The main parts of Orosi are curved wooden pieces called Kala and Vadar. (Ekhlassi & Rafati, 2015, pp. 01-11)	 Figure 50: View of Takht Orosi window (Hosseini, 2023)
Tabesh _Band	• A thin strip of glass that keeps the sun from shining directly in the room. (Pirnia, 2007, p. 352) • Placed over door openings or orosi. • Surrounds simple wooden frame. Adds decorative touch. • . (Habib, et al., 2013, pp. 11-20)	 Figure 51: View of Tabesh_Band in the main façade of the Moshir Divan Mansion. (Tourist-attractions, 2017)
Rozan	• Wall Aperture Overview • Opens onto wall, usually on top. • Provides contrast, visual variety, light, shadow, and virtual composition. • Used over arches or brackets. (Habib, et al., 2013, pp. 11-20)	 Figure 52: View of Iwan and main Panjdri and Rozan (Hosseini, 2023)

Table7 Architectural Elements of Moshir Diwan's main *courtyard-facing facade _The uppermost level (by researcher)*

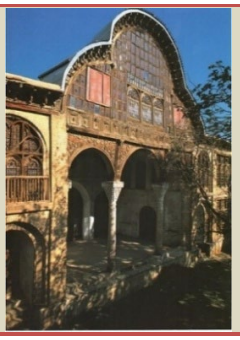
Elements	Description	View
Wooden Cornice Afzir	• Horizontal strip at top of façade. • Used for decorative, structural, and final purposes. • May hide or contain wooden beam. (Pirnia, 2007, p. 350)	 Figure 53: View of Afzir in western façade (Tishineh, 2018)
Timber Eaves Shirsari	• Shirsari: Wooden Cantilever • Can extend up to 80cm • Used during heavy rains (Ekhlassi & Rafati, 2015, pp. 01-11) (Memarian, 2021, p. 96)	 Figure 54: View of Shirsari along the western facade (Hosseini, 2023)
Brick Eaves Rokhbam	• Brick Eaves in Builders • Consolidate terrace border. • Guide rainwater into gutter.	 Figure 55: View of roof that covered by Rokhbam the western facade (Prince, 2017)
Frangi	• Building Component Overview • Crown-shaped dome with inverted arch. • Based on panels above flower-shaped porch. (Pirnia, 2007, p. 356) • Wooden Rooms and Frankish Hats • Main house features wooden room. • Frankish hats popular in late Qajar period. • . (Ekhlassi & Rafati, 2015, pp. 01-11)	 Figure 56: View of Farangi that made of wooden structure (Hosseini, 2023)

Figure 57: Comparison of the architectural composition element- symmetry in the main courtyard-Facing Facade of Ali Mam Sheikh's house - Moshir Diwan's mansion (by researcher)

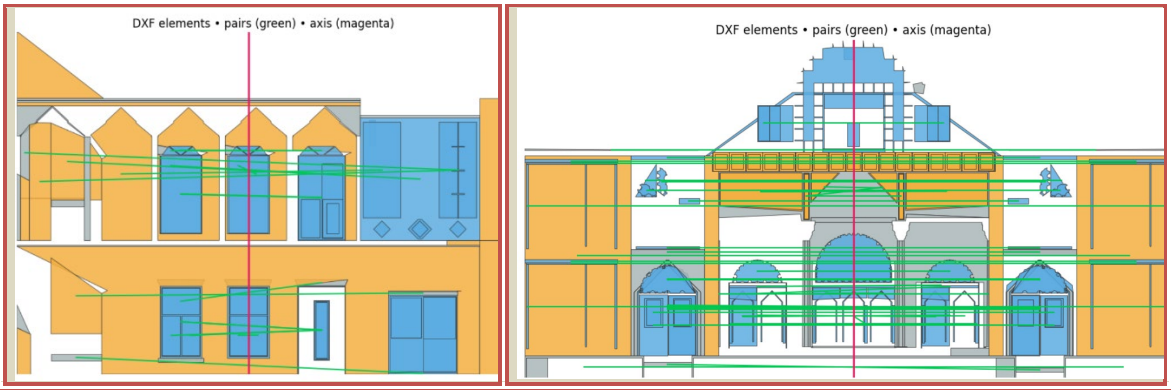


Figure 58: comparison of the architectural composition element- proportion in the main courtyard-facing facade of Ali Mam Sheikh's house - Moshir Diwan's mansion (by researcher)

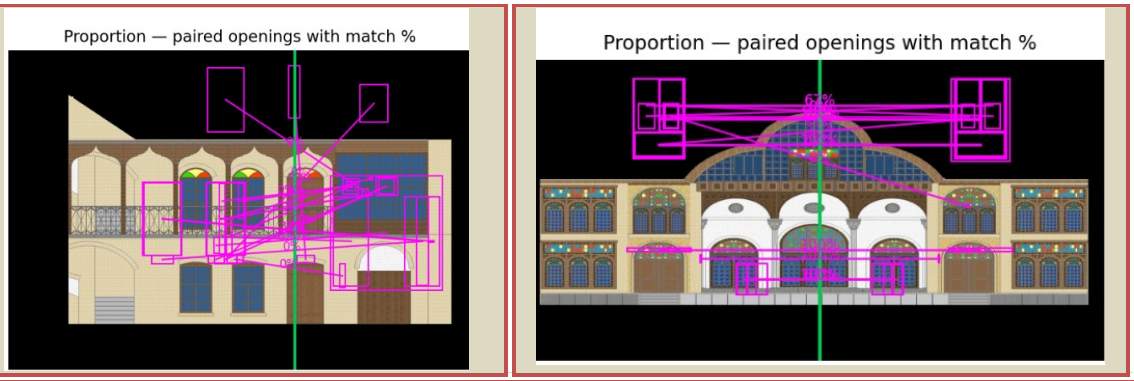


Figure 59: Comparison of the architectural composition element- balance in the main courtyard-facing facade of Ali Mam Sheikh's house - Moshir Diwan's mansion (by researcher)

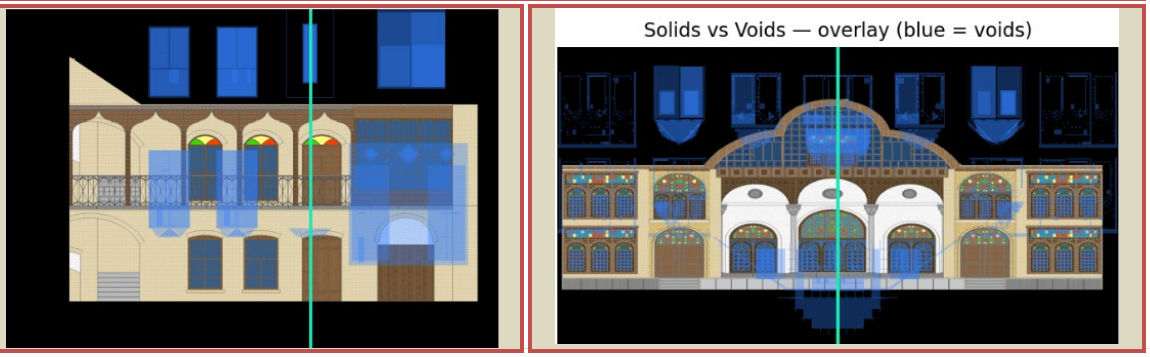


Figure 60: Comparison of the architectural composition element - in the main courtyard-Facing Facade of Ali Mam Sheikh's House - Moshir Diwan's mansion diversifying the decorations (by researcher)

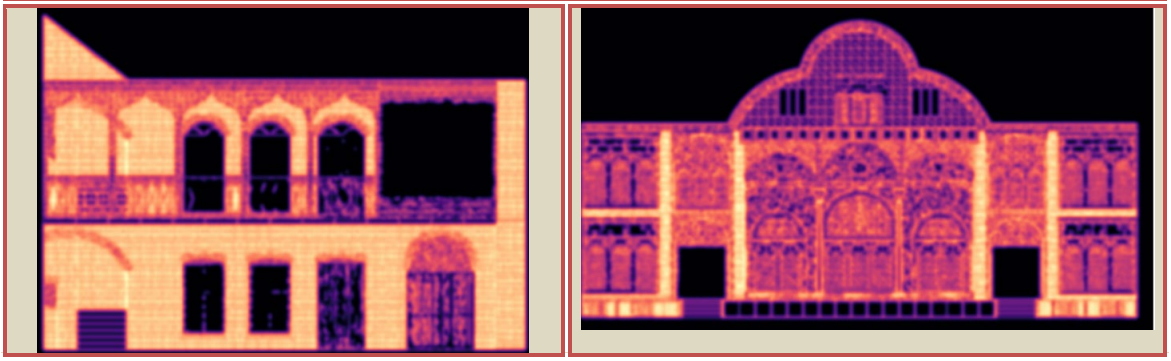


Figure 61: Comparison of the architectural composition element- hierarchy in the main courtyard-facing façades of Ali Mam Sheikh's house - Moshir Diwan's mansion (by researcher)

Figure 62: local perceptual dissimilarity Heatmap of Ali Mam Sheikh's house - Moshir Diwan's mansion (by researcher)

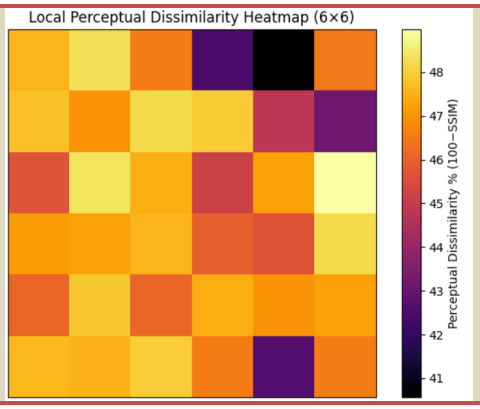


Figure 63: Perceptual difference Proxy of Ali Mam Sheikh's house - Moshir Diwan's mansion (by researcher)

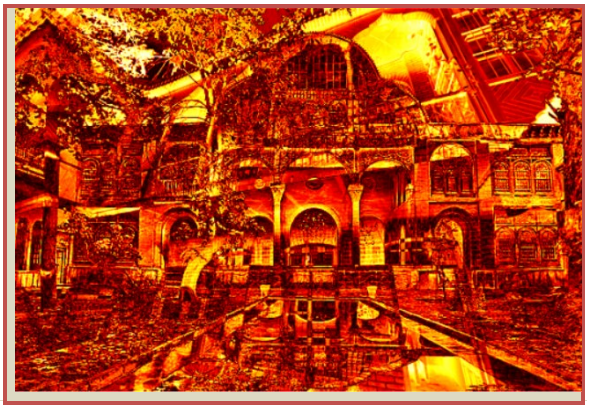


Table 8: Comparison of the architectural composition element - in the main courtyard-facing façades of the house of Ali Mam Sheikh Sulaymaniyah Moshir Diwan's mansion (by researcher)

Elements	Aspects	Sulaimani	Sanandaj	Difference%	Similarity%	Match_Level
Unity %	Repetition _Rhythm	33.90	46.50	٢٤,٤0	75.60	Moderate Match
	Proportion _scale	15.80	56.10			
	Material_ color Harmony	10.50	10.80			
	Alignment_ Axis	35.70	29.70			
	Consistency _ Style_ Language	54.40	55.70			
	Unity _ final	30.10	39.80			
Symmetry %	Axis of symmetry	82.230	90.510	٢١.00	٧٩.00	Moderate Match
	Element Count Symmetry	87.91	97.20			
	Size & Proportion Symmetry	50.88	86.96			
	Shape Matching Symmetry	75.61	87.87			
	Hierarchy Symmetry	58.19	86.76			
	Final Symmetry	70.96	89.86			
Rhythm%	Repetition Of Element	60.0	60.0	7.20	92.80	High Match
	Variation Within Repetition	72.70	82.80			
	Progression	50.00	50.00			
	Spatial Interval	60.00	68.90			
	Rhythm Final	60.70	65.40			
Balance %	Axis _ Distribution	97.50	89.40	24.00	76.00	Moderate Match
	Solid Vs Void _ Balance	88.80	98.70			
	Proportion _ Balance	5.10	60.70			
	Material Color_ Balance	97.80	99.80			
	Ornament_ Balance	45.70	92.40			
	Final Balance	67.00	88.20			
Hierarchy %	Scale	55.00	55.00	16.10	83.90	High Match
	Location	68.36	68.43			
	Contrast	75.85	44.20			
	Ornamentations	13.87	11.27			
	Final hierarchy	53.27	44.72			

Contrast %	Material	23.69	24.87	14.30	85.70	High Match
	color	30.55	38.37			
	Scale/size	55.00	55.00			
	Texture/Ornamentation	27.47	27.57			
	transparency	37.38	57.31			
	Final contrast	34.82	40.63			
Scale%	Human Scale	100.00	92.00	7.40	92.60	High Match
	Hierarchy via Scale	36.90	34.80			
	Final scale	68.45	63.40			
Transparency %	SVR_DXF	13.95	30.59	45.70	54.30	Moderate Match
	SVR_IMG	30.02	44.61			
	SVR_FUSED	17.75	32.69			
OVER ALL %		50.٣٨	58.٠٩	20.00	80.00	Moderate Match

Table 9: Comparison of the material - in the Main Courtyard-Facing Facade of the Ali Mam Sheikh's house & Sulaymaniyah Moshir Diwan's mansion (by researcher)

Type of material	Sulaymanyah Ali Mam Sheikh %	Sanandaj Moshir Diwan %	Difference%	Similarity%	Match_Level%
Wood	53.60	44.64	8.96	83.28	High
Brick	34.65	36.68	2.03	94.47	High
Glass	6.26	9.90	3.64	63.23	Moderate
Stone	1.83	5.85	4.02	31.28	Low
Plaster	1.72	2.92	1.20	58.90	Moderate
Metal	1.49	0.00	1.49	0.00	Low
Rammed Earth	0.43	0.00	0.43	0.00	Low
Over all	99.98	99.99	10.90	82.29	High

Figure 64: Comparison of the type of materials used in the Ali Mam Sheikh's house &Mosher Diwan's mansion (by researcher)

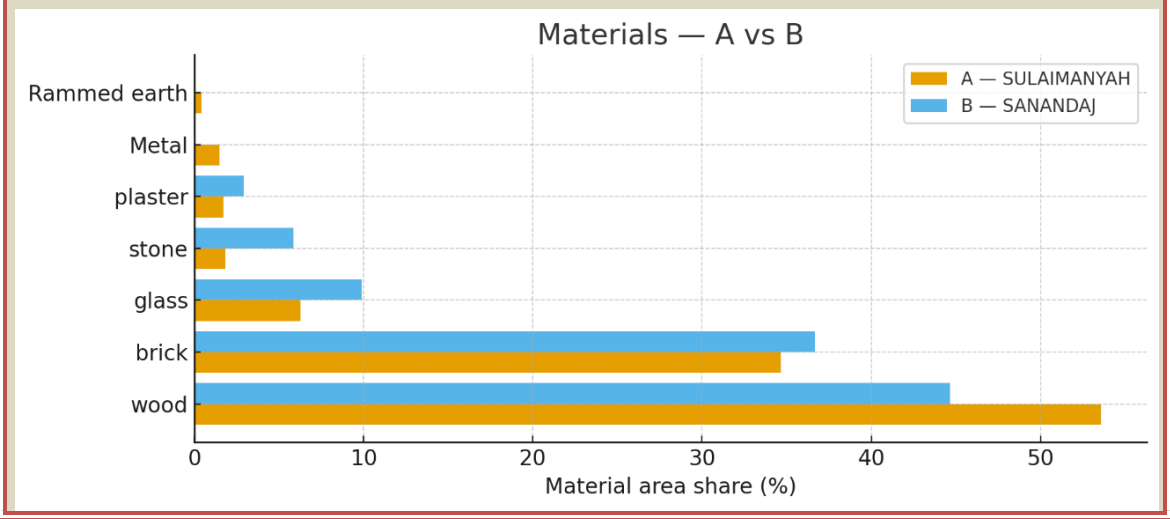


Figure 65: Percentage of similarity and difference in the subjects in the Ali Mam Sheikh's & Moshir Diwan's mansion (by researcher)

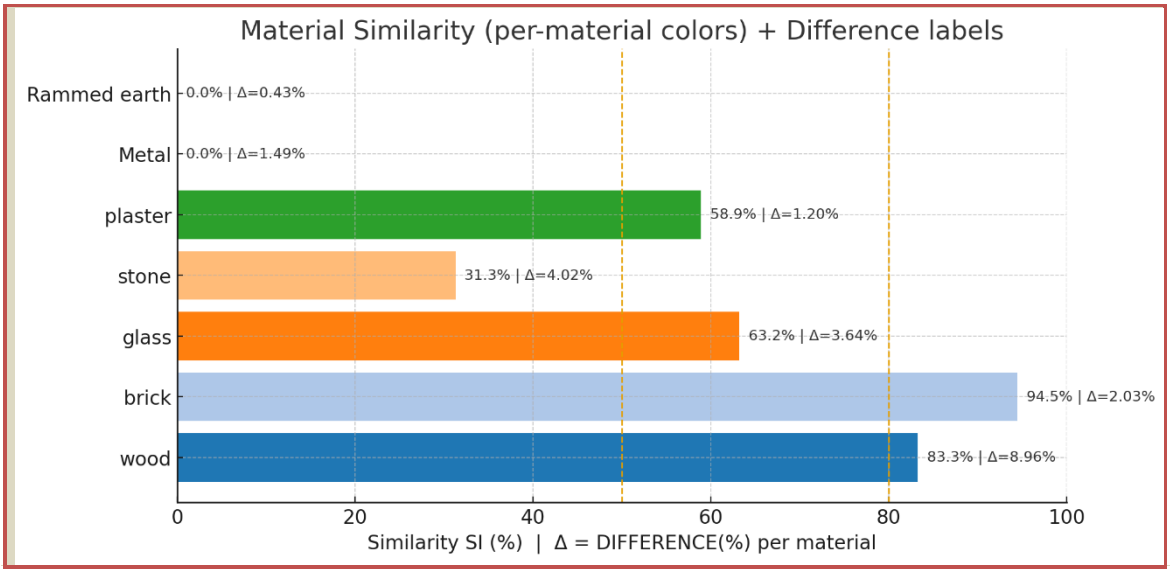


Table 10: The spurious similarity between the Main Courtyard-Facing Facade of Ali Mam Sheikh and Moshir Diwan's house (by researcher)

Metric	Ali Mam Shelh %	Moshir Diwan %	Diffference %	Similarity %
AR_NORM	23.68	23.68	0.00	100.0
SYMMETRY	56.53	52.79	3.74	96.26
SOLID	47.41	43.93	3.48	96.52
VOID	52.59	56.07	3.48	96.52
RHYTHM	100.00	100.00	0.00	100.00
COLOR HARMONY	31.52	17.17	14.39	85.61
OVERALL AVERAGE (UNWEIGHTED) ≈	95.82%			

Table 11: Indicators of perceptual similarity between the Main Courtyard-Facing Facade of Ali Mam Sheikh & Moshir Diwan's mansion (by researcher)

Perceptual Metrics	Value %
PERCEPTUAL SSIM	53.40
PERCEPTUAL MS.SSIM	52.24
GRID SSIM (6*6 MEAN)	53.44
GRID SSIM (SD)	1.83
PERCEPTUAL DISSMILARITY (100_SSIM)	46.60
PERCEPTUAL LPIPS (SIMILARITY %)	17.91
(PERCEPTUAL AVERAGE) ≈	41.18%

Table 12: Perceptual vs Spurious (by researcher)

SSIM	53.4 %
MS-SSIM	52.2 %
GRID-SSIM (MEAN)	53.44 % ± 1.83
DSSIM (100 − SSIM)	46.6 %
LPIPS (SIMILARITY %)	17.9 %
SPURIOUS SIMILARITY (RAW AVG.)	95.8 %
GAP (PERCEPTUAL VS SPURIOUS)	54.6 %