Preserving Tradition, Embracing Innovation Mohsen Foroughi's Maison de'lIran

Iranian architecture has left its mark on world history, with its influence reaching the farthest corners of Europe through the creation of Byzantine architecture. The traditional architecture of Iran, as described by Professor Pirnia, is built upon five principles. These principles highlight the evolution of Iranian civilization over time. Mohsen Foroughi, an exemplary Iranian architect, has skillfully merged the essence of Iranian architecture with contemporary ideals, exemplified by his masterpiece, the "Maison de l'Iran" in Paris, designed in a modern style. In this study, we aimed to explore how Foroughi incorporated these five principles of Iranian architecture into his project in France. Employing a descriptive and analytical method, we assessed the physical and structural components of Iranian architecture, examining how Foroughi's work aligns with the principles and values of Iranian architecture. Our findings demonstrate that Foroughi is in line with traditional Iranian architectural values, contextual materials, and climate-friendly design in his works. Furthermore, Foroughi's expertise in Statics, Material Studies, and Structural techniques sciences enabled him to successfully execute large-scale projects. The Maison de l'Iran exemplifies his understanding of modern styles while honoring the principles of Iranian architecture. His work has been instrumental in shaping modern Iranian architecture, reflecting his artistic creativity and inspiration from Iran's architectural heritage.

Keywords: *Mohsen Foroughi, Maison de l'Iran, Iranian Architecture, Principle, Pirnia*

Introduction

The architecture of Iran has left an indelible mark on the world, with its rich history of monumental structures that span vast geographical areas. From its inception, Persian architecture has embraced a wide range of styles, incorporating diverse materials and techniques to create magnificent buildings that exude a sense of unity and coherence. Despite the various architectural expressions, Persian architecture has maintained its fundamental principles throughout the centuries.

One notable architectural gem that exemplifies these principles is designed by Mohsen Foroughi. Although limited research has been conducted on this specific subject, it offers valuable insights into the application of Iran architectural principles in contemporary design. The aim of this study is to explore the architectural principles employed and their alignment with the concepts previously discussed by renowned architect Prof. Pirnia.[1]. While they may embody a multitude of architectural principles highlighted by him, the principle that

[1]The late Mohammad-Karim Pirnia, a renowned scholar in the history of Iranian architecture, pioneered the application of contemporary language and knowledge to study ancient architectural structures. His notable works include the Glossary of traditional architecture, architectural stylistics, and Principles of Iranian Architecture.

significantly stands out in Foroughi's design is the technology of structure, which can be considered one of the core principles emphasized by Professor Pirnia.

Persian architecture, throughout its history, has exhibited remarkable versatility, adopting various styles and structures. From imposing stone buildings with square footprints to graceful brick structures with circular plans, Persian architecture has demonstrated its ability to adapt to diverse architectural forms. Furthermore, it has pioneered the creation of underground waterworks as well as soaring towers that seemingly reach the heavens. Yet, amidst this diversity, the coherence of Persian architecture has always been maintained, preserving its virtues and expressing them harmoniously according to the relevant styles and demands of each era (Hejazi et al., 2015).

The enduring nature of Persian architecture is evident in its emphasis on longevity and permanence. The architecture of Iran has continually developed innovative methods and techniques to construct buildings that stand the test of time. These historical structures represent the epitome of advanced structural engineering, embodying a myriad of yet-to-be-unveiled mysteries that hold the potential to illuminate the principles of sound design and correct engineering. Rooted in a gradual and thoughtful evolution, the architecture of Iran has been established upon subtle foundations, giving rise to a more authentic and enduring expression. Serves as a contemporary testament to this architectural legacy.

By delving into the architectural principles employed, this study seeks to shed light on the unique characteristics of Persian architecture and contribute to a deeper understanding of its timeless principles. Through this exploration, we aim to uncover the significance of the technology of structure as a prominent principle evident in Foroughi's design, bridging the gap in existing research and expanding our knowledge of Iran's architectural heritage.

Methodology

Literature Review: A comprehensive review of existing literature on Iranian architecture, architectural principles, and the specific principles mentioned by Prof. Pirnia and specially Mohsen Foroughi's works are conducted. This includes academic journals, books, research papers, and reputable online sources.

Comparative Analysis: Visual materials, such as photographs, drawings, and architectural plans, are collected and analyzed. A comparative analysis is conducted to identify the architectural features and principles employed in the design and construction of the building.

Expert Interviews: Interviews are conducted with architectural experts, historians, or individuals knowledgeable in Iranian architecture. These interviews provide insights, interpretations, and expert opinions on the architectural principles employed, particularly the technology of structure.

Data Analysis: The collected data from the literature review, comparative analysis, and expert interviews are analyzed and synthesized. Patterns, trends, and relationships related to architectural principles are identified and interpreted.

The findings of this research provide a comprehensive understanding of the architectural principles employed in Mohsen Foroughi's, specifically focusing on the technology of structure.

Iranian Architecture: Exploring Time, Culture, and Identity

The country of Iran, historically known as the "Land of the Aryans," has its roots in the arrival of the Aryans on the Iranian plateau approximately 10,000 years ago (Haerizadeh et al., 2022; Pope & Ackerman, 1938), although human culture in the region dates back 100,000 years (Haerizadeh et al., 2022; Vahdati Nasab, 2020). Persia once encompassed a vast territory extending from Northern Africa and Eastern Greece to Western China (Grant & Banks, 1976). With a land area of 1.648 million km2 and an estimated population of 87,923,432 million (World Bank Open Data, 2022), Iran is the second-largest country in the Middle East after Saudi Arabia. Iran's geographical features result in a wide range of climates, from cold to hot-arid (Misra, 2022). It stretches from the Caspian Sea in the north to the Persian Gulf in the south and from Turkey and Iraq in the west to Afghanistan and Pakistan in the east. Iranian architecture has had a profound and enduring influence for over 3,000 years, characterized by its interactions with various cultures and traditions. This architectural heritage has spread across vast regions, spanning from the Far East to the Near East (Hejazi et al., 2015).

Architecture embodies life itself, focusing on the creation of spaces rather than mere forms. Space is temporal as we move through it, while time becomes spatial through our construction of space. Moments, captured through drawings, photos, and recordings, reflect the small events that occur within the context of space and time. These spaces, according to Lefebvre, are like everyday life—trivial yet omnipresent, encompassing sustenance, clothing, homes, and neighborhoods, with a dramatic and lyrical essence. Everyday life, structured by time and space, follows daily routines, work and leisure patterns, and repetitive gestures of commuting and consumption (Lee & Park, 2015).

Iran's traditional architecture showcases a rich heritage spanning centuries, characterized by intricate geometric patterns, vibrant colors, and harmonious integration with nature. It reflects the cultural, social, and historical influences that have shaped Iran's architectural identity. In the traditional architecture of Iran and, based on geographical location, bio-ecology, climate, and by choosing a special roof type, the exposure of the exterior surface was reduced to direct sunlight, creating a shade in accordance with the climate of each region, windcatcher, cellar, central courtyard and windows facing the sun is faced to the environment to gain the best comfort in interior spaces without making use of polluting facilities. In other words, the ancestors of this territory were completely aware of passive solar systems and always used this functional method (Kasmaei, 2003; Shahamat, 2014). Besides, performance and functional ability have been very important in designing and constructing buildings. It has been tried to avoid creating unutilized space, and in detail, the whole space was engaged for a special function(Pirnia & Memarian, 2007; Shahamat, 2014).

According to Pirnia (2005), a prominent scholar of the traditional architecture of Iran, traditional architecture is based on five principles: 1- "Introversion," 2- "Autonomy," 3- “Human- conformity," 4- “structure and Modulation” 5- “Purposefulness” (Pirnia & Memarian, 2007; Shahamat, 2014).

Principles of Iran's Traditional Architecture

Identification of the Principles of Iranian Architecture is one of the two prominent achievements of Pirnia (Qayyoomi Bidhendi & Abdollahzadeh, 2014).

Human Scale (mardumvârî) Mardumvari, a principle emphasized by Pirnia, encompasses the idea of designing buildings in harmony with human scale and proportions. Pirnia learned this principle from skilled Iranian traditional architects who emphasized the importance of creating structures that are mardum-vãr, or "like humans". Human-Scale architecture considers both human values and social interactions, as well as individual human characteristics. It prioritizes facilitating human behavior and addressing human needs in an appropriate manner. This people-oriented approach serves as the foundation for the other four principles, highlighting its significance in architectural design (Naderi et al., 2012; Qayyoomi Bidhendi & Abdollahzadeh, 2014).

Inward-Looking (Darûngerāyī) Structures vary in their orientation toward open and closed spaces. Some are inward-looking, resembling reticular cages in open areas, while others bring the outside view inside by situating open spaces within enclosed areas (Qayyoomi Bidhendi & Abdollahzadeh, 2014). The presence of introversion is prominently demonstrated in traditional Iranian houses with central courtyards, leading observers to initially associate introversion solely with this architectural feature while labeling other expressions as non-introverted or extroverted. However, upon deeper examination, exploring the literal meaning of introversion across various disciplines and architectural examples reveals two fundamental aspects: introversion and seclusion. This inclination towards "inside" and "privacy" finds its physical manifestation in the central courtyard or other architectural forms, depending on how the boundary between interior and exterior spaces is defined (Naderi et al., 2012).

Self Sufficiency (khudbasandagī) Self-sufficiency, along with introversion and the avoidance of wastefulness, prioritizes utilizing available resources and reflects the cultural values and practicality of people. While it applies to both design and construction, its effectiveness is particularly notable in the construction field(Naderi et al., 2012). Iranian architects made concerted efforts to obtain construction materials from nearby sources, aiming for self-sufficiency. They emphasized the use of domestically sourced materials and local facilities in order to expedite construction, enhance the structure's integration with the surrounding environment, and ensure easy access to materials for future repairs (Qayyoomi Bidhendi & Abdollahzadeh, 2014).

Avoiding Non-essentials (parhīz az bīhudagī) After the emergence of Islam, Iranian artisans and architects strived to execute their work with utmost excellence. They were steadfast in avoiding any futile actions or the use of

insignificant materials, even in prominent structures. Unlike in other regions where arts like stonecutting and painting were considered decorative, in Iranian architecture, they served a purpose beyond ornamentation. Every element had to exist and possess quality. For instance, tiling a dome from top to bottom wasn't solely for decorative purposes; these tiles were also waterproof and heatproof. Colorful patterned tiles were employed to conceal imperfections that might arise after repairs, as monochromatic tiles would be difficult to restore to their original condition. Mosaic tiles (Murray) were used as replacements and repairs (Qayyoomi Bidhendi & Abdollahzadeh, 2014).

Structural Rigidity (niyārish) "Structural Rigidity," also known as Homogeneous Proportion, pertains to the structural integrity and stability of a building. It encompasses the scientific principles and techniques employed to ensure the structure's resistance, stability, and cohesion. This concept encompasses three key areas: Statics, which involves structural analysis, force calculations, and stability assessment; Material Studies, which focus on the selection and use of appropriate building materials such as plasters and mortars; and structural techniques, which encompass the execution and constructional elements of the building. Iranian architects emphasized Structural Rigidity, prioritizing technical aspects, vaulting, and construction details, unlike their European counterparts. This emphasis on structural rationality ensured stability and contributed to the overall aesthetic beauty of Iranian architecture. In Iranian art and architecture, beauty is not merely about superficial prettiness but rather the harmonious alignment of elements, symmetry, and the proper placement of every component(Naderi et al., 2012).

Mohsen Foroughi

Mohsen Foroughi (1907–1983), who holds the distinction of being the first Iranian graduate of the École des Beaux-Arts, played a significant role in the professionalization of architecture in Iran (Akhgar & Moulis, 2021). With his close personal ties to the Pahlavi dynasty as the son of Mohammad Ali Foroughi, the first prime minister of Reza Shah, Foroughi emerged as one of the most influential architects in Iran during a time when architecture was undergoing professional development. He played a crucial role in fostering the relationship between Iran and the West, introducing Modern architecture to Iran and elevating the status of Iranian architecture on the global stage (Maragheh & Örmecioğlu, 2021; Tarkalam, 2022).

The notion of the architect as an educated individual, trained in a European architectural institution rather than acquiring knowledge through practical experience, was introduced to Iran during the reign of Reza Shah Pahlavi (1926–1941). In 1938, formal architectural education began in Iran, following the model of European university training. Given the prevalent position of French experts in Iranian archaeology and the French language's dominance in modern learning in Iran since the mid-nineteenth century, it was natural for the École des Beaux-Arts

to play a significant role in modernizing architectural education in Iran (Akhgar & Moulis, 2021).

Mohsen Foroughi played a significant role as an architect, undertaking various projects for the National Monuments Council of Iran, including the design of the mausoleums of Saʿdī in Shiraz and Bābā Ṭāher in Hamadan, the Ministry of Finance and a series of buildings for the National Bank (Bank-e melli) in Tehran's bāzār, and branches in Shiraz, Isfahan, and Tabriz (Tarkalam, 2022).

Additionally, Foroughi made significant contributions to residential architecture by designing numerous private residences and villas in Tehran. His innovative approach embraced a distinctively modern style, revolutionizing the traditional spatial division based on private and public spheres of life. Instead, he introduced a new western floor plan that emphasized functionality, with functional rooms replacing the conventional layout. This pioneering approach set a new pattern for residential design, reshaping the architectural landscape of Tehran (Marefat, 1988).

He also collaborated with architects Godard, Siroux, and Dubrul on the master plan and buildings for the University of Tehran, including the Department of Law and Political Science (Moghaddasi et al., 2020). Throughout his extensive and illustrious career spanning more than four decades, Mohsen Foroughi collaborated with several renowned Persian architects, including Ali Ṣadegh, Kayqobad Ẓafar, and later with Heydar Ḡīāʾī. Together, they contributed to the architectural landscape with their collective expertise and shared passion for design and construction. Their collaborative efforts left a lasting impact on the architectural heritage of Iran. As a modernist architect, he held a deep admiration for Iranian cultural values and emerged as one of the prominent architects during the final years of Reza Shah's rule. In 1948, the Iran Architect Journal described Foroughi as a highly esteemed architect who contributed significantly to the architectural developments of the country with passion and dedication. Notably, Foroughi emphasized functionality and sustainability in his architectural approach (Maragheh & Örmecioğlu, 2021).

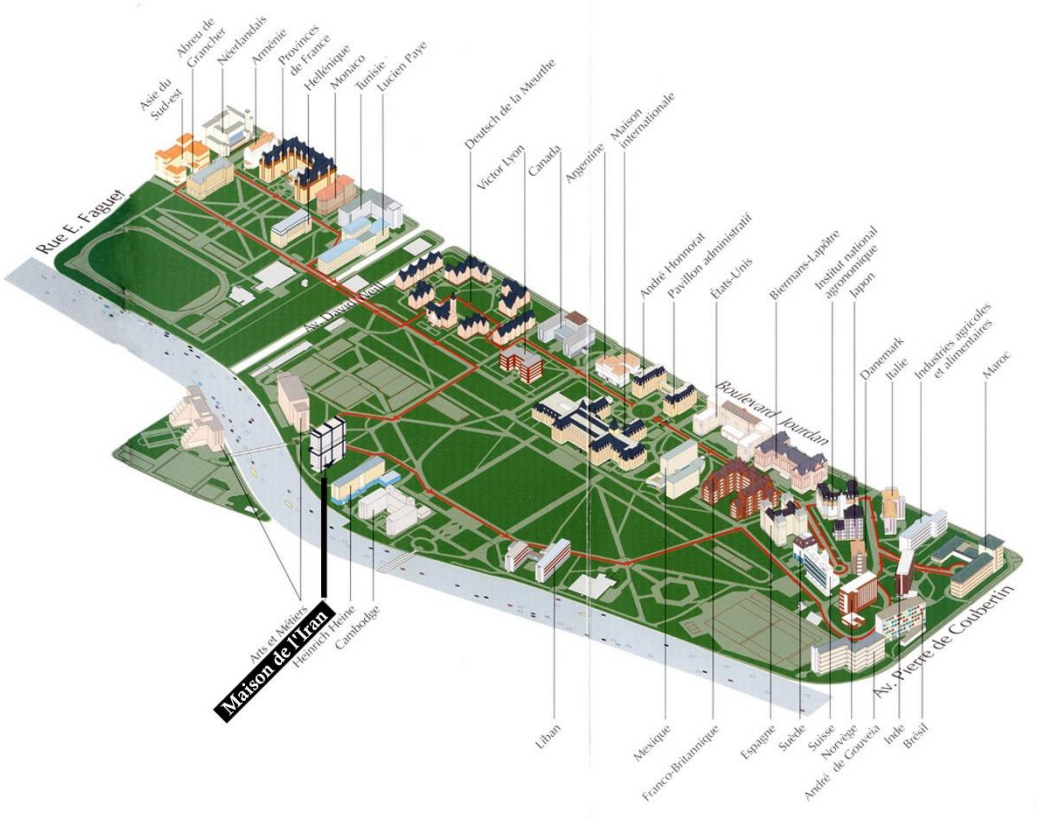
Foroughi's impact as an architect extended beyond his architectural designs. His most significant contribution may lie in his efforts to advance architecture as a recognized profession. He played a pivotal role in establishing the first school of architecture, the Society of Persian Professional Architects (Anjoman-e aršītekthā-ye īrānī-ye dīploma), and was instrumental in the founding of Architecte, Persia's inaugural professional journal dedicated to architecture. Furthermore, his esteemed reputation led to his appointment as a foreign corresponding member of the renowned Académie des Beaux-Arts, an honor he held for the final sixteen years of his life. Through his pioneering initiatives and prestigious affiliations, Foroughi significantly contributed to the professionalization and recognition of architecture in Iran (Gillet & David-Weill, 1983).

Maison de l'Iran

Located in the picturesque Cité Internationale Universitaire[2] In Paris, it stands as the final addition to a collection of student residences constructed by various countries between 1925 and 1968. Notable pavilions within the campus include the renowned works of architects such as Le Corbusier for Switzerland and Brazil, as well as Dudok for the Netherlands (Zeinstra, 2014).

In the early 1960s, during Farah Diba[3]'s tenure, the initiative to construct a student building in Paris for Iranian students was entrusted to a team of architects, including Claude Parent, André Bloc, Mohsen Foroughi, and Heydar Ghiai (Moghaddasi et al., 2020). This collaboration resulted in the creation of the Avicenne Foundation[4], formerly known as Iran House, which stands as the final addition to the Cité internationale following the post-World War II construction boom.

Figure 1. *Cité Internationale Universitaire de Paris*



Source: http://journals.openedition.org/insitu/docannexe/image/855/img-1.jpg

[2]The Cité internationale universitaire de Paris (CiuP) is a collection of university residences located in the 14th arrondissement of Paris, between Porte de Gentilly and Porte d'Orléans. Established as a foundation under private law, it has been recognized as being of public utility since June 6, 1925, by decree.

[3]Farah Diba (Pahlavi) is the widow of the last king of Iran, Mohammad Reza Pahlavi, and was successively Queen and Empress of Iran from 1959 to 1979.

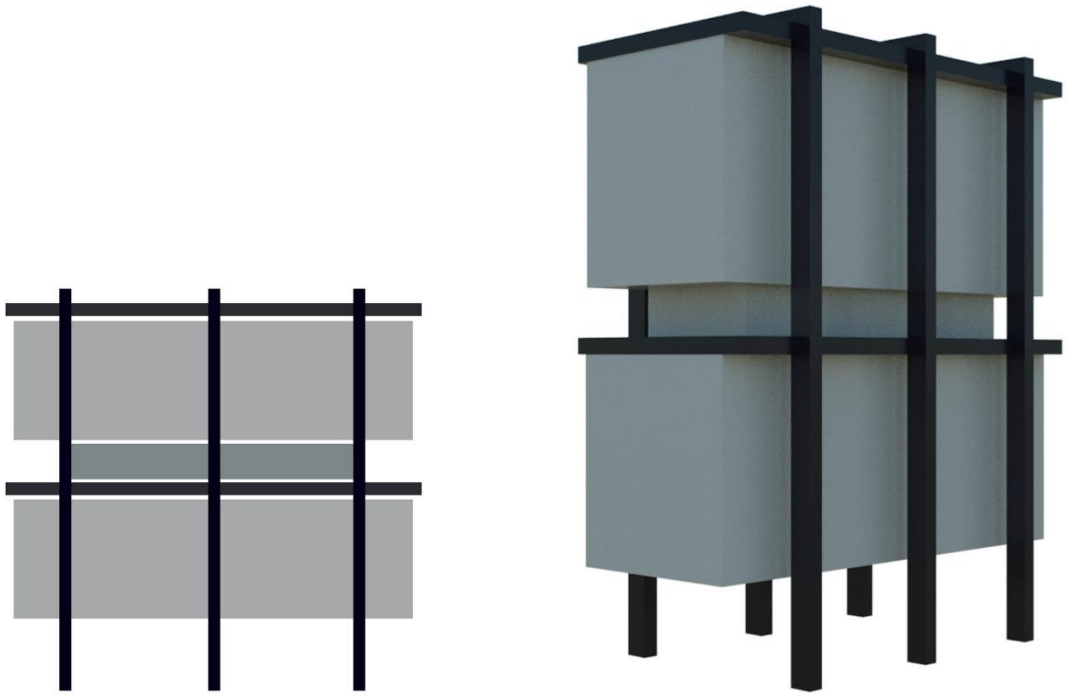
[4]The Avicenne Foundation, previously known as Maison de l'Iran or Iran House,

According to Pierre Merlin, student accommodation construction in France was limited until 1955. However, in the subsequent decade, during the height of intensive construction for student housing, university buildings, and facilities, more than 60% of the current rooms were built. The period from 1950 to 1960 witnessed ongoing discussions, including the International Student Housing Congress held at the Cité internationale universitaire de Paris and the influence of the events of May 1968, which challenged traditional notions of student housing. Prior to this time, separate staircases for girls and boys were still present in some residences. To address the high demand, early solutions focused on standardized and industrialized buildings. For instance, the Jean Zay residence in Antony (architect Eugène Beaudouin) was registered under the "Industrialized Sector" of the Ministry of Reconstruction and Urban Planning in 1954. These buildings often took the form of bars or towers located on the outskirts of the city, where land was more affordable. The rooms, mostly individual, had basic equipment and a minimum area of 9 m2 per person. Toilet facilities were often communal and located on each floor (Marantz & Méchine, 2016). Furthermore, Foroughi was advised to prioritize a simpler and cost-effective approach to the construction process, emphasizing economic functionality. The consideration of operating expenses, which reflected the financial management of the buildings, was an implicit imperative. This was despite the primary responsibility for funding being placed on the donor country (Marantz & Méchine, 2016).

The student flat's architectural composition comprises three towering steel portals, reaching an impressive height of 38 meters and adorned in a sleek matte black finish. Within these portals, two volumes are suspended above each other, accommodating the student rooms. The façades of these volumes reveal a deliberate design approach: on the west side, the light-grey façade slabs create a solid barrier, shielding the rooms from the bustling traffic noise of Boulevard Périphérique.[5]. On the east side, the rooms' glass fronts are slightly set back, adorned with balcony strips. The floor plans of the volumes are simple, featuring 12 student rooms on each level along a corridor, with centrally located sanitary facilities and lifts. An open space between the two volumes houses the warden's apartment and four guest rooms, designed with setbacks and staggered façades to accentuate the contrast with the standardized room arrangement. Positioned in a rotated configuration on the ground floor, the communal area and entrance are housed in two volumes, punctuated by the imposing columns of the tower. This thoughtful layout maximizes functionality and creates visual interest within the overall architectural composition of the student flat (Zeinstra, 2014).

[5]The Boulevard Périphérique, often called the Périph, is a controlled-access dual-carriageway ring road in Paris, France.

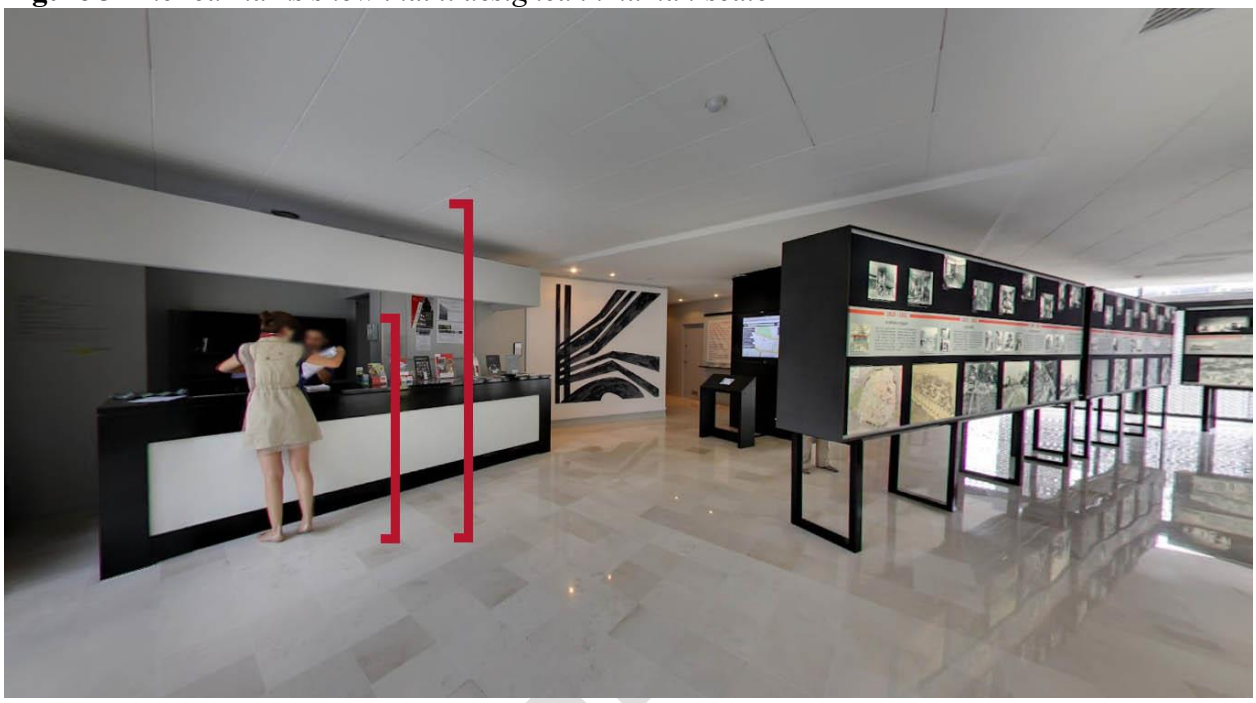
Figure 2. *Schematic view of design*



Source: Sketched by Author

Mohsen Foroughi's profound expertise in the fields of Statics, Material Studies, and Structure Techniques sciences played a pivotal role in successfully managing the construction of the monumental structure. His comprehensive understanding of these disciplines enabled him to effectively analyze and apply the principles of static forces, material properties, and construction techniques, ensuring the stability and functionality of the project. In addition to his technical knowledge, Foroughi also leveraged Iran's rich architectural heritage and indigenous technology. By drawing upon traditional Iranian architecture techniques, he incorporated elements that had been developed and refined over centuries. These techniques encompassed a deep understanding of local materials, construction methods, and design principles that were intrinsic to Iran's architectural traditions.

Figure 3. *The red marks show that it designed in human-scale*



Source: Image from Google map, Lines by Author

The history of technology in Iran provides insights into the evolution and development of these architectural techniques. Over time, Iranian architects and builders adapted to the regional climate, available resources, and cultural preferences, resulting in the creation of unique architectural solutions. From the ancient civilizations of Persia to the Islamic era and beyond, Iran's architectural technology evolved in response to various influences and advancements. Foroughi's utilization of Iran's architecture technology showcases his appreciation for the country's rich heritage and his ability to incorporate traditional wisdom into modern construction practices. By combining his scientific knowledge with indigenous techniques, he not only achieved structural excellence but also preserved and celebrated Iran's architectural legacy.

In summary, Foroughi's proficiency in Statics, Material Studies, and Structure Techniques sciences, coupled with his integration of Iran's architecture technology, allowed him to successfully manage the construction of a large-scale structure. His approach demonstrates the significance of combining scientific principles with the wisdom of historical architectural practices, resulting in a remarkable fusion of innovation and cultural heritage.

Iranian Architectural Technology

Technology is widely recognized as a vital component of progress and industrial development in all nations. An essential gauge of industrial advancement lies in the construction techniques and technological innovations employed in building construction (Haerizadeh et al., 2022). In Iranian architecture, the

integration of design, execution, and material was paramount. Architects did not work on separate stages but rather had to consider them simultaneously. This harmony was achieved through the use of "Homogeneous Proportions" (paymun), a set of guidelines ensuring that the various elements of the structure were proportionate to each other. Paymun was based on tested ratios derived from the experience that guided the design and construction of the architecture and materials. Iranian architects believed in the power of proportions over precise numbers and sizes, as they had proven to be suitable and reliable. These proportions, known as paymûn, encompassed the relationships between different elements such as corridor lengths, arch spans, and entrance sizes. It is within this framework of paymun that the concept of Structural Rigidity was embedded, representing the overall rationale of the architecture, including the choice of building materials and people's living needs. An architect's understanding of these proportions was a testament to their talent and skill in architecture. This approach allowed even an inexperienced bricklayer in a remote village to construct a small dome with the same stability and beauty as a master architect from a bustling city. The focus on paymun ensured that designs were efficient, stable, practical, and aesthetically pleasing, irrespective of the builder's expertise or location (Taghizadeh, 2011).

Structural Technology in Iranian Architecture

The remaining constructions from ancient Iran represent invaluable works that showcase the rich architectural heritage of the region. Through an examination of traditional Iranian architecture alongside significant architectural contributions from around the world, a harmonious relationship between structure and design becomes evident, emphasizing their inseparable nature. It is virtually impossible to separate the architectural and structural elements from one another, as they have emerged together based on form, space, geometry, and proportional considerations. The spaces created within these works reflect human influence and align with the architect's intentions. The intelligent utilization of arches and domes in traditional Iranian architecture exemplifies a thoughtful approach to creating architectural spaces. The application and advancement of dome architecture have been instrumental in shaping Iranian craftsmanship and have garnered significant appreciation and recognition (Mehdi, 1984; Taghizadeh, 2011). Despite the lack of advanced engineering techniques during the 11th century AD, engineers and builders demonstrated remarkable intuition and experimentation in developing static forms with a deep understanding of construction principles (Mehdi, 1984; Taghizadeh, 2011). Some of the notable innovations in this regard include truss roofs, diagonal roofs, movable roofs, vaults, arches, domes, vaulting without forming, squinches, and square domes (Chahartaq[6]), all of which highlight the ingenuity of Iranian architects and builders in addressing structural considerations (Taghizadeh, 2011).

[6]Chahartaq was a prominent element in Iranian architecture, having various functions and used in both secular and religious contexts for 1,500 years

Integrating Architecture and Structure

In historic Iranian architecture, the relationship between architectural design and structure is inseparable, with the structure serving as an integral part of the design. The structural elements are intricately intertwined with the architectural elements, creating a unified and harmonious composition. The use of materials and decorative forms is integrated into the structural design, enhancing the authenticity and integrity of the buildings. Examples from different periods, such as the Khaki dome of the Jame Mosque and the Vakil Bath in Kerman, showcase the genius of craftsmen and the meticulous construction techniques employed. The Seljuk and Timurid periods are particularly noteworthy for their integration of architectural design, structure, and technology, resulting in valuable and admired works. These examples highlight the delicate brickwork and abstract geometry that contribute to the overall spatial experience (Taghizadeh, 2011).

A Historical Journey

To understand the origins and development of technology in Iran, we must glimpse some periods' rich history as a sample. So we just mentioned the era Seventh Millennium BC, Achaemenid, Sassanid, and Pahlavi. Iran has been a land of great civilizations with a cultural heritage spanning thousands of years. Throughout its history, Iranian society has made significant contributions to various fields, including architecture and technology.

The architectural styles of ancient Iran, spanning over 3-4 thousand years, have left a lasting impact on various civilizations. From the Elamites to the Achaemenids, Parthians, and Sassanids, each period produced a magnificent architecture that has influenced and been embraced by diverse cultures throughout history. Despite the destruction Iran has faced, such as the burning of Persepolis by Alexander the Great, there are still enough remnants to piece together a glimpse of its classical architecture. The architectural achievements of the Elamites, Achaemenids, Parthians, and Sassanids have transcended time and geography, leaving a profound legacy that continues to resonate in other cultures (Taghizadeh, 2011).

Insights from the Seventh Millennium BC

Iranians have accumulated thousands of years of experience and witnessed significant transformations during this period, despite occasional stagnation in the development process. The earliest human settlements on the Iranian plateau date back approximately 9,000 years. These structures featured mud walls, showcasing irregular geometry and undefined architectural spaces (Matthews & Nashli, 2022).

In the sixth millennium BC, significant advancements were made with the introduction of larger mud bricks. The production process for mud bricks also evolved, gradually incorporating materials like straw. The clay production process continued to develop in the fifth millennium BC, as seen in Tepe Yahya (Kerman).

Mud bricks from this era exhibit distinct fingerprints and a certain level of order. This period also saw the emergence of light load-bearing walls, particularly in central Iran (Fars), where niches were used in interior walls. Moving into the fourth millennium BC, mud bricks became smaller and began to resemble the size of contemporary bricks. This standardization in size and geometry allowed for greater control over the architectural components. Notably, a geometric revolution took place in the third millennium BC, with the Burnt City showcasing regular geometry in its load-bearing walls and architectural spaces (Matthews & Nashli, 2022; Taghizadeh, 2011).

Throughout the second millennium BC, sites such as Hasanlu and Bastam demonstrate further developments in geometric design. During this period, individual buildings underwent changes in scale and function to cater to local communities to accommodate larger spaces, structural bays were significantly expanded, and materials like mud bricks, wood, and stone were utilized in the construction of load-bearing walls, columns, and other elements. These innovations led to the creation of complex structural systems. From this period onward, buildings grew in size and scale. The prevalence of stone and mud as construction materials during the first millennium AD, which was also used as mortar in the seventh millennium BC, contributed to the massiveness of architectural structures (Edwards, 1973; Taghizadeh, 2011).

These findings shed light on the continuous evolution of Iranian architecture over thousands of years, offering valuable insights into the use of materials, structural design, and the development of architectural techniques.

Exploring the Interplay of Structure and Architecture in Achaemenid Buildings

The Achaemenid clan, led by Cyrus in the 6th century BCE, established the Achaemenid Empire after overthrowing the Median ruler. The Achaemenians, renowned architects and geometers in Iranian history, demonstrated advanced knowledge of pure mathematics and engineering. Analysis of structures such as columns and conical forms at Persepolis reveals that the Achaemenians utilized p-value, a mathematical concept, approximately 2500 years before mathematicians. They understood the secret of p-value and successfully applied it in constructing conical masse (Kharazmi & Sarhangi, 2013).

Incorporating elements from Assyrian and Egyptian architecture, the Achaemenids blended different architectural traditions into their designs. They utilized materials and craftsmen from different parts of the empire, employing mud bricks, stone, and cedar from Lebanon. The structural system of Achaemenid buildings employed a combination of materials for walls, columns, and beams, considering their specific properties. The connection between these elements was achieved through notches, grooves, and stone clamps, ensuring mechanical stability and efficient distribution of forces (Dahlén, 2020; Ebrahimi & Aliabadi, 2015).

Columns played a vital role in supporting the structure and defining the architectural spaces. They consisted of piers, bodies, and capitals, contributing to the overall aesthetic and functional aspects of the design. The integration of

architectural considerations and appropriate materials resulted in resilient and cohesive spaces. Removing these elements would not only lead to structural collapse but also disrupt the spatial composition and the relationship between the interior and exterior environments(Dahlén, 2020; Taghizadeh, 2011). Achaemenid architecture emphasized verticality and incorporated symbolic elements of continuity. Columns were pivotal in defining and articulating space, serving as a connection between the structure and its surroundings. They provided a visual and physical anchor, establishing a sense of harmony and unity within the architectural composition (Oranskiĭ et al., 1977).

Overall, the Achaemenid era exemplifies the integration of structure and architecture in Iranian design, where the choice of materials, construction techniques, and spatial organization work in harmony to create enduring and meaningful architectural spaces.

Sassanid Architecture: Innovation and Symbolism in Persian Design

On the rise of the Sassanid dynasty, a national government was established, leading to significant artistic changes by drawing inspiration from Achaemenian art and incorporating influences from the Roman and Greek civilizations in Iran (Ghirshman, 1961). The Sassanid art introduced elaborate geometrical structures, intricate rhythms with various motifs, and central symmetry, which had a profound impact on the architectural changes in subsequent empires, particularly in the geometrical motifs of Islamic architecture (Kharazmi et al., 2012).

In Sassanid architecture, the dome played a significant role, employing specific techniques derived from Iranian architecture. The construction of domes on square bases involved a process of tightening four conical three-cornered elements at the corners of the square, gradually transforming it into an octagon and then a multilateral shape with corners closely resembling a circle. This unique approach can be observed in structures such as the central porch of the Kasra Palace, which follows specific ratios in its dimensions (Bemanian et al., 2011; Taghizadeh, 2011).

One of the distinctive characteristics of Sassanid architecture was its exceptional use of space. Architects conceptualized buildings in terms of geometric masses and surfaces, resulting in massive brick walls adorned with molded or carved stucco decorations (Taghizadeh, 2011).

Pahlavi era and starting of technology

According to Ebrahimi and Islami (2019), the architecture and urban developments in any country reflect its social, political, and cultural background. Understanding the concepts and significant events that shape architectural styles in each period is crucial. Historical, cultural, economic, social, and environmental contexts play a significant role in the formation of architectural works (Haerizadeh et al., 2022). During the Pahlavi II era, which spanned from the 1340s to the 1350s, Iranian-educated architects, both those who studied abroad and graduates of Tehran University, played a pivotal role in promoting modern architecture (Haerizadeh et al., 2022; Mohammadi & Ebrahimi, 2018). This period witnessed a rapid transformation towards modernity, characterized by the adoption of modern

technologies, changes in building materials, and the utilization of new materials in architecture (Haerizadeh et al., 2022). The consequences caused by the increase in oil prices and the increase in national income in this period also had significant effects on architecture and urban planning. The acceleration of economic growth played a pivotal role in the formation of modern architecture in Tehran(Bani Masoud, 2009; Ghobadian, 2013; Khatami & Boujari, 2022; Sabatsani, 2013)

The influence of modern architecture was particularly pronounced in the second Pahlavi period, where advancements in technology and the industrialization of architecture further propelled the movement toward modern architectural practices (Haerizadeh et al., 2022).

Conclusion

In conclusion, Mohsen Foroughi's architectural works exemplify the successful fusion of traditional Iranian architectural values, contemporary design principles, and advanced scientific knowledge. By prioritizing elements such as privacy, contextual materials, and climate-friendly design, Foroughi stays true to the essence of Iranian architecture while incorporating modern influences.

While Foroughi's designs may deviate from the traditional introversion found in Iranian houses, he maintains a harmonious balance between the proportions of the building's elements and the needs of its occupants. This demonstrates his understanding of the human aspect of architecture and his ability to create spaces that are functional and visually appealing.

Moreover, Foroughi's expertise in Statics, Material Studies, and Structure Techniques sciences is evident in the successful execution of his architectural projects. His deep understanding of these disciplines allows him to navigate the complexities of constructing large-scale structures, ensuring their stability and longevity.

The Maison de l'Iran serves as a prime example of Foroughi's ability to blend the principles of Iranian architecture with contemporary design concepts. By considering the characteristics of modern architectural styles while remaining faithful to the core principles of Iranian architecture, Foroughi produces valuable works that harmoniously blend tradition and innovation.

Furthermore, Foroughi's appreciation for Iran's architectural heritage and indigenous technology is reflected in his designs. By incorporating traditional Iranian techniques and materials, he pays homage to the country's rich architectural legacy while adapting it to modern construction practices. This demonstrates Foroughi's commitment to preserving and celebrating Iran's architectural heritage.

In summary, Mohsen Foroughi's architectural achievements highlight his exceptional talent, scientific knowledge, and dedication to merging the spirit of Iranian architecture with contemporary ideas. His designs not only contribute to the architectural landscape of Iran and European countries but also serve as a bridge between tradition and innovation, leaving a lasting legacy in the field of architecture.

Reference

Akhgar P Moulis A (2021) The legacy of the École des Beaux-Arts in twentieth-century Iran: the architecture of Mohsen Foroughi. *The Journal of Architecture* 26(7) 945-968.

Bani Masoud A (2009) Contemporary architecture of Iran. *Publication of Honar va Memari gharb*. Tehran (In persian)

Bemanian M, Okhovat H, Baghaei P (2011) Applications of geometry and proportion in architecture. *Tehran: Hlh Press in collaboration with publishing Than* (Persian ed).

Dahlén A (2020) Achaemenid Anatolia: Persian Presence and Impact in the Western Satrapies 546–330 BC Proceedings of an International Symposium at the Swedish Research Institute in Istanbul 7–8 September 2017. *Acta Universitatis Upsaliensis*.

Ebrahimi A N, Aliabadi M (2015) The role of mathematics and geometry in formation of Persian architecture. *Asian Culture and History* 7(1) 220.

Ebrahimi S, Islami S G (2009) Architecture and urban planning of Iran in the transition period *City identity* 4(6) 3-14.

Edwards I E S, Hammond N G L, Sollberger Edmond (1973) History of the Middle East and the Aegean region, c. 1800-1380 BC / edited by I.E.S. Edwards, N.G.L. Hammond, E. Sollberger. *Cambridge: At the University Press.Ghirshman* R (1961) Iran: from the earliest times the to Islamic conquest (3rd ed., Cambridge ancient history; v. 2, pt. 1).

Ghobadian V (2013) Styles and Concepts in Iranian Contemporary Architecture. *Elme memar publication Tehran*.

Gillet G, David-Weill M (1983) Discours prononcés dans la séance publique tenue par l'Académie des beaux-arts présidée par M Guillaume Gillet président de l'Académie le mercredi 27 avril 1983 pour la réception de M Michel David-Weill: élu membre de la Section des membres libres en remplacement de M Bernard Gavoty. *Institut de France*.

Grant M, Banks A (1976) Ancient history atlas: [1700 BC to AD 565]. *Weidenfeld & Nicolson*.

Haerizadeh S M Sadegh, Sana'i A (2022) Investigating and analyzing the role of technology in the progress of building construction in the architecture of the second Pahlavi period. *Green Architecture Quarterly* 8.

Hejazi M Hejazi B & Hejazi S (2015) Evolution of Persian traditional architecture through the history. *Journal of architecture and urbanism* 39(3) 188-207.

Kasmaei M (2003) Climate and architecture. *Soil publication*.Esfahan Iran 210.

Kharazmi M, Sarhangi R (2013) Geometric Analysis of Forumad Mosques' Ornament. *Proceedings of Bridges 2013: Mathematics Music Art Architecture Culture*.

Kharazmi M Afhami R & Tavoosi M (2012) A Study of Practical Geometry in Sassanid Stucco Ornament in Ancient Persia. *Persian Architecture and Mathematics* 227-250.

Khatami S M, Boujari P (2022) Analyzing the heritage of Tehran's urban façades in the recent century. *City Territory and Architecture* 9(1) 1-15.

Lee M -S & Park Y (2015) The Courtyard as a Microcosm of Everyday Life and Social Interaction. *Architectural Research* 17(2) 65-74.

Maragheh F G, Örmecioğlu H T (2021) The Spaces of Finance in Iran and Turkey at the Beginning of the 20th Century: The Cases of Melli Bank the Sepah Bank Turkish Central Bank and the Ziraat Bank. *İran Çalışmaları Dergisi* 5(2) 393-425.

Marantz E, Méchine S (2016) Construire l'université Architectures universitaires à Paris et en Île-de-France (1945-2000). *Publications de la Sorbonne*.

Marefat M (1988) Building to power: architecture of Tehran. *Architecture Thesis of University MIT* 1921-1941.

Matthews R, Nashli H F (2022) The archaeology of Iran from the Palaeolithic to the Achaemenid Empire. *Taylor & Francis*

Mehdi F (1984) History of Engineering in Iran. *Gooyesh and Bonyad Nieshabour Publication*.

Misra M (2022) Traditional architecture in Iran. *Taylor & Francis* Vol 79 pp 181-186.

Moghaddasi A Moghaddasi M H, Hosein K (2020) MOHSEN FOROUGHI (1907-1983): THOUGHTS AND SUSTAINABILITY IN THE WORKS OF AN IRANIAN MODERNIST ARCHITECT. *Architecture and Engineering* 5(4) 28-34.

Mohammadi I & Ebrahimi H (2018) Examining the contemporary architectural buildings of the Second Pahlavi and its impact on the current architecture formation process. *International Conference on Civil Engineering Architecture and Urban Development Management in Iran* https://civilica com/doc/847318.

Naderi N Nadimi H, Jadidi A (2012) Denial proof or reflection? Pyrenees and verification of principles of Iranian architecture. *Soffeh* 59(22) 15-24.

Oranskiĭ I M Blau J, Lazard G (1977) Les langues iraniennes. *C Klincksieck*

Pirnia M K, Memarian G H (2007) Stylistics of Iranian architecture. *Soroush Danesh Publication.* Tehran: Ed: Gholam Hossein Memarian

Rice D (1960) Theodore Besterman (comp.): A survey of Persian art from prehistoric times to the present. Arthur Upham Pope, editor, Phyllis Ackerman, assistant editor. Index volume, [v], 136 pp. London, etc.: *Oxford University Press* 1958. 35s. *Bulletin of the School of Oriental and African Studies* 23(2) 399-399. doi:10.1017/S00419 77X00150074Qayyoomi.

Bidhendi M, Abdollahzadeh M M (2014) Architecture Land and Man Rereading reviewing and criticism of Pirnia's suggested principles for Iranian architecture. *Kimiya-ye-Honar* 3(11) 72-99.

Sabatsani N (2013) Investigation of Effective Factors of Iranian Contemporary Architecture (1961-1978). *Armanshahr Architecture & Urban Development* (11).

Shahamat H (2014) Formal sustainability in traditional architecture of Iran according to five principles of traditional architecture of Iran. *Journal of applied environmental and biological sciences* 4(1) 100-110.

Taghizadeh K (2011) An investigation of historical structures in Iranian ancient architecture. *Architecture Research* 1 (1) 1-7.

Tarkalam G (2022) Morphological and space features in Iranian Modern architecture Mohsen Foroughi's Melli banks. *Dromos magazine online gallery*. Italy.

Vahdati Nasab H (2020) Carton Coon's Riddle: Anthropologist Archaeologist or CIA Agent? (Critical Review of Carlton Stevens Coon's Methodology and Publications in the Iranian Paleolithic Archaeology). *Pizhuhish/nāmah-i intiqādī-i mutūn va barnāmah/hā-yi ʿulūm-i insāni (Critical Studies in Texts & Programs of Human Sciences)* 20(6) 349-373.

World Bank Open Data (2022) Population growth (annual %) - Iran Islamic rep. *https://data worldbank org/indicator/SP POP GROW?locations=IR*

Zeinstra J (2014) Paris: Claude Parent André Bloc Moshen Foroughi & Heydar Ghiaï-Chamlou DASH. *Delft Architectural Studies on Housing*(10) 132-139.