

## Extracting the design principles of contemporary roadside service complexes using the architectural model of historical Iranian caravanserais

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### Detailed abstract

#### Introduction

Iranian caravanserais are a valuable legacy of the rich civilization and architecture of this land that have been formed and evolved over centuries along trade and communication routes (Farshchi and Hajizamani, 2019). As midway stations, caravanserais, in terms of form and function, have fundamental differences from inner-city caravanserais and follow a specific and unique architectural pattern. The flourishing of Iranian caravanserais during the Safavid period was due to the establishment of security, the expansion of communications with European countries and India by land or sea, and the development of domestic and foreign trade (Hosseini and Naghizadeh, 2016). During this period, Shah Abbas I (1588–1629 AD) ordered the construction of a network of caravanserais throughout the country, which is said to have reached 999 caravanserais (Ayvazian, 2010). Iranian caravanserais were registered as the twenty-seventh Iranian site on the UNESCO World Heritage List in 2023. This file includes 54 caravanserais, among which a wide range of architectural styles, adaptation to climatic conditions, and building materials can be observed (Ayvazian, 1379). Main research question: Can the architectural pattern used in roadside caravanserais be used to reach the design principles of Iranian roadside complexes so that the identity and authenticity used in the caravanserais can be expressed in a new form? Main objective: Analyzing the architectural pattern of nine of Iran's leading roadside caravanserais and examining their similarities and differences within the framework of the dominant architectural pattern of Iranian caravanserais is the main objective of the research. Applied objective: Extracting design principles for roadside service complexes, based on the architectural patterns of historical caravanserais, is the applied objective of the research. The climatic diversity of the selected caravanserais (from the central desert to the northern foothills) provides the opportunity to study the impact of climate on the architectural patterns of these buildings.

#### Materials and Methods

The present study is qualitative in nature, descriptive-analytical in purpose and historical-comparative in nature. This study uses a comparative case study approach and the Delphi Method to examine and analyze the architectural patterns of Iranian roadside caravanserais. The steps of implementing the Delphi Method in this study are presented in Table 1. The expert panel of this study consisted of 15

experts, including university professors (history of Iranian architecture), researchers of Islamic architecture, restoration architects (Cultural Heritage Organization), and holders of a PhD in Iranian architecture with 10 to 18 years of experience. The experts were selected based on their research background, expertise in Iranian architecture, university teaching experience, and professional experience in the field of restoration and traditional architecture. The questionnaire consisted of 32 questions in the first round and 24 questions in the second round. The criteria for the end of the Delphi process were achieving a Kendall agreement coefficient (W) of 0.85 and the stability of the responses in two consecutive rounds.

The results of three rounds of Delphi implementation led to the selection of 9 final caravanserais, which are presented in Table 2. These 9 caravanserais are the statistical population of this research. The average final score is 4.51 out of 5 and the agreement coefficient of the Delphi panel (Kendall's W) is equal to 0.85, which indicates a significant agreement of the experts at a significance level of 0.05 with a degree of freedom of 14, and the reliability and validity of the research is advanced. The caravanserais that were selected using the Delphi method are: Qasr Bahram Caravansary, Shah Abbasi Caravansary of Neyshabur, Aminabad Caravansary of Isfahan, Zein al-Din Caravansary, Tajabad Caravansary of Hamedan, Shah Abbasi Caravansary of Meybod, Robat Sharaf Caravansary, Deir Gachin Caravansary and TT Caravansary of Siahkal, which have been physically analyzed.

## Findings

By examining the samples, it can be seen that the four-bayan pattern is the dominant pattern of Iranian roadside caravanserais. In addition to the four-bayan and two-bayan patterns (TT Caravansary) and the four-bayan pattern with a central four-arch (such as Deir Gachin Caravansary), the circular pattern (such as Zein al-Din and Tajabad Caravansary) and the octagonal pattern (such as Aminabad Caravansary) are also observed in Iranian roadside caravanserais. The two-aisled pattern is one of the lesser-known but important patterns in the architecture of Iranian caravanserais, which is mainly observed in the cold and mountainous climate of northern Iran (Gilan and Mazandaran regions) (Cultural Heritage Organization, 1999). For example, the ratio of the length to the width of the courtyard in the Robat Sharaf caravanserais is 1.618, which is equal to the golden ratio. This ratio in the Deir Gachin caravanserais is 1.382, which is almost the golden ratio. These ratios indicate the deep knowledge of Iranian architects in using geometry in designing caravanserais (Taheri, 2019). An examination of the results shows that out of the nine caravanserais studied, six caravanserais (67 percent) follow the four-aisled pattern or its derivatives. The circular pattern with a frequency of 22% in the caravanserais of Zain al-Din, Taj Abad is next in order. Iranian caravanserais can be divided into three categories in terms of geometry: perfect square, golden rectangle, and circular or octagonal geometry. On the other hand, the factors affecting the diversity of architectural patterns include climatic factors, security factors, functional factors, communication and trade routes, historical period, and available materials. Today, on Iranian roads, roadside service complexes mainly lack Iranian architectural identity and are

built more like Western examples or without a specific design. Based on the climatic range of the location of Iran's leading caravanserais, four main climatic zones can be introduced for the design of roadside service complexes, including hot and dry climate (central desert), cold and mountainous climate (north and west), temperate and semi-desert climate and cold, windy foothill climate. Based on the studies of selected caravanserais, the physical plan of roadside service complexes has been proposed in three sections: public service and welfare spaces, residential and rest spaces, and vehicle service spaces. Finally, solutions can be found to design a welfare service complex with an Iranian-Islamic model. In addition, utilizing the climatic patterns of caravanserais can significantly reduce energy consumption in roadside complexes.

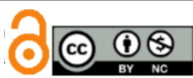
### Discussion and Conclusion

A study of nine of Iran's leading caravanserais, selected using the Delphi method and with the participation of 15 Iranian architectural experts, shows the dominance of the four-bay pattern (67 percent of caravanserais follow the four-bay pattern or its derivatives). In addition, the TT caravanserais (two-bay), Zeyn al-Din and Tajabad (circular), Aminabad (octagonal), and Deir Gachin (central square) exhibit rare patterns that demonstrate innovation and creativity in the caravanserais pattern. Comparing the TT caravanserais in (northern climate) with desert caravanserais shows that climate is one of the most important factors determining the caravanserais pattern. This study showed that the architectural patterns of historical Iranian caravanserais can be the basis for the design of contemporary roadside service complexes. Accordingly, the four-porch pattern with a central courtyard is recommended for hot and dry climates (central desert), the two-porch pattern with a compact courtyard for cold and mountainous climates (north and west), and the modified four-porch pattern for temperate climates and the circular pattern for cold, windy areas. The suggestions of this research include the conservation and restoration of caravanserais while maintaining historical authenticity, the functional revival of caravanserais as traditional residences and cultural centers, the use of the findings of this research in the design of Iranian roadside service complexes, further research on caravanserais in different climates, and the documentation of caravanserais for future conservation and research. Today, with the registration of Iranian caravanserais on the UNESCO World Heritage List, it seems more necessary to pay attention to the conservation and restoration of this valuable heritage with a sustainable tourism development approach. But beyond conservation, utilizing the knowledge hidden in these buildings to solve contemporary architectural problems (such as designing roadside service complexes) can be a new approach in Iranian architectural research. Therefore, the main innovation of the present research is in transforming the physical features of historical caravanserais into principles that can be used in contemporary architecture, in such a way that components such as the central courtyard, peripheral organization, climate adaptation, and the use of local materials are translated into the language of today's architecture.

### Declarations

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**Keywords :** Interstate Caravanserai, Iranian architecture, four-porch pattern, comparative study, Interstate Service Complex.



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