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# Overview of the parameters affecting physical sustainability (case study: Esfahani style)

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ABSTRACT

Sustainability refers to a concept which has been widely evaluated in recent years, affirming the development and continuity over the time. Sustainability can be examined at all the aspects of life and architecture, so that physical sustainability of architecture has been regarded as an aspect which has not been evaluated in the architecture. Physical sustainability refers to the continuity and survival of building as well as accountability based on the *addressee*'s needs and interests over the time. Recognition of factors affecting the physical sustainability of the buildings which have remained sustainable can assist us in exploiting from the parameters which provide the physical sustainability. The present research has aimed to evaluate and recognize the factors affecting physical sustainability in Iran via descriptive-analytic method and evaluation of the buildings with Esfahani style which are accounted as the sustainable samples in Iranian architecture.

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## Sustainable development .

Esfahani style,

Keywor ds

Aesthetic,

## Introduction

Dehkhoda has described sustainability as durability and permanence (Dehkhoda, p. 47). The current meaning of the term "sustainability" which has been represented here implies what can be continued in future. The term "sustainability" has been originated from the term "sustain" which means protection, continuity and survival.

This sustainability encompasses all the aspects associated to development of human life; further sustainable development refers to an architecture which can maintain its sustainability without damaging to the future over the time. This development encompasses all the dimensions of architecture including structure, energy, body and so forth, yet what has been constantly drawn into attention in energy crises and environmental awareness at the 1970s has included the exploitation from sustainable materials and sustainability of energy and what has been examined in the present research has included physical sustainability, i.e. the sustainable architecture which has been remained unknown. A quick look into the most beautiful cities in the long lost past informs us that such cities have still sustained alive. This feeling is not an ambiguity, but is an accurate image from the special structural quality which has existed in these cities, yet such thing cannot be true in most of contemporary cities. On the other hand, it cannot reconstruct most of buildings by the passage of years, and this difficulty comes to realize due to the destructions which occur in the body of building, or lack of harmony between the body of building and the current conditions in today's world undergoing the changing styles; in this regard, several buildings have still existed by the passage of time which have maintained their value and accountability. Through overview of the samples which have been witnessed with physical sustainability, the present research has aimed to detect the indicators which have resulted in sustainability, so as to acquire the approaches for design of the buildings with sustainable bodies. Accordingly, responding to physical sustainability including the identitybased factors and assisting social sustainability and saving

energy, power, time and consumption materials for construction of new buildings can assist the sustainable development at the area of energy. For this, Esfahani era which is one of the most significant periods of time at which Iranian architecture prevailed was considered as the case study.

## **Research method**

The present research has been considered as an applied research type, in which the analytic-descriptive and qualitative methods and case study have been used, and the research method has been grounded on the qualitative method and logical reasoning. Further, documentary and library study has developed the origin of elaboration, analysis, description and interpretation of the existing contents in this article. For this, firstly interpretation and analysis of the nature of sustainability, physical sustainability and parameters of physical sustainability are considered. With retrospect to prevailing qualitative data and variables, the research hypotheses are examined using qualitative method with inductive approach, qualitative analysis of variable, analysis of articles, interviews and questionnaires, and ultimately the conclusion is represented. To increase accuracy at work, the case study has been used, and architecture "Esfahani style" at Safavid era has been selected as the pattern. Further, it should be noted that architecture "Esfahani style" has been considered as variable sustainability.

## Definition of form and body in architecture

The architecture space emerges in case the architecture had granted a special form to the mass and material which are the material cause. According to Sheikh Zein al-Din, any architecture work requires for two aspects as follows:

1-the concepts of issues which have no material and tangible aspect

2-the contents and characteristics which have been totally tangible and measureable

The first aspect represents a qualitative attitude, under which the architecture work is examined in the aesthetic or psychological aspects such as majesty, induction and so forth.

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The second aspect represents a quantitative attitude which draws attention into the tangible and applied aspects. Materials, functional features, technology sizes and proportions are the prevailing subjects in this study(*Sheikh Zein al-Din*, 1989, p. 167).

According to the definitions for form, form enjoys a structural aspect and a structural aspect, thus the form can refer to the tangible and material aspect of an architecture and also to the intangible aspect of it, that is, tangible aspect refers to the constituent elements and components of an architecture, and intangible aspect refers to the relationship between the components and how such a relationship comes to realize. If we define the building or an architecture work as a system, this will imply a series of components with a mutual relationship with each other, thereby it must state that the form can refer to the material components and the relationship between the components which assist for survival of the architecture.

## Physical sustainability

Sustainable architecture can be conveyed as the living architecture, and living space depends on the sense of life, living addressees and their close relationship with space. A space in which people have not had sense of living and have not made relationship with it, condemns the man to death (Golabchi, Zeinali, 2012, p. 1). To avoid collapse and destruction of an architecture work by the passage of time, a large group of addressees must be attracted to it in order that it sustains on *over* the past *millennium* in the memories and nostalgias (Golabchi, Zeinali, 2012, p. 1).

In general, physical system implies how to organize the form of building via proper materials, using visual and aesthetic relationship, developing rhythm and harmony in the form and façade of building, displaying the systematic architecture (Noghrehkar, 2008, p. 368). Physical system implies a fundamental system in the architecture which includes: functional system, structural system and physical system, so that this has been proposed with the principle of Vitruvius concerning architecture, i.e. utility, sustainability and beauty, mentioned that the physical system is in correspondence to the beauty(Noghrehkar, 2008, p. 367). Hence, with regard to the aforementioned definitions and comparison of the architecture systems concerning principle of Vitruvius, it can perceive that most of the factors affecting physical sustainability include those factors which cause beauty and attractiveness of architecture work to the addressee. Another factor which causes attractiveness of architecture work includes exploitation from the fundamental sustainable patterns. Increasing communities' information on the green issues influenced of carbon pollution has not been manifested in an integrative form in the aesthetic issues.

The present research represents a reflection of the previous studies by the architects, designers and planners who have displayed the green aesthetic; a series of parameters were obtained by overview of these works and proposed issues in this context, and in following the extent to which these factors influenced the buildings was measured by evaluation of case studies.

## Overview of the case studies

Pirnia house: The Pirnia traditional house which was constructed in the Safavid Period represents a perfect example of the desert houses in this region in terms of architecture and art. At the time this house was constructed, it consisted of all of the facilities that a lord's house needed to have, an exterior, an interior, a deep garden, a silo room. It can arrive at an octagonal room called "hashti" — which used to be a waiting room for

clients and visitors — if we enter the house and pass the first corridor. The living room has been decorated via beautiful paintings, amazing plasterwork of Qur'anic stories, a book of famous poems and exquisite calligraphy. In beginning, a judge of Na'in lived there; later, during the Qajar Period, the house belonged to a governor of Na'in. Ultimately, the house was purchased by the Ministry of Culture and Art just a few decades ago. The house was converted into the desert ethnology museum after renovation in 1994.



Kasemdeh house is a building located in the district around Emamzadeh Abdollah, and the history of this building dates back to Safavid era.



Bridge		Tomb		Bathroom		Mosque		House		Factors associated to physical sustainability				
Cheshmeh bridge	Khaju Bridge	Mir bozorg Marashi's shrine	Sheikh Safi al-Din tomb	Boran bath	Ganjali Khan bath	Farah Abad Sari Mosque	Shah Mosque	Kasemdeh house	Pirnia house					
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## Overview of physical sustainability in case studies

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#### Shah Mosque

Shah Mosque (Masjed-e Shāh) is a mosque in Isfahan. This mosque which is on the south side of Naghsh-i Jahan square, has been renamed to Imam Mosque after the Islamic Revolution. This building which represents an excellent example of the Islamic architecture of Iran was built during the Safavid period. In point of view of a majority of people, this mosque has been assumed as the masterpiece of Persian Architecture. The Imam Mosque of Esfahan is one of the perfect masterpieces of architecture in Iran and throughout the world. It is registered as a UNESCO World Heritage Site along with the Naghsh-i Jahan Square. Shah Mosque was constructed in 1611, in which sevencolor mosaic tiles and calligraphic inscriptions have been mainly used, granted a majesty and beauty to it. The height of the port in this mosque roughly equals to 27 meters. On top of this mosque, there are two minarets 42 meters which are tall. The mosque is surrounded with four iwans and arcades. Seven-color mosaic tile has been used to decorate the walls at this mosque. The iwan which is 33 meters high across the qibla is the most magnificent iwan at this mosque. Behind the mosque, there is a space which is roofed with the largest dome in the city at 52 meters height. The dome is double layered. An amusing interest for many visitors can be the reflections at the central point under the dome. Further, there are two seminaries at the southwest and southeast sections of the mosque.



#### Farah Abad Sari Mosque

This historical mosque of Imam Hassan Mojtaba(AS) well known with Farah Abad Sari Mosque has been regarded as a part in historical collection of Farah Abad belonging to Safavid age in Sari.The building was constructed in 1025 AH. This mosque which has been built via brick and mortar is located in a rectangular-form ground by the dimensions 65\*75. The building has been built in form of four iwans, consisting of a large entrance at the southern side of the Shabestan mosque with curved arches on the brick columns. One-storey chambers are considered around the yard to train the seminarians, that major iwan of the mosque with large dome has been located at the southern side of this mosque in which mihrab is located. There are two big Shabestan around two sides of iwan. The dome at southern Shabestan has been covered via brick. According to the maps of building, it seems that the dome has undergone repairs.



## Ganjali Khan bath

Ganjali Khan bath has been decorated with arches, tile and plaster and also paintings. The bath consists of two sections named as, cloak room and the hot bath itself, in which the entrance has been painted with ornaments of the Safavid era, and its architectural facets were performed by Ostad Mohammad Sultan Yazdi(Ghayoumi, 1999, pp. 47-53). As the sculptured stones of the ceiling coincide with that of the flooring, this can be the most interesting feature of its architectural finish. The cloak room of the bath has been divided into six sections. Currently in each one of these sections, two statues portray this scene. The main bath comprises a ceiling similar to that of a tent supported by eight beautiful pillars. Its water inlets and fountains of the bath have been so meticulously designed (Haji Ghasemi, 2004, pp. 112-114).



## Boran bath

This bath has been located at the center of Boran village-Amol county-Mazandaran province at Safavid age. This bath has been established at the center of village with the eastern-western direction. Further construction has been fulfilled around this bath, which this building has been 20.16 and 9.24 meters in length and width, and the height of this building has been 2 meter. The roof of this building has been built via the materials such as brick, stone and mortar concerning the arch-based architecture, performed in three sections: Sar bineh, Mian dar and Garm khaneh. It should be noted that this building has been used by people as that of in the past in previous decades, and no change has been made in it, and only the entrance and Garm khaneh have been closed in it.



#### Sheikh Safi al-Din tomb

Sheikh Safi al-Din tomb was built at the end of the 18th century, this place of spiritual retreat in the Sufi tradition uses Iranian traditional architectural forms to maximize use of available space to accommodate a variety of functions including a library, a mosque, a school, mausolea, a cistern, a hospital, kitchens, a bakery, and some offices. It incorporates a route to reach the shrine of the Sheikh divided into seven segments, which mirror the seven stages of Sufi mysticism, separated by eight gates, which represent the eight attitudes of Sufism. The ensemble includes well-preserved and richly ornamented facades and interiors, with a remarkable collection of antique artefacts. It constitutes a rare ensemble of elements of medieval Islamic architecture. The tomb of Sheikh Safi al-Din is located at the southern side of the main courtyard and southwest side of Dar al-Huffaz. The tomb is covered with a cylindrical tower and a dome, with the height being 17.5 meters and a 22 meters circumference, which stands on a stone plinth with a 1.5 meter height. The cylindrical tower is made of a combination of brick and tile, also known as hazarbaf design. According to Islamic spiritual art, the dome is what connects the earth and the Divine World with one another; as the base of the monument is a metaphor for earth, and the dome a metaphor for the Divine World. The Shrine Ensemble and Khāngāh of Sheikh Safi al-Din Ardabili is considered one of the most exquisite artworks of the Islamic civilisation and Safavid Dynasty. It is both a symbol of the Safavid Empire and a monumental paradigm of Iranian architecture, as it includes many different art forms, such as tilework, silver and gold work, muqarnas, inscriptions, tazhib and brickwork. The Shrine had both a fundamental role in the development of Safavid architecture and was also the spiritual and temporal heart of the Safavid Empire.





#### Mir bozorg Marashi's shrine

Mir bozorg Marashi's shrine has been considered as one of the important historical buildings. The main building dates back to the 8<sup>th</sup> century with a foursquare plan, yet the current building are renewed in the 11<sup>th</sup> century and Safavid age. This monument is important in historical perspective due to the architecture features, decorations, tiling and entrance. The old inscription exists under the arch and a unique tiling exists inside and outside it. The pool at the top of the monument has been a masterpiece, which sometimes seminarians used to go to the building and engage in studying. Clay tile pieces at the top of entrance and under the dome date back to Safavid age.



#### Khaju Bridge

Khaju Bridge in Isfahan has been described as the finest bridge (Ghazvini, 1945, p. 233). This structure was originally decorated with artistic tilework and paintings, and served as a teahouse (Al Isfahani, 1988, p. 44). In the center of the structure, a pavilion exists inside which Shah Abbas would have once sat, admiring the view (Hami, 1994, p. 19). Today, a remnant of a stone seat is all that is left of the king's chair. This bridge is one of the finest examples of Persian architecture at the height of Safavid cultural influence in Iran (Ansari, 1999, p. 160).



Davazdah Cheshmeh bridge

This bridge has been built by the order of Shah Abbas by Sheikh al Islam Amoli in Safavid age and then was repaired by Mirza Shafie, the prominent minister at Mazandaran. The width of bridge has been widened via concrete at the age of first Pahlavi by establishment of concrete bases. The materials including brick, mortar, stone, plaster and limestone have been used to build it. At the two sides in end of this bridge, the remnants of brick walls are seen, established as the dam. Various bridges have been built around this building, deteriorated due to flood, and finally Davazdah Imam bridge was built. There are 12 openings in this bridge, connecting two western and eastern side of Amol to each other. Yet, in the past, regarding the maps in city, this bridge has been considered as the entrance of city. This bridge enjoys 12 Cheshmeh that there is water under three Cheshmeh. There is an open space under the bridge which has been transformed to a green space, that there is also an asphalt road for coming and going under two openings at the west side of bridge. The bridge is well known with Davazdah Peleh and Imam Hasan Asgari. Etemad al Saltaneh knows the foundation of this bridge dating back to before Islam and states that such bridge is a long and low-width bridge made of stone and brick. Some have known establishment of this building in the 8th century(Shayan, 1987, p. 112).



### Conclusion

Physical sustainability is an issue which has been remained obsolete in communalizing the attitude towards sustainable development, yet the body of a structure manifests all the thoughts of the designer, responsiveness to the performance, visualization of content and a part of architecture that the addressee has the most interaction with it, mentioned that physical architecture manifests the identity of cities and neighborhoods, thereby physical sustainability is one of the important parts in sustainable development. As shown in table above, physical sustainability in the buildings under study has been found with a tangible and significant relationship with the effective factors. Yet, as observed, the extent to which the parameters affect physical sustainability of buildings differ with each other concerning their functions, but a wide range of parameters exist in all the samples. Using the aforementioned elements can assist use to reach an architecture that its body manifests the concrete architecture. If attention to these

elements is drawn via the preliminary planning for designing, it can pave the way for physical sustainability. As mentioned above, since the body of a structure represents a concrete part of the architecture and the output of the process of designing, the sustainability can be considered as the manifestation of the sustainability at all the systems of the architecture. Indeed, by overview of the indicators mentioned in the table and attention to the definitions proposed for the fundamental systems of architecture, it can deduce that the physical sustainability of architecture relies on the sustainability of the systems, encompassing the harmony of the structure with form extended to the harmony of form with content.

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