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COMPARATIVE COMPATIBILITY ASSESSMENT ON REUSED IRANIAN HOUSES FROM QAJAR ERA

AVALIAÇÃO COMPARATIVA DA COMPATIBILIDADE EM CASAS IRANIANAS REUTILIZADAS DA ERA QAJAR

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Abstract

Reusing heritage buildings with a compatible function provides the opportunity to sustain their significance. In this regard, the listed traditional houses in Tabriz, as one of the historical cities of Iran, play an important role in presenting cultural heritage values. Privacy as an intangible aspect of culture along with both physical and socio-cultural factors, have played a major role in the spatial organization of traditional Iranian houses, and formed the access hierarchy in the interior spaces. The purpose of this study is assessing the continuity or discontinuity of interior spaces in original and reused states of listed traditional houses in Tabriz from Qajar Era, to contribute to a better understanding of compatibility of new functions with the existing heritage building. The research methodology is based on literature survey for defining the original functions and observation of interior spaces for defining the current functions of each space. Additionally, the analytical approaches of 'space syntax methodology' are used to achieve the access hierarchy in space organization of the houses. Findings are derived from the comparison of 'relative depth value' as a reflection of privacy; and 'integration value' as a reflection of accessibility in both states.

Keywords: Residential interior Space, architectural conservation, space syntax method, space organization, space hierarchy.

Resumo

A reutilização de edifícios patrimoniais com uma função compatível oferece oportunidade de sustentar seu significado patrimonial. Nesse sentido, as casas tradicionais listadas em Tabriz, como uma das cidades históricas do Irã, desempenham um papel importante na apresentação dos valores do patrimônio cultural. A privacidade como um aspecto intangível da cultura, além de fatores físicos e socioculturais, desempenhou um papel importante na organização espacial das casas tradicionais iranianas e formou a hierarquia de acesso nos espaços interiores. O objetivo deste estudo é avaliar a continuidade ou descontinuidade de espaços interiores em estados originais e reutilizados de casas tradicionais listadas em Tabriz da Era Qajar, para contribuir para um melhor entendimento da compatibilidade de novas funções com o edifício existente. A metodologia da pesquisa baseia-se em levantamento bibliográfico para definição das funções originais e observação de espaços interiores para definição das funções atuais de cada espaço. Além disso, as abordagens analíticas da 'metodologia de sintaxe espacial' são usadas para alcançar a hierarquia de acesso na organização espacial das casas. As conclusões são derivadas da comparação do "valor relativo da profundidade" como um reflexo da privacidade; e "valor de integração" como reflexo da acessibilidade nos dois estados.

Palavras-chave: Espaço interior residencial, conservação arquitetônica, método de sintaxe espacial, organização espacial, hierarquia espacial.

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INTRODUCTION

Conservation comprises all processes and procedures that specifically protect the values of cultural heritage and prolong their physical life through safeguarding the elements that express the character of cultural heritage (1, 2, 3, 4). Historic buildings as important aspects of cultural heritage are “the most durable symbols of past civilisations, and a medium through which to understand past lifestyle, behaviours and habits, as well as art and technology” (5 p.6). Generally, change in use within conservation decision is accrued during the adaptive reuse that is a kind of “conversion of the facility or a part of the facility” to be used differently from the original state (6 p. 46). According to Burra Charter (7), the process of adaptation refers to any modification of place in addition to a selection of the compatible use with the preservation of its cultural heritage value (8). The Department of Environment and Heritage (DEH) has outlined the adaptive reuse of heritage buildings as “essential component of sustainable development” (9, p.2), while the new function of heritage building is depicted as one of the parameters to ensure its sustainability (9, 10, 11, 12, 13, 14).

The reuse of heritage buildings is regarded as a strategy to provide cultural sustainability with a specific social reference. Hence, adaptive reuse of heritage buildings improves the living quality through providing social and cultural activities according to the community needs and requirements (15, 16). The success of an adaptive reuse project is strongly based on the new use (17 p. 109). The Washington Charter (18) stated for the first time that building reuse needs to be compatible with architectural heritage identity and that conservation problem should take precedence over new user requirements. There should also be compatibility of a historic building with its new function by preserving the cultural significance. This needs both assessing the needs of future users and detecting the building transformation constraints posed by the culture of a building (19, p.39).

This study has focused on three cases of registered traditional Iranian houses in Tabriz from Qajar era, which are converted to different categories of new contemporary functions. The aim of this research is to evaluate the success of adaptive reuse in terms of compatibility of new function with the spatial organization of existing buildings focusing on the changes in privacy levels and hierarchy of access to interior spaces. A combination of quantitative and qualitative approaches is considered for the data collection and analysis in this research. The qualitative approach of the research contains the on-site observations of interior spaces in each case study for defining the new functions of each space in addition to literature survey for determining the original functions. Observation is supported by taking the photos of component spaces. Additionally, plan organisations of both original and reused versions of each case are examined by considering the analytical approaches of ‘space syntax methodology’ in order to achieve the access hierarchy in space organization of Iranian traditional houses. Numerical outputs related to the syntactic properties are calculated through Microsoft Excel© software (version 2010). Thereafter, the comparison of the relative depth of each space (Relative Asymmetry) within original and reused space organizations is illustrated in linear graphs.

Tabriz, as one of the important cities, has historical significance and was the second capital of Iran during the Qajar Dynasty (20, 21). Moreover, prominent individuals such as merchants and political people lived in this city (22). It is evident that the climatic and socio-cultural factors had a strong impact on the architecture of Tabriz traditional houses in the Qajar era as in other traditional settlement (23). In that period, the building's orientation was selected according to the climate and direction of sunlight, so buildings generally faced the south. Somehow, about the buildings with two parts, the south part was usually used during the summer (21). Nowadays, many historical houses have been registered as valuable heritage buildings by the Cultural Heritage Organization and are being conserved and restored. Some of these houses have been re-used with respect to their original space organization by assigning new contemporary functions.

CONSERVATION FRAMEWORK OF CULTURAL HERITAGE BUILDINGS IN IRAN

Cultural heritage activities in Iran can be classified in terms of the three stages of identification, conservation and presentation (24, 25). Identifying heritage values such as social, cultural, historical, functional, aesthetic, symbolic, educational and scientific values is the first step in the conservation process (2, 12, 26, p.82).

In the process of cultural heritage conservation, not only must the physical and tangible aspects of the building be preserved, but also the heritage values and intangible features must be conserved (18, 24, 25, 27). In this context, the scope of any intervention should be as minimal as possible (7, 17, 25, 27).

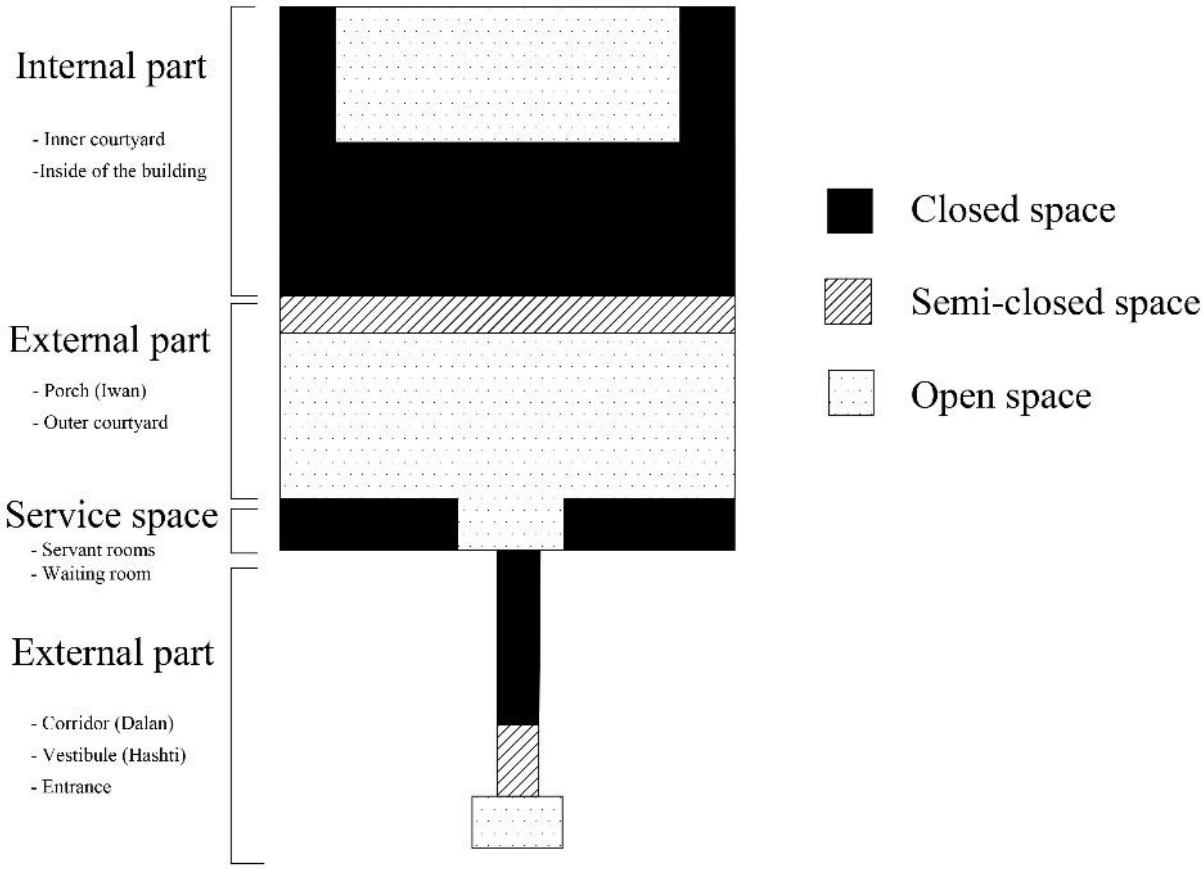
SPACE ORGANIZATION OF TRADITIONAL IRANIAN HOUSES

Rapoport (28) in the book ‘House Form and Culture’ refers to the interrelationship between architecture and culture. He proceeded to present his fundamental theory that “house form is not simply the result of physical forces or any single causal factors, but is the consequence of a whole range of socio-cultural factors seen in their broadest terms” (28, p.47). Rapoport (28) states that the mechanism of change in vernacular architecture is socio-cultural forces, whilst cultural factors contribute to the "cosmic image, ritual orientation, and symbolic character of the built form" (29, p.6). House as a symbol of culture and life style of individuals represent a specific spatial system and the sequence of spaces are based on desired level of privacy as a basic human need.

Social and cultural patterns are key elements for the identification of architecture in traditional Iranian houses. Traditional houses in Iran include a variety of different open, semi-open, semi-closed and closed spaces, and illustrate a distinctive space organization, created by the combination of religious and socio-cultural values as well as physical considerations (30, 31). In this context, Iranian traditional houses are composed of two main parts: the internal part (Andarooni) and the external part (Birouni). Pirnia (32)

states that 'Birouni' consists of the external part that was connected to the entrance section; and 'Andarooni' is identified as the parts that were specified for family members. Notably, the female members had a privilege to specify this part (Table 1). In addition, in the internal part female visitors were served. In essence, the main purpose of defining these two parts is to detach the inhabitants from the outside, while the central courtyard (outer courtyard) is the main interface between the internal and external parts (Figure 1) (32).

Figure 1: Schema of external and internal spaces of traditional houses in Tabriz (The abstract map is based on Sarraflar house plan (24))



According to the spatial hierarchy of traditional houses, privacy acts as a cultural feature in spatial organization of those houses while the inner spaces are secured from foreign visits, especially with consideration of genders (39, 40). Two types of privacy are included in the traditional Iranian housing: Privacy by secluding from the outside of the house and inner privacy secluding semi-public common areas of the house from private areas on the next level (33 p.129). Outer entrance space which includes the sitting platforms and main door of traditional houses isconsidered as public, while spaces where guests do not have access to are regarded private (Table 2).

Table 1 Spaces of traditional Iranian houses (Qajar Era)

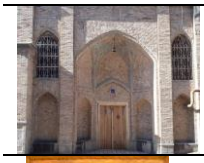
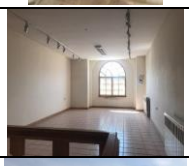
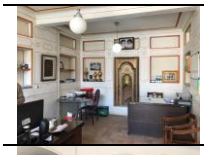
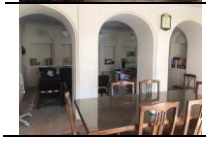
Image	Name & Explanation of space	Image	Explanation
	*Entrance Sitting Platform (Pir-neshin):* These platforms on both sides of the house's main entrance were used as a seat to wait, to rest or to meet up with neighbours (33 p.63).		*Back storage (Sandoq-khaneh / pastoo):* The storage spaces called 'Pastoo' or 'Sandoq-khaneh' had been placed at the rear of the main rooms. (34).
	*Entrance door (Dargah):* Twin types of entrance doors existed in most traditional houses, and each had a special doorknocker, which was provided for males and females separately. Therefore, the gender of the person who wanted to enter the home was recognizable (33 p.63).		*Pool room (Hoez-Khaneh):* Generally, this space was located at the basement with a pool inside the building for the summer housing (35).
	*Vestibule (Hashti):* The vestibule, mostly in the form of an octagon, half octagon or sometimes square, was the first space after the entrance. This room was used to distribute various accesses to the other parts of the house (33 p.64).		*Cellar (Sardab):* The cellar (Sardabe) which was located underground, was a storage area, where food has been stored and prevented from being damaged (35).
	*Corridor (Dalan):* The corridor was a narrow passage which lead the entry from the porch to the yard. This labyrinth corridor provided the house with privacy, and the guests could never immediately understand the activities happening at the house (31).		*Cistern (Ābanbār):* The cistern was a place for storing water. It was usually placed in the basement floor. It worked as a management system that enabled inhabitants to have water the whole year, especially during the hot and dry season (37).
	*Porch (Iwan):* The porch was a semi-open space that was located between the courtyard and the building (31). The porch distributed access to the different parts of the house (33 p.87).		*Upper / Guest room (Bala-khaneh / Goushvar):* The guest room was located on the upper floor and definitely had a high ceiling on a veranda or alcove (up to two floors) for one-storey buildings (35).
	*Outer Courtyard (with pool and gardens):* The courtyard as the main element of the house's spatial organization, connected the external parts of the house (Birooni) to the internal parts (Andarooni) (34).		*Terrace (Bahar-khab / Mahtabi):* The terrace was a type of roof used in warm seasons to sleep in the night (34).
	*Reception hall (Tanabi / Otagh Oroesi):* Generally, distinguished guests were welcomed in the reception hall (33 p.65) where various types of decoration were used with colored glass and paintings on the walls (35).		*Inner courtyard (Hayat-Andarouni):* In houses with several yards, there was usually such a division. The inner courtyard was called 'inner' because it is the house's private part. Generally, the inner courtyard was surrounded by private rooms (34).
	*Triple door room (Se-Dari):* Typically, this room was named after its triple division with three doors in front of the yard (35).		*Hallway (Dehliz):* Hallway was a space which provides indoor transition and circulation (38)
	Five-door room (Panj-Dari): Family gatherings were happening in this space which was also named after its division which consisted of five doors or windows (36).		*Service section:* The services part was generally located on the west and south side of the house. This section contained kitchen, dining room, food, and fuel stores, servants' rooms and waiting room for guests (31).
			Photos: Author 1, 2019.

Table 2: The privacy layers as the framework of this research (Adapted from Vassilaki & Ekim (41), Robinson (42), Fallah & Khalili (43))

Public	Semi-public		Semi-private		Private
	Men social layer	Women social layer	Men social layer	Women social layer	
Anyone	Users and guests	Female users and guests	Users and guests	Female users and guests	Users
Outer entrance space	-Vestibule -Corridor (Dalan) -Outer courtyard -Porch -Waiting room -Male Servant room	-Vestibule -Corridor (Dalan) -Outer courtyard -Porch -Waiting room	-Reception hall (Tanabi) -Inner courtyard -Hallway (Dehliz) -Corridor -Guest room (Goushvar)	-Reception hall (Tanabi) -Female servant room -Inner courtyard -Hallway (Dehliz) -Corridor -Guest room (Goushvar)	-Five-door room -Three door room -Two door room -Pool room (Houz-khane) -Back storage (Pastoo) -Toilet -Cistern -Cellar -Kitchen

Moreover, a wide range of human activities used to take place between public and private zones (41). Some spaces, including outer courtyard (Hayat-birooni), reception hall (Tanabi) and upper rooms (Goushvar) were allocated for activities such as hosting, mourning and ceremonies in the semi-public and semi-private domains (43). The family domain contains inner courtyard (Hayat-andarooni); five-door rooms (Panj-dari), three-door rooms (Se-dari) and poolroom (Houz-khane) for daily activities such as family gathering, house jobs and personal activities. Private areas include areas like back storage, two-door room, and cellar or certain activities, such as sleeping, relaxation, and privacy attendance of one or two people. Inside and outside the house, the domain border is not a separating line. These two domains are identified by a set of consecutive portal spaces, lobbies, and corridors (43, 44).

SPACE SYNTAX METHODOLOGY

The interior space of a building carries the access hierarchy in its spatial system (45). In this way, spatial relation can be investigated according to space syntax theory (46). Space syntax as an analytical framework identifies the logic of society by its manifestation in spatial systemsranging from large urban settlements to small domestic settlements (47, p.21). In this way, there is ample research on the necessity of examining the interior spaces, mostly focused on houses, through the method of space syntax, in order to assess the relation between interior spaces and accessibility based on privacy issue. They include Robinson (42), Edgü and Ünlü (48), Hanson (46), Kim Et al (49), Mustafa and Hassan (50), Alkhazmi and Esin (51) and Shahbazi, Et al (52).

Through ‘Justified Plan Graph’ (JPG) as one of the main tools under space syntax methodology, the graphs that are brought up from an architectural plan map were analysed. The JPGs are drawn in ‘Edraw Mind Master’© software in order to analyse the compatibility of space organization of Tabriz traditional houses in two states of before and after adaptive reuse, and to examine the possibilities for visitors’ and inhabitants’ accessibility in the

reused state of houses. Therefore, the JPGs are provided to show the access hierarchy and also to present the syntactic values to achieve indicators such as “depth”, “integration”, “connectivity”, “choice” and “control” (53 p.223).

The research follows four steps to obtain the required data to be used in the comparison of space organization of different states of reused buildings.

Initially, the Total Depth “TD” has been calculated for the specified ‘carrier node’ by the number of spaces (nx) on the relevant level. ‘Depth’ property in space syntax methodology serves to show the degree of privacy. In other words, as the depth of space increases, space becomes more private, and the possibility of direct access is reduced. Depth from the root takes into account the number of steps in the graph that separate a certain space from the front door (47 p. 115). Eventually, linear states graph, as a reflection of privacy in original and reused states, is obtained to make a comparison between the depths of spaces.

TD value has been used for the second step. Secondly, “MD”or the Mean Depth, which refers to the average depth of a node in the JPG has been calculated, where *nx* refers to the number of nodes (spaces) being on that particular level and *K* is the number of nodes (spaces) defining the place (54).

Thirdly, the Mean Depth has been employed to calculate the ‘Relative Asymmetry’ (RA); it is relative depth of space which normalizes the range of potential outcomes to between 0.0 and 1.0 (55).

Thus, the ‘Integration Level’ (I) of the nodes has been calculated, which has an inverse relationship with RA, (46). The integration level means a broad range of accessibility from one space to the others; in other words, a high level of integration demonstrates the easier accessibility from one point to others (47 p. 115).

Step 1	TD= (0×nx) + (1×nx) + (2×nx)+....	Total Depth
Step 2	MD= TD / (K-1)	Mean Depth
Step 3	RA=2(MD-1) / (K-2)	Relative Asymmetry
Step 4	I= 1 / RA	Integration Level

SPACE CONTINUITY ANALYSIS OF CASE STUDIES ACCORDING TO THE NEW CONTEMPORARY FUNCTIONS

The purpose of this study is a comparison of different new contemporary uses, among listed traditional houses from Qajar Era, which are located in Tabriz. Three houses converted into administrative, educational, cultural, and commercial functional categories are selected as case studies in this research (Table 3). The fourth case that has retained its original use (residential use) is eliminated due to the absence of change in function.

The first case, Behnam house, has been converted to administrative part of Islamic Art University. The second case is Gadaki house, where educational functions of the same university are located. The third case study is Sarraflar house (Alavi house) that has been converted to a multi-functional place including cultural and educational functions. All three case studies are registered as cultural heritage buildings.

Table 3: Selected case studies

Houses name	Behnam House (56, 57).	Gadaki House (57).	Sarralar House (Alavi house) (58)
Image			
Period	At the early Qajar dynasty (1781-1925)	At the second half of the Qajar	Late Qajar period
Date of listing for cultural heritage conservation	April 1997	April 1997	March 2003
Date of refunctioning	October 1999	October 1999	2005
Contemporary use	Islamic Art and Architecture University	Islamic Art and Architecture University	The live Pottery museum and workshop
	Mainly offices Additionally, temporary accommodation for guest professors, restaurant space	Mainly classrooms, architecture studios, exhibition, workshop and copy center, Additionally praying room, storage spaces, and offices	Mainly pottery artwork museum, workshops, training courses of pottery, pottery products sale
Main Category of new function	Administrative	Educational	Multi-functional (Cultural, Educational)
Additional Category of new function	Accommodation, commercial	Administrative relegious	Commercial

Generally, the space organization of all three cases display the response to privacy through the hierarchy of access (59). Accordingly, the access hierarchy to internal spaces in original state is almost similar in all three examples, so that after crossing the entrance section, the outer courtyard and the porch become visible, and therefore act as the access point to the other spaces of the house.

Furthermore, in all three cases, the reception hall (Tanabi) is located on the main axis with the side rooms and the five-door rooms (Panj-dari) on each side on the ground and first floor. Similarly, in the spatial layout of the Gadaki house and the Sarraflar house, the poolroom (Havouz khane) space is located on the main axis of the building. As it is clear from the plans of houses, the entrance space in original state of all three houses consists of three main parts: Entrance, vestibule (Hashti) and hallway (Dalan) (Figure 2, Figure 5, Figure 8). However, with the changes that occurred in the entrance space of the Sarraflar house before and during the reuse process, the entrance door, vestibule, and the hallway have been removed, and so the

entrance of the building in the current function includes two new entrance doors.

Tables 4, 5, 6 list all the constituent spaces of traditional Iranian houses with the full names and abbreviations of spaces. Additionally, these tables examine the continuity or dis-continuity of each space by mentioning the current specific function of each in the three situations which include the original state of the building; the state before the adaptive reuse process; and the state after reusing the buildinge.

According to the space continuity analysis of the Behnam building (Table 4), it can be seen that the space organization of this house is based on privacy and hierarchy of access to internal spaces. The entrance section consists of several spaces that restrict the direct access of foreign visitors to the house. This house consists of the main section that is called winter building and a summer building which is smaller. The western side, which included the stable, kitchen and toilets, has been destroyed many years ago (exact date is unknown). The original space organization of the Behnam House is conserved during and after adaptive reuse as the administrative building of the Islamic Art University. The majority of spaces have been converted to administrative functions including the offices for the Chair and the Vice-Chair, and the offices for other professors. Meanwhile, one of the five-door rooms is converted to the private residential studio and used as temporary accommodation for guest professors. Likewise, during the adaptive reuse, a restaurant space has been added to summer building (south side).

The space organization of Gadaki house also follows the privacy levels and the hierarchy of access through interior spaces. The entrance part of Gadaki House is similar to Behnam house and consists of the vestibule (Hashti) and corridor (Dalan) due to access into the house as well as the central courtyard. According to the space continuity analysis of Gadaki house (Table 5), the original space organization has been maintained during the reuse process. Additionally, it is observed that most spaces in the reused version have educational functions such as classrooms, architecture studios, exhibition, workshop, and copy center. However, some of the spaces of this building are used as praying room, storage spaces, and offices.

According to the historical information on the Sarraflar House (Table 6), this house also followed hierarchy of access and privacy in its original state, although over time, the vestibule (Hashti) had been removed from the entrance part of the house, long before the investigated adaptation process. While the entrance section only includes a long corridor (Dalan), during the adaptive reuse, the corridor section has been removed for the development of the courtyard space. Due to this change, access to the interior spaces is easier and is facilitated by passing through the entrance door and entering directly to the central courtyard instead of passing through multiple spaces. Therefore, this issue has a great impact on the analysis of the depth and integrity of the spaces as well as the study of the privacy in reuse state of the house. The space continuity analysis related to Sarraflar house clarified that spaces had been re-used with multiple uses (Cultural, Educational and Commercial). In addition to the current use as the pottery artwork museum, some spaces are also dedicated to the workshops and pottery training courses as well as the sale of pottery products.

Table 4: Space continuity analysis of Behnam house spaces

	Space	Original state	state before reuse	state after the reuse	New function
Sp	Sitting Platform (Pir-neshin)	✓	✓	✓	Sitting Platform
E	Entrance door (Dargah)	✓	✓	✓	Entrance door (Dargah)
H	Vestibule (Hashti)	✓	✓	✓	Vestibule (Hashti)
D	Corridor (Dalan)	✓	✓	✓	Corridor (Dalan)
Cr	Corridor	✓	✓	✓	Corridor
Dz	Hallway (Dehliz)	✓	✓	✓	Hallway (Dehliz)
Cy	Outer courtyard (Hayat-birooni)	✓	✓	✓	Outer courtyard
Iw	Porch (Iwan)	✓	✓	✓	Porch (Iwan)
Tb	Reception hall (Tanabi)	✓	✓	✓	Chair's office
5D	Five-door room 1 (Panj-dari)	✓	✓	✓	Vice chair's office
5D	Five-door room 2 (Panj-dari)	✓	✓	✓	Teachers'room
5D	Five-door room 3 (Panj-dari)	✓	✓	✓	Guest room
3D	Three door room (Se-dari)	✓	✓	✓	Office
2D	Two door room (Do- dari)	✓	✓	✓	Service room
P	Back storage 1 (Pastoo)	✓	✓	✓	Storage
P	Back storage 2 (Pastoo)	✓	✓	✓	Kitchen
P	Back storage 3 (Pastoo)	✓	✓	✓	Toilet
G	Guest room (Goushvar)	✓	✓	✓	Offices
M	Terrace (Mahtabi)	✓	✓	✓	Terrace
I.C	Inner courtyard (Hayat-andarooni)	✓	✓	✓	Inner courtyard
K	Kitchen (Matbakh)	✓	×	×	×
Sb	Stable	✓	×	×	×
S	Cellar (Storage)	✓	✓	✓	Technology Units
Wc	Toilet	✓	✓	✓	Toilet
Sr	Servant room	✓	✓	✓	Offices
Wr	Waiting room	✓	✓	✓	Free space
St	Stair	✓	✓	✓	Stair
Nc	Neighbor courtyard	✓	✓	✓	Neighbor courtyard
Ms	Middle space	✓	✓	✓	Middle space
*E2	*New entrance	×	✓	✓	University entrance
*Rs	*Restaurant	×	✓	✓	Restaurant

* refer to the added new functions during adaptive reuse
*Grey highlighted functions refer to the functions which continue during adaptive reuse

Table 5: Space continuity analysis of Gadaki house spaces

	Space	Original state	state before reuse	state after reuse	New function
Sp	Sitting Platform (Pir-neshin)	✓	✓	✓	Sitting Platform
E	Entrance door (Dargah)	✓	✓	✓	Entrance door (Dargah)
H	Vestibule (Hashti)	✓	✓	✓	Vestibule (Hashti)
D	Corridor (Dalan)	✓	✓	✓	Corridor (Dalan)
Cr	Corridor	✓	✓	✓	Corridor
Dz	Hallway (Dehliz)	✓	✓	✓	Hallway (Dehliz)
Cy	Outer courtyard (Hayat-birooni)	✓	✓	✓	Outer courtyard
Iw	Porch (Iwan)	✓	✓	✓	Porch (Iwan)
Tb	Reception hall (Tanabi)	✓	✓	✓	Prayer room
5D	Five-door room (Panj-dari)	✓	✓	✓	Architectural Studio
3D	Three door room 1 (Se-dari)	✓	✓	✓	Office
3D	Three door room 2 (Se-dari)	✓	✓	✓	Classroom
2D	Two door room 1 (Do-dari)	✓	✓	✓	Copy center
2D	Two door room 2 (Do-dari)	✓	✓	✓	Publishing office
G	Guest room 1 (Goushvar)	✓	✓	✓	Free space
G	Guest room 2 (Goushvar)	✓	✓	✓	Praying room
I.C	Inner courtyard (Hayat-andarooni)	✓	✓	✓	Inner courtyard
K	Kitchen (Mabakh)	✓	✓	✓	Storage
Hz	Pool room (Havouz khane)	✓	✓	✓	Exhibition place
S	Cellar (Storage)	✓	✓	✓	Cultural affairs center
Cs	Cistern	✓	✓	✓	Water pipes network
Wc	Toilet	✓	✓	✓	Toilet
Sr	Servant room	✓	✓	✓	Storage
PI	Private Iwan	✓	✓	✓	Iwan
St	Stair	✓	✓	✓	Stair
Nc	Neighbor courtyard	✓	✓	✓	Neighbor courtyard
Ms	Middle space	✓	✓	✓	Middle space
*E2	*New entrance	×	✓	✓	University entrance

* refer to the added new functions during adaptive reuse
*Grey highlighted functions refer to the functions which continue during adaptive reuse

Table 6: Space continuity analysis of Sarraflar house spaces

	Space	Original state	state before reuse process	state after reuse process	New function
Sp	Sitting Platform (Pir-neshin)	✓	✓	✓	Removed
E	Entrance door (Dargah)	✓	×	×	Removed
H	Vestibule (Hashti)	✓	×	×	Removed
D	Corridor (Daalan)	✓	×	×	Removed
Cr	Corridor	✓	✓	✓	Corridor
Dz	Hallway (Dehliz)	✓	✓	✓	Reception
Dz	Hallway (Dehliz)	✓	✓	✓	Museum
Cy	Outer Courtyard (Hayat-birooni)	✓	✓	✓	Outer Courtyard
Iw	Porch (Iwan)	✓	✓	✓	Porch (Iwan)
Tb	Reception hall (Tanabi)	✓	✓	✓	Museum
5D	Five-door room (Panj-dari)	✓	✓	✓	Museum
3D	Three-door room (Se-dari)	✓	✓	✓	Maintenance and sale of pottery utensils
2D	Two-door room (Do-dari)	✓	✓	✓	Service room
G	Guest room (Gooshvar)	✓	✓	✓	Temporary exhibition space
G	Guest room (Gooshvar)	✓	✓	✓	Workshop
K	Kitchen (Matbakh)	✓	✓	✓	The place of old and electric furnace
Hz	Pool room (Havouz khane)	✓	✓	✓	Workshop
S	Cellar 1 (Storage)	✓	✓	✓	Storage
S	Cellar 2 (Storage)	✓	✓	✓	Workshop
Wc	Toilet	✓	✓	✓	Toilet
Sr	Servant room	✓	✓	✓	Staff room for resting
St	Stair	✓	✓	✓	Stair
*E2	*New entrance	×	✓	✓	University entrance
*As	*Added storage	×	✓	✓	Storage

* refer to the added new functions during adaptive reuse
*Grey highlighted functions refer to the functions which continue during adaptive reuse

Analysis of Change in Space Organization

Analysis of change in space organization has been achieved through 'Justified Permeability Graphs' - JPGs and numerical outcomes of syntactic values. In acquired JPGs for the original and reused states of selected houses, mainly the original entrance and the new entrance are defined as a carrier node (space), and other spaces are placed in sequence levels related to the carrier node. Consequently, each space is given a depth value, which are accessible through passing the levels from the carrier node.

By comparing original (house) and reused states (university's administration) of Behnam house (Figure 2 & Figure 3), it can be seen that the relative depth of all spaces in the second version has decreased (Figure 4).

Due to the unique heritage significance of these traditional houses, the least amount of intervention has been realized in the architectural elements. Therefore, according to space organization analysis, it is observed that, the physical aspects of the building, including the openings and access nodes in the original state, have been preserved in the reused state of each house. Moreover, the reused state has been defined by a new entrance. In addition, the university complex (Behnam house) has been identified through the connection with the neighboring courtyard and providing the restaurant space by linking to the side building. This has led to an increase in the number of spaces, as well as reduced privacy and depth in each space of the university complex.

Based on JPGs (Figure 3), the depth value for university entrance is lower than the house's original entrance depth value. The porch (Iwan) and the outer courtyard have the lowest depth (least private) and the highest integrity, which shows that they are easily accessible within both original and reused states of the building. On the other hand, the back storage (pastoo) and the storage (cellar) spaces, that are placed at the upper level of JPG, include the higher depth (most private) and lowest integrity, which shows they are not easily accessible.

Figure 2: Original plans of Behnam House (Adapted from registered architectural plans (24))

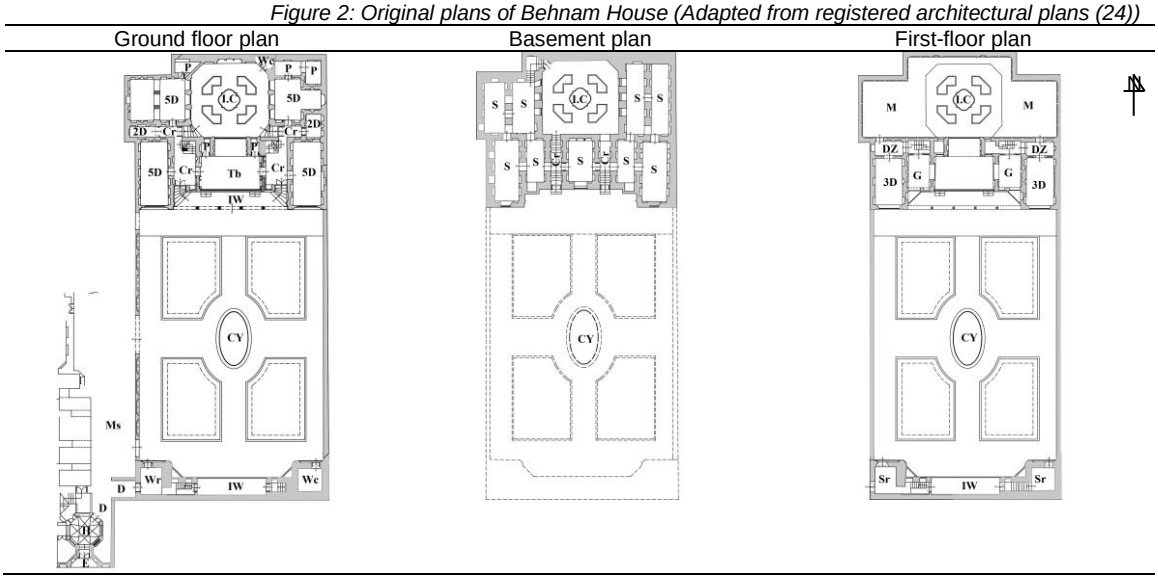


Figure 3: Justified plan graph of Behnam house: a) original state (Left), b) reused state (Right)

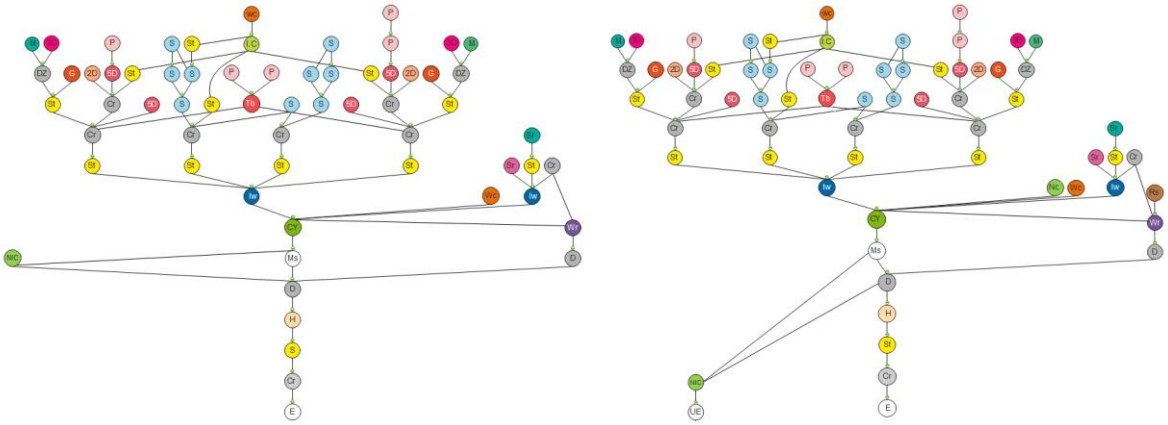
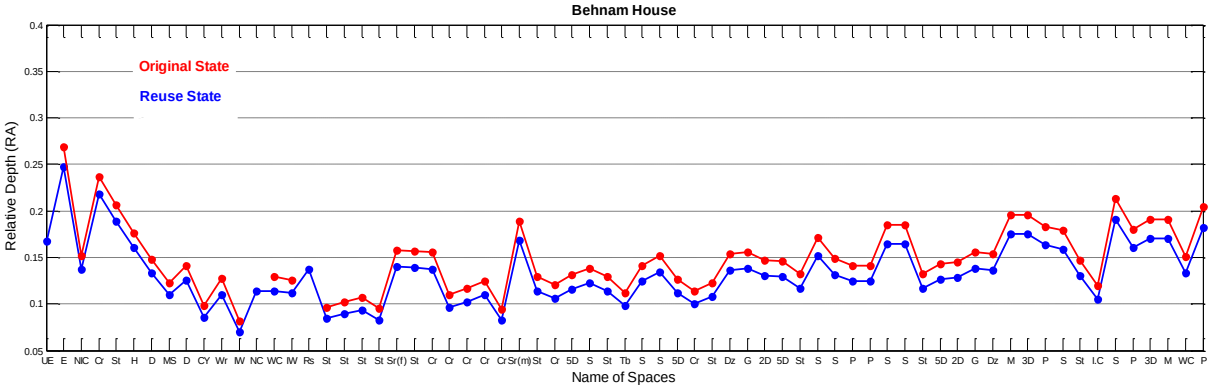


Figure 4: Relative depth values of spaces in original and reused states of Behnam house



By comparing the original (house) and reused states (university's educational part) of Gadaki house (Figure 5 & Figure 6), it can be observed that the relative depth has slightly decreased in the reused version (Figure 7).

JPGs of Gadaki house (Figure 6) illustrate that the university entrance that has been assigned to space organization of the house in the reused state provides easy access to the inner courtyard of the Gadaki house and the interior spaces of the building as well. Communication with the neighboring courtyard that is shown as a new space is also evident in linear graph.

In addition, according to JPG (Figure 6), the outer courtyard is considered as the most accessible space by the lowest depth (less private) and the highest integrity within both original and reused states of building. On the other hand, the back storage (Pastoo), three-door room and storage spaces, that are close to the inner courtyard placed at the upper level of JPG (Figure 6) have the higher depth value (more private) and lowest integrity. It means that they are not easily accessible. The main entrance and the two-door room on the top of the vestibule are also the deep spaces in the house's space configuration, and also considered as more isolated spaces.

Figure 5: Original plans of Gadaki House (Adapted from registered architectural plans (24))

Ground floor plan First-floor plan

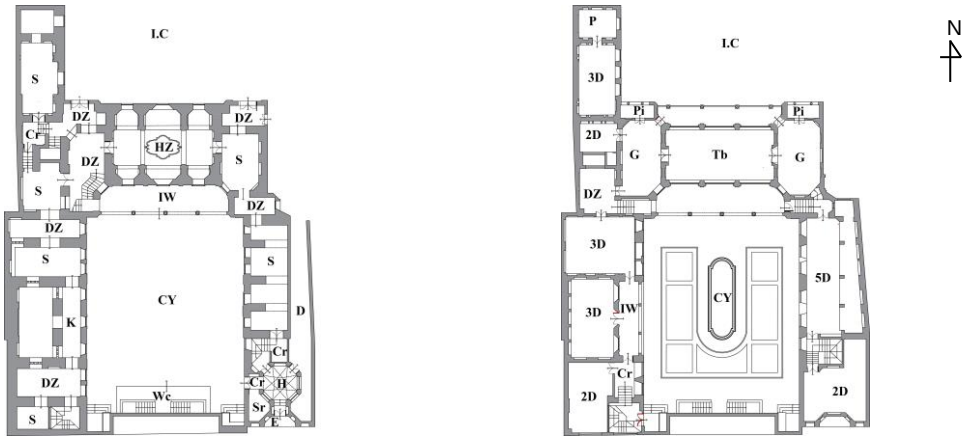


Figure 6: Justified Plan Graph of Gadaki house: a) original state (Left), b) reused state (Right)

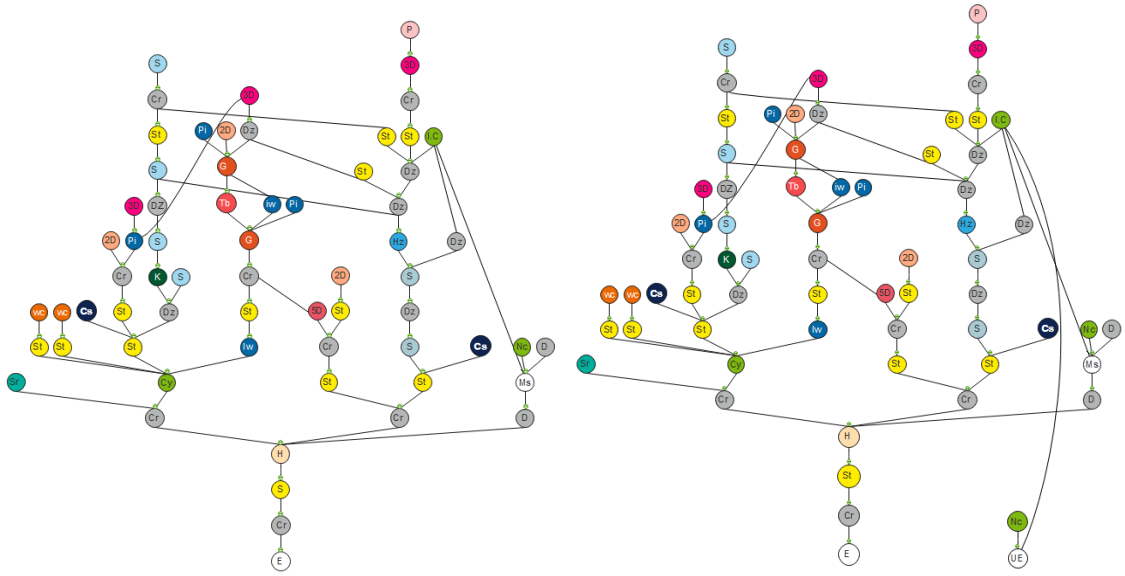
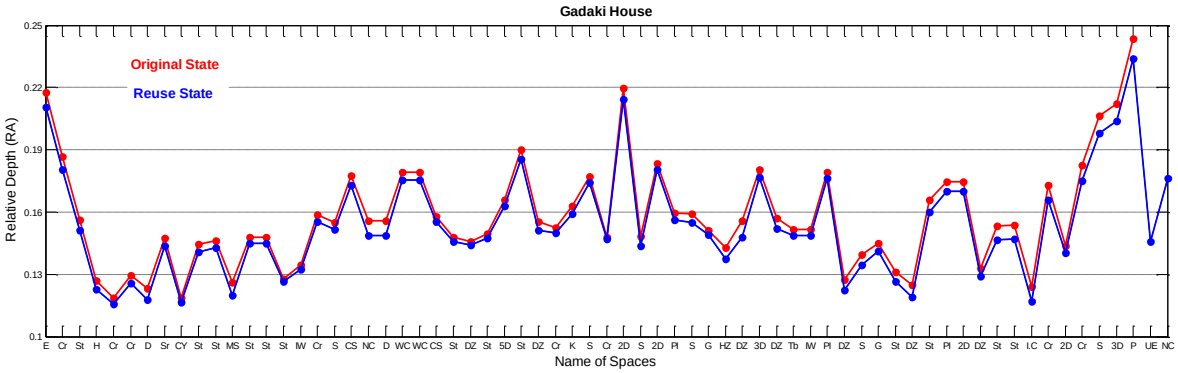


Figure 7: Relative depth values of spaces in original and reused states of Gadaki house



Comparing original (house) and reused (museum) states of Sarraflar house (Figure 8 & Figure 9), it can be found that the relative depth has also slightly decreased in the reused version (Figure 10).

According to JPGs (Figure 9), it is evident that there is a new entrance and two added spaces that are used as storage in reused state. As mentioned in the previous discussions, the vestibule was an important part of entrance section removed before reusing practices; however, the long corridor (Dalan) was removed from the entrance during the adaptive reuse project.

Moreover, the outer courtyard has the lowest depth and the highest integrity. This space is the most accessible as in the previous two cases. On the other hand, the upper rooms (Goushvar) and the storage that was located on the upper level of JPG (Figure 9) have the higher depth value and lowest integrity in both states.

Figure 8: Original plans of Sarraflar House (Adapted from registered architectural plans (24))

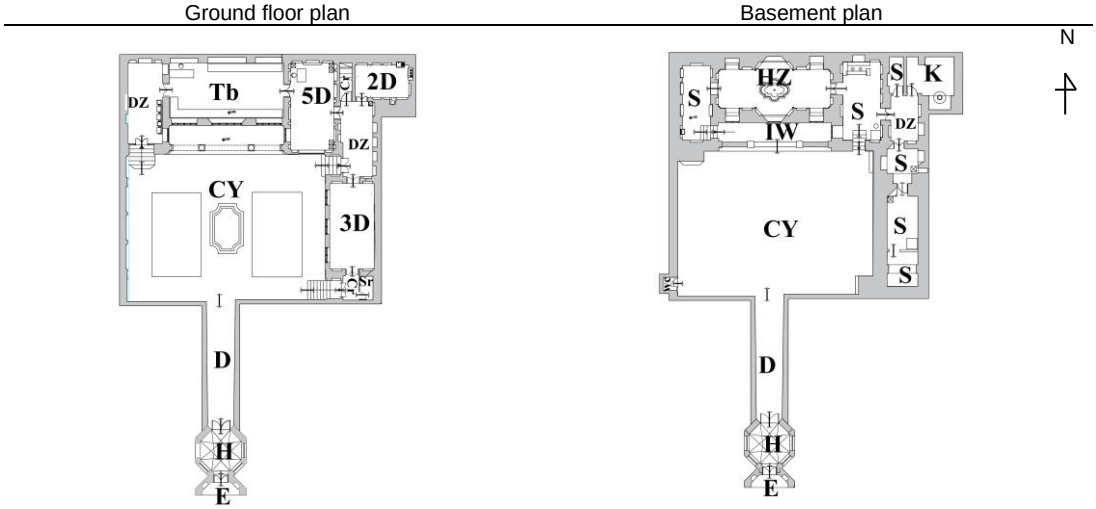


Figure 9: Justified Plan Graphs of Sarraflar house: a) original state (Left), b) reused state (Right)

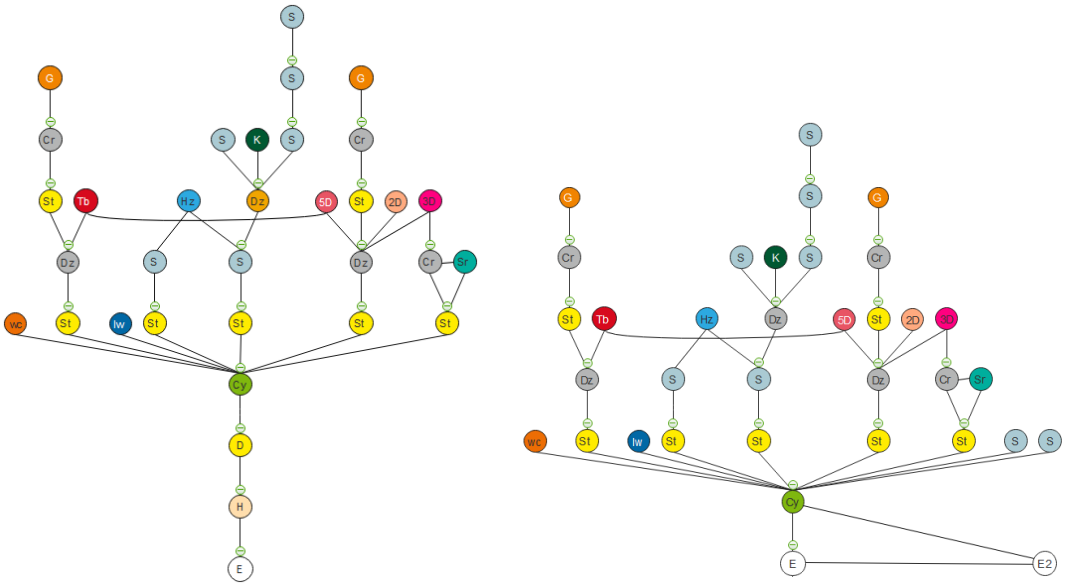
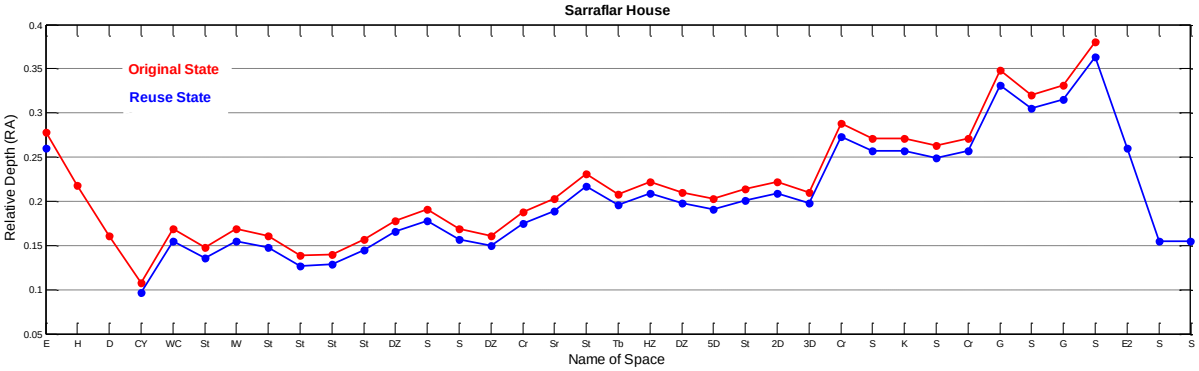


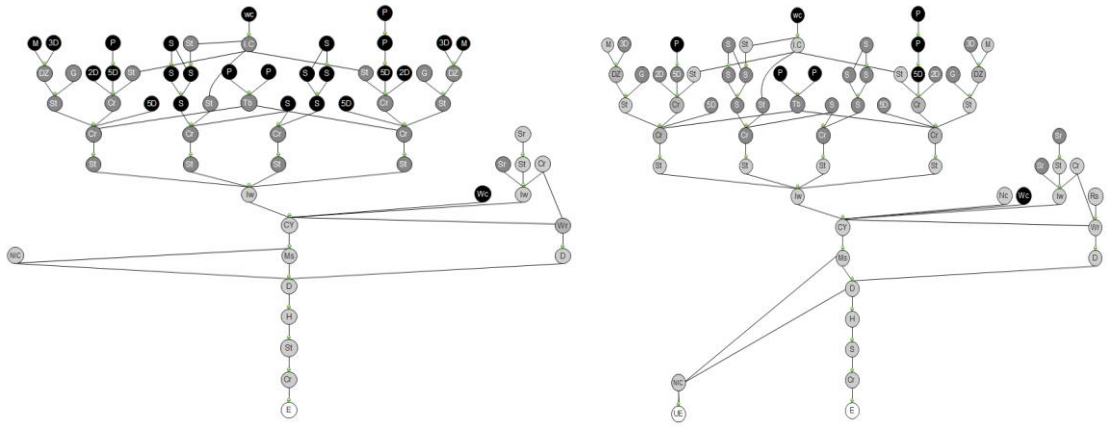
Figure 10: Relative depth values of spaces in original and reused states of Sarraflar house



In the third part of the analysis, privacy diagrams have been formed for the original spaces of each three cases. Based on the classification of privacy degrees in spaces of traditional Iranian houses in literature review (Table 2), they are classified into four categories: 'public', 'semi-public', 'semi-private' and 'private' spaces. Additionally, the degree of privacy for the spaces of reused state has been displayed based on the numerical outputs of depth and integrity (degree of privacy) and the accessibility which are obtained from JPGs and in-situ observations. In the graphs, a monochromatic color spectrum shows the degree of privacy in the spaces for both the original and the reused layouts. The bold color spaces represent the spaces with the highest level of privacy *t*. The brightness of the node colors respectively defines the semi-private (dark grey) and semi-public (light grey) spaces. Likewise, the white color displays the public spaces within the system layout.

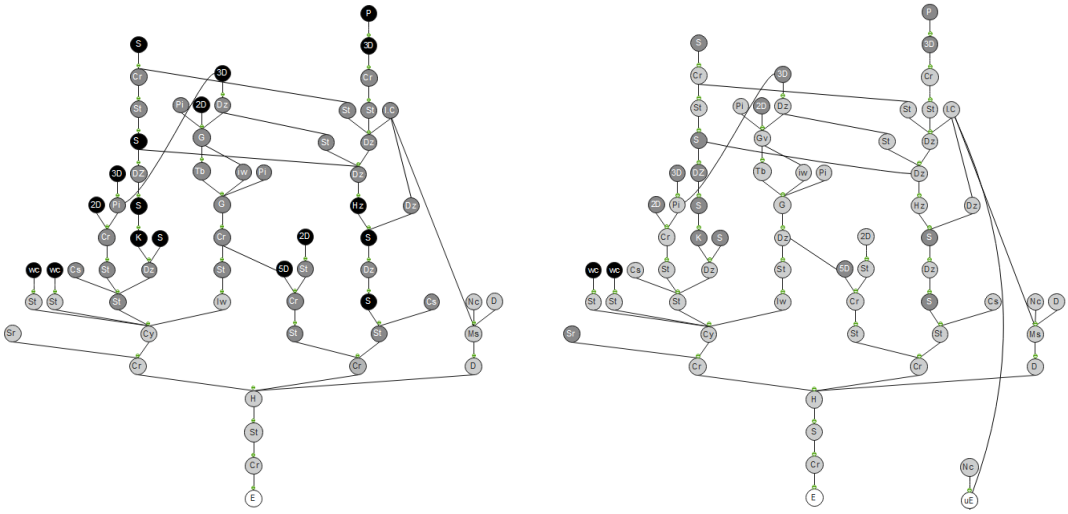
According to Figure 11, private spaces in the original state of Behnam house are changed to the semi-private spaces in the reused state via changing the function of those spaces as mentioned in Table 4.

Figure 11. Privacy graphs of Behnam house whitin original and reused state



The number of semi-private and private spaces in the reused state of Gadaki House is relatively lower than the Behnam house. Accordingly, most semi-private spaces in the original state of this building have been changed to semi-public spaces in the reused state (Figure 12).

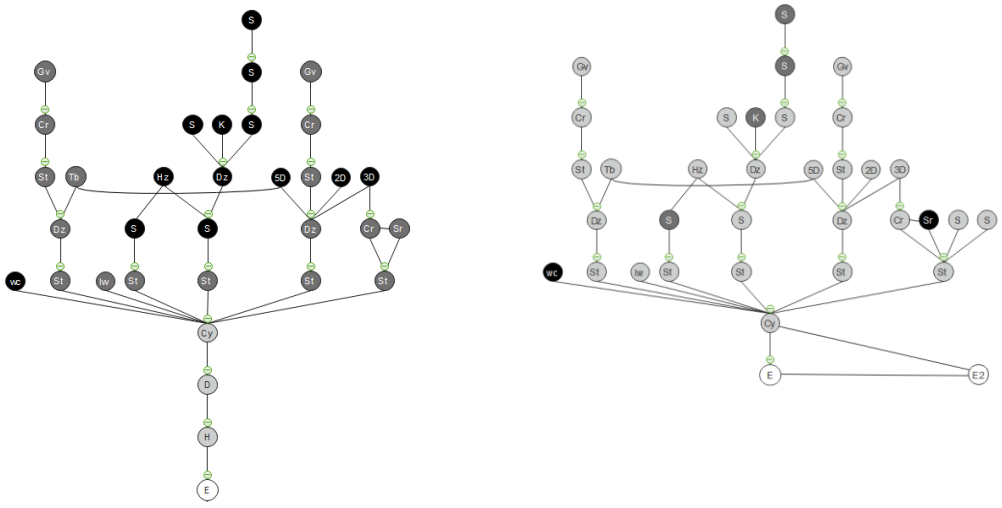
Figure 12. Privacy graphs of Gadaki house whitin original and reused state



Privacy digrams for Sarraflar house reveal that most private and semi-private spaces in the original state have been changed to the semi-public spaces in the reused state (Figure 13).

Spaces such as the traditional and electric furnace (formerly in the kitchen area), as well as the storage where the raw materials for the pottery production are kept, emerge as semi-private spaces. The servant's room on the eastern front of the building, which is also home to the caretaker of the complex, and toilets are the only private spaces within the museum complex.

Figure 13. Privacy graphs of Sarraflar house whitin original and reused state



In all three examples, no radical changes can be observed. Compatibility between new uses and space organization of existing buildings has not interfered with linking to added spaces in the reused state; however, it has reduced the depth of space and increased access to new uses. Therefore, based on the space continuity analysis, justified and linear graphs, and privacy diagrams, it can be concluded that the new different contemporary functions in the three case studies are compatible with the original spatial organization of the heritage buildings, and provide the required access for the type of assigned contemporary functions. Similarly, it can be stated that the new use intended to preserve the originality of the building in order to conserve all the values of cultural heritage buildings.

Finally, the level of privacy changed as private spaces shifted to semi-private spaces or from semi-private spaces to semi-public spaces in all three cases.

CONCLUSION

Iranian traditional houses constitute an important part of valuable cultural heritage that must be preserved for future generations. Over the past decades, reusing the listed traditional Iranian houses has gained momentum. Therefore, selecting the most appropriate function to achieve success in adaptive reuse projects is prioritized. There are many effective issues such as basic environmental qualities, economic and intangible benefits, public access, minimal adaptation cost in relation to the appropriateness and compatibility of the new function during the adaptive reuse process.

The configuration of traditional Iranian houses affirms the direct impact of the cultural values of society on the spatial organization of those houses. The analyses that have been carried out based on the spatial organization of traditional Iranian houses in Qajar era indicate that privacy as one of the main factors of Iranian culture has a significant impact on spatial configuration and access hierarchy in residential buildings from Qajar era. Based on the JPGs of space syntax method, privacy as an intangible feature of culture affects spatial organization of the selected case studies, not only in the original state, but also in the reused state of the residential buildings. Hence, based on the JPGs, it can be seen that the new contemporary functions in each of the three buildings are compatible with the existing original space organization. In this context, the original space organization is maintained in general and the least amount of interventions are applied in the conservation of these buildings for preserving the heritage values.

On the other hand, obviously, the contemporary functions, which are inserted in the space organization with a high degree of privacy, required an improvement in the hierarchical access system that is related to the new uses. Therefore, the addition of new spaces, including the assignment of a new entrance has facilitated access needed for the new use of the building, while preserving the main entrance of the buildings, as well as enhancing the connection with adjacent spaces. However, in the case of the Sarraflar house, minor modifications have been made to remove the corridor (Dalan) from the entrance section, which can alter accessibility and reduce privacy in the reused state, based on examining the graphs. Considering that the

vestibule had been demolished before the renovation project, there was no serious damage to the space organization of building by removing that corridor (Dalan) in the reuse state.

As a result, the compatibility of the new use with the existing spatial organization is key in measuring the success of a reusing project. Overall, the findings of this study show that administrative use in Behnam house, educational use in Gadaki house and mixed use (cultural, and educational) in Sarraflar house have been attained in the buildings by making minimal intervention in the existing space organization and through the intention of sustaining the heritage values to the present and future generations. Therefore, those contemporary functions are compatible with original space organization of the buildings. This can be a criterion according to which the success of adaptive reuse of such heritage buildings can be measured.

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