Investigate the Sustainable Efficient Spaces in Islamic Inheritance Houses

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Abstract. Due to the changes are generally happened in the architecture and the architectural design process, and especially in the inheritance houses design fields. Because of the large increase in the demands for houses in the world. In Addition to that, the imported concepts and shapes from the foreign architecture in the Islamic Arabic architecture. The Islamic inheritance houses had suffered from the problem of contemporary transformations and threat urban structure. For the previous reasons this research will discuss the research problem which is: what are the characteristics of sustainable efficient spaces in Islamic inheritance houses. The research objective is to explore the sustainable traditional efficient elements to use it in the contemporary hosing; to sustain the Islamic traditional heritage and Islamic identity. This Study has a try to investigate the pheno-type and geno-type of the sustainable efficient spaces of Islamic inheritance houses (tradition inheritance houses). Research methodology will be inductive method through making surveying for the efficient spaces in selected traditional cases study in Arabian cities. Five distinguished inheritance houses in Bahrain as cases study have been selected: "Sheikh Issa Ibin ali Inheritance houses", "Seiady Inheritance houses in Moharaq", "the inheritance houses of Sheikh Salmaan", "the inheritance houses of Ahmed Khalaf" and "the inheritance houses of Yusuf Redha in Manama". These five inheritance houses are similar to many Islamic inheritance houses in Arabian cities and they are the most Islamic traditional reputed inheritance houses in the Gulf area. The study has try to investigate pheno-type, geno-type for the efficient spaces in Islamic inheritance houses. The study finds number of pheno-types, genotypes and another characteristic for sustainable efficient elements. The research finds that; the genetic features in the Islamic selected inheritance houses have three efficient spaces. The efficient spaces are "specific, specific- general and general". Those spaces are opened to a certain courtyard, or they are sharing the same one. And probably one of the previous spaces has more than one courtyard. So; there are clear separation for these efficient spaces in the Islamic inheritance houses, through the concept of the hierarchy from (Specific spaces) then (Specific-General spaces) then to the (General spaces). All selected inheritance houses have another characteristic; they have the fact that the privacies in the ground floor is less than the privacy in the first floor.

1. Introduction

The architecture of the Islamic inheritance houses nowadays is suffering from the losing of Islamic architectural identity. Using of the foreign architectural concepts and architectural shapes are stormed the contemporary design. This research acts the prospecting of the geno-type characteristics and pheno-type visible elements for Islamic inheritance houses in Arabic cities. research's aims are investigating the sustainable inherited genetic with virtual characteristics responsible for the efficient of spaces. In order to sustain the Islamic traditional architecture and heritage. Contemporary designer can re-use the identical genetic characteristics and develop the pheno-type elements to reach the demands for the cotemporary residential needs. The research analysed different Islamic inheritance houses in Arabian cities such as; "Inheritance houses of Sh. Issa Ibin ali in Moharaq", "Seiady
Inheritance houses”, “the inheritance houses of Sh. Salmaan”, “the inheritance houses of Ahmed Khalaf” and “the inheritance houses of Yousif Redha”. The study has been addressed Islamic traditional the properties of (pheno-type – genotype) for the efficient spaces of both general and specific functions.

2. **Sustainability in sustainable efficient spaces**

Sustainability is an appropriate framework for intensifying efforts to reach a higher level of human life through economic, social development and environmental conservation 'figure.1', without draining land resources. Sustainability today is one of the most important considerations to be taken from architects and planners to design or conserve building and cities in the developed countries, as this coincided with the increased risk of the negative impacts of the building structure constructed on the environmental condition, in addition to Increased economic challenges as a result of rising energy and building materials costs. State intervention does not always lead to more efficient results and identifying effective interventions more difficult than identifying the need for intervention. [1]

![Figure 1. Cycle of sustainable axis. [2]](image)

It should therefore be emphasized that the concepts and applications of sustainability in urbanization are not a scientific luxury but a new practical method of meaningful professional practice. Sustainability affects all levels of urban design from single dwelling to the entire urban area. Sustainability is therefore different from the traditional frameworks for evaluating or preparing urban plans in which urbanization is addressed through the functional distribution of different land uses, this method makes the architect deal with the different aspects of the building in a separately custom contrary to what is known about sustainability as a general, comprehensive and integrated framework. Therefore, the methodology for applying the principles of sustainability in urban design depends on the activation of these principles at all levels of urban design, from the level of the urban area as a whole to the smallest building unit in the neighbourhood. Because adopting sustainability as a comprehensive methodology in evaluating urban projects and working to apply their concepts as much as possible in our urban areas will solve much of what the living environment in Arab cities suffers, as for the elements of sustainability that are applied at these different levels, they are represented by: urban fabric design, social environment, cost, functionality and movement. Because sustainability arises from the balanced interaction between the social, environmental, and economic components of urbanism, therefore any attempts to study urbanization must start from these components because they express the content of sustainability in urbanization in a comprehensive manner. This methodology can be applied to all levels of urbanization, where the strategies applied in each urban level are shown with tools that are appropriate to the urban size. Upon careful consideration of the reality of the traditional Arab urban environment for residential inheritance houses and the need to sustain resources and spaces with no loss of spiritual heritage, we realize that our need for applications to concepts of
sustainable urban planning more than anywhere on the face of the privacy of this region and its richness in Islamic architectural heritage. Therefore, in order to find solutions to the problems of the residential heritage areas of a traditional Islamic nature and to ensure the sustainability of major projects foreseen for the future, we urgently need to change the traditional patterns used in the design and implementation of the built environment. Because adopting sustainability as a comprehensive methodology in evaluating urban projects and working to apply their concepts as closely as possible in our urban areas is enough to solve much of the living environment's suffering in Arab cities. [3]

So the suitable efficient spaces are those efficient spaces which were founded in the inheritance houses and could be useful efficient spaces in the contemporary inheritance houses and keep the identity of Islamic traditional architecture. Accordingly, this research has try to performs an applied analysis for the sustainable efficient spaces in the Islamic inheritance houses in Arab cities to reach the possibility of using these space in the contemporary inheritance houses to the Islamic traditional identity.

3. Geno-type and Pheno-type; environmental relationship

This study has been focusing the characteristics of pheno-type and geno-type elements for the efficient spaces of Islamic inheritance houses. the terms pheno-type, geno-type and environmental influence will be considered. Generally, it is a scientific fact that the pheno-type of any organism is determined by its geno-type and its environment. Often it is supposed that the pheno-type is the collection summation of the geno-type and the environment. 'figure 2'. The pheno-type can also be seen as the interaction between genetics and environmental factors, some genotypes are improved in one environment and others are improved in another environment. [4]

![Pheno-type and Geno-type relationship](image)

**Figure 2.** Geno-type and Pheno-type environment relationship.

The geno-type characteristics' is not recognizable immediately. [5], and it is only the pheno-type elements, the appearance, that is recognizable by others. When we applied this evolutionary concept to the forming of this phenomena architecturally; geno-type is: "Analogous to an agent’s strategy and, pheno-type is analogous to the agent’s behaviour", [6]. The pheno-type elements, are characteristic expression of the features were coming from geno-type plus environmental factures.

Geno-type + environment → Pheno-type .......... [7]
The study has to use the previous descriptions, and they have to be applied to efficient spaces in the cases study. The study has to investigate the spaces and features of traditional Islamic inheritance houses that according to the function architectural shapes to the efficient spaces in Islamic inheritance houses in the traditional cities.

The hypotheses of the research supposed that: "the efficient spaces are sustainable spaces because its approved a successful social, environment and economic goals".

4. Previous studies

Many studies classified the components of Islamic inheritance houses such as: the study of (Mohammed, w.) which classified in two parts; the first is conceptual Characteristics of the local traditional architecture, while the second part is Physical components of the local traditional architectural which has two sections; elements and spaces as shown in 'figure.3'. [5]. The study didn’t tackle the sustainable efficient spaces in the Islamic inheritance houses.

![Figure 3. The physical components of the local inheritance houses.[5]](image)

While Farry k supposed in his manuscript “Gulf Islamic Architecture” that the local traditional architecture hade four elements. These elements can be mentioned as: a. wind towers 'figure.4'. b. double enclosure 'figure.5'. c. timber louvers at balconies 'figure.6'. d. portico. [8]. The study didn't approach to the sustainable efficient spaces in the Islamic inheritance houses.
Figure 4. Inheritance house with wind tower. [8].

(a) Typical single enclosure  (b) Typical double enclosure.

Figure 5. (a, b) Single and double enclosure in inheritance houses. [8].

Figure 6. Louvres balconies in Bahrain. [Researcher]
5. Cases study
The study has to extracting the pheno-types, geno-types and other characteristics for the efficient spaces in the Islamic inheritance houses. The study based on the divisions of previous revisions', in some typical Islamic cities in kingdom of Bahrain. The study selected Bahraini cities and elect as the cases study; because it has one of the rich Islamic traditional heritage and Bahrain has not yet lost its historical buildings and traditional city areas, the study has analysed selected five cases study in several cities in the area to reach the sustainable Geno-type and Pheno-type for efficient spaces in Islamic inheritance houses.

5.1. Inheritance house for sh. issa ibin ali
It's an inheritance house founded in the early 19th. Cent. The house is sited in Moharaq traditional city. 'figure. 7', [9].

![Figure 7. Sh. Issa Ibin Ali inheritance house.](image)

This is a huge inheritance houses comparing with surrounded buildings. its plot area about "70m. x 27m.". It has small four courtyards and contain many rooms in the double floors. It can be noticed clearly there are separated functions in each courtyard. One of them is specific for male rooms second one is for the visitors while the third is for family spaces and the last is for the servants. As shown in 'figure. 8', 'figure. 9'.

![Figure 8. Sh. Issa's inheritance house "Ground level and Elev.](image)
5.2. Seiady inheritance house
This inheritance house had been founded in the 19th Cent. sited in Moharaq. Its built on a plot is around four hundred forty meters. There are many ornamentations and richness in the details outdoor and indoor. It had the smallest plot and highest three levels spaces related to the surrounded inheritance houses. The inheritance house is containing double sectors; the first sector is for male while the second is for occupants of the inheritance home. The parts were divided in double courtyard and many functional rooms. As shown in 'figure.10', 'figure.11'.

5.3. Sh. Salmaan's inheritance houses
This inheritance house situated in Al Quthaibiyah, its area around a thousand meters. The inheritance house has two courtyards [10]. Parts of it is using for the efficient functional spaces for the occupants, the second parts were using for servant’s efficient spaces. Each part consists of a court-yard and many efficient functional rooms 'figure.12'.
5.4. Ahmad ibn Khallaf Inheritance House:
The inheritance house was constructed in the initial part of the 20th century. It was owned by the famous pearl merchant in Bahrain. The location of the house is in traditional City (Manama). The inheritance house features or features of many decorative objects. The owner had brought one of the achievement Builders to make a special ornamental work. Material had been used in this house were wood and gypsum, also they and used colors in the interior decorative. The house contains a large central courtyard with many rooms involved around it. The rooms were used for living and some of them were used only in winter season only and others were used in summer season. 'Figure 13'.

5.5. Yusuf Retha Inheritance Houses:
This inheritance house located in Manama and owned by a rich trader man in Bahrain so it's one of the costliest and discriminate house in the Arabian traditional region. It's distinguish comes from the using of Islamic ornamentation and designs, also it has a badger and large courtyard with double floors as shown in 'Figure 14'.
After demonstrated these inheritance houses (cases study) the research Explored that:
1. there were systematized hierarchy in a clear arrangement begun from (sustainable general efficient spaces, then sustainable general-specific efficient spaces, leading to sustainable Specific efficient spaces).
2. These sustainable efficient spaces were worked as balance for the social relations between family and Specific members of society as a whole.

6. Discussion
The spaces creation in Islamic traditional architecture had depend on the principle of sustainable housing, which seeks to achieve the dimensions of social, environmental and economic sustainability, which in turn reflects on the building of sustainable and self-sufficient societies. Based on the five inheritance Islamic cases study and the revisions were discussed in this study, and in order to achieve the research's hypotheses, research has depended to these sustainable spaces:
   1) Sustainable General spaces: "Majlis".
   2) Sustainable Specific spaces: private rooms "Haram".
   3) Sustainable General-Specific spaces: (Wind tower and courtyard) as a one environmental combination related to each other, Services, Entrance, Liwan).

6.1. Sustainable General Spaces: Majlis (Reception)
There is only one General space appearing in the five inheritance houses which the research discussed and analysed as cases study which that; Majlis (Reception). This space has discussed as the followings: 'figure 15'.

6.1.1. Geno-type characteristics
From the social side Geno-type Characteristics expressing and reflecting the beliefs, Customs and traditions of the Islamic society as following:
a. Generally, the specific spaces of the inheritance houses reflect the separation between male and female, which is provided the complete privacy from the social vision. the "Majlis" is conceded the specific room for the male, while the "Haram" which almost is privet for female in same house.

b. To achieve the separation between the entries for male and female, "Majlis" has a private entry coming from the street (neighbourhood), which is separated from internal spaces entry on the ground floor using by the occupants.

c. Usually bent "entrance" connected to the courtyard indirect, where the "Majlis" is opened to the "Liwan" and this provide more privacy.

d. "Majlis" is "semi-enclosed space" because it has windows to the street on the ground floor. It's around 1.5 m height from the ground which gives the privacy to the internal place and in the same time give the visual contact to the streets.

6.1.2 Pheno-type characteristics

From the economic and environmental sides, the pheno-type Characteristics in Majlis appeared as following:

a. Economically, "Majlis" present as a boasting and proudly signs for rich owners. That’s happened throw the doors, decorations' details and ornaments that used indoor and outdoor.

b. Environmentally and Economically "Majlis" has windows that opening to external street of the neighbourhood. These windows almost made from wood or steel artefacts, shutters were done in a definite orientation to use the main wind direction. these details depend and reflect the economic situation of the inheritance house's owner.

c. Economic factor could be a reason to classified the inheritance houses according to the location of the "Majlis" as an interstitial and richness specific details into the followings:

- It has a separated mass and linked to the house.
- It has a self-entity and private courtyard and entrance.
- It has a main hall connected to the main courtyard.
- There is no "Majlis" particularly in the mass.
- The "Majlis" could be in the public coffee shops.

6.2. Sustainable specific spaces: specific rooms (Haram)

There is only one Specific space appearing in the five inheritance houses which the research discussed and analysed as cases study; this space has been discussed as the followings:

6.2.1. Geno-type Characteristics

from the social side Geno-type Characteristics performed and reflecting the privacy and the inward looking for the specific rooms (Haram) which is used almost from women and children in the Islamic society, as following:

a. Bent entrance is a sustainable social space which a solution for the separation between the "majlis" and "haram".

b. "Liwan" is a sustainable social space which have been created to be use in summer seets.

c. Specific rooms for sleeping in summer seasons which have been located in the basement. While the winter rooms usually located in the first floor.

6.2.2. Pheno-type Characteristics

From the economic and environmental sides, the pheno-type Characteristics appeared in the specific rooms as following:

a. Specific spaces and served rooms are annular or semi-annular around the Haram. These rooms rarely had windows and the only direct light comes from doors.

b. There are niches in the bedrooms used to hold stacked water bottles or roses.
c. Opening and details in the specific rooms change according to its location, if the specific room has street view the opening will be small.

d. Haram are classified to winter rooms in the ground floor and summer rooms in the first floor.

6.3. Sustainable General-Specific Spaces

There are many Specific space appearing in the five inheritance houses which the research discusses and analyses them as case studies; these spaces have been discussed as the followings:

6.3.1. Services:

6.3.1.1. Geno-type Characteristics

from the social side Geno-type Characteristics performed and reflecting the privacy and the inward looking for services as following:

a. The servant spaces might be separated for each "Haram" and the "Majlis", or could be associated and located in the middle area between them.

b. The sustainable servants' spaces are hidden to the strangers and guests but close to the "Haram" in the same space.

c. The services were assigned on the roof particularly uses for women, but for the rich people the services could be separated.

6.3.1.2. Pheno-type Characteristics

The restroom in the aristocracy houses provided with step flooring level in the middle of the restroom and some details of bath accessories.

6.3.2. Courtyard and Wind-Tower

The wind tower constructed as an environmental element working through the "positive" and "negative" air pressures of mass structures when exposed to the wind, climatically, wind tower or "air traps" consists as a complementary to the central court yard, the Central courtyard is working as a vacuum in the Significant centre of living area, and it is also an operative combination to resistor heat with the wind tower.

6.3.2.1. Geno-type Characteristics:

Wind tower (air traps) from the social, environmental and economic sides can be divided into following depending on its working way:

- Wind-towers (Badgeer): it's an inheritance style of a sustainable vertical empty element which can provide the internal functional spaces with the cold air during the summer season. Usually the external walls of the "Badgeer" had been built with the sustainable materials (brick) higher than the other masses in the inheritance houses. The wind tower is oriented to get the fresh air according to the main wind direction. The fresh hot air will be changed to a cold fresh air while its movement though the tunnels of the "Badgeer", it reaches to the basement first then it goes to the courtyard. All the sustainable functional spaces will use the cold air in the courtyard. ‘figure 16’.
“Malaqof” opens in the parapet for air catchers: using the concepts of the impression to the wind pressure for the walls of large rooms. “al-malaqof” are horizontally niches which extend in the higher outer wall (parapets). They have different shutters which will control the tunnel or the combination lock from the inheritance house. ‘figure 17’.

“Darawy mlaqaf” wind catcher: it's a shape of difference style of “Al-Badger”, where niches are based between two vertical walls in the roof.

6.3.2. Pheno-type Characteristics
Wind tower contain many different ornaments which depend on the economic factor for the house's owners. It could be designed with a geometric form with a square plan.

6.3.3. The Entrance
6.3.2. Geno-type Characteristics
The entry "entrance": it is the initial component when entering the space for the house. it is not directly (bent entrance) entered the courtyard. It is giving the same purpose of the Muslims' Hijab (women's head cover) or is look like a filter among internal and external inheritance spaces.

6.3.2. Pheno-type Characteristics
Based on the Islamic inheritance houses, the entry arrangements could be as one of the followings:
a. The exposed entry:
It is divided for: direct entry opens straight to the court yard "Housh"/ and: bent entrance which is opening indirect to the court yard "Housh".

b. The protected entry:
It is divided for: direct entry opens straight to the court yard "Housh", and the other is open to the "Liwan"/ and: bent entry opens indirect to the court yard "Housh", and the other is open indirect to the "Liwan".

6.3.4. "Liwan"
Liwan it is a sustainable efficient space with yard covering located either, in the ground floor, or in the first floor with extended roof."Liwan" has three barriers and the fourth sideways is totally exposed to air or might headed by a column or verandah overseeing the internal court-yard. 'figure18'. "Liwan" is the "Majlis" or a broad shaded or closed vault with open entrance.

![Figure18. The "liwan".](image)

6.3.4. 1. Geno-type Characteristics
Socially and environmentally the adaptable nature for "Liwan", it is an open's portion space, although it is covered.

6.3.4. 2. Pheno-type Characteristics
The "Liwan" is opens to the court-yard that is usually has arches and the gravity differs regarding to the design of the house. "Liwan" in the Haram has a variety of forms and carrying ceilings on a series of arched and its vary in their patterns, sometimes "Liwan" floor has been increasing in the ground floor of the court yard.

7. Results
Finally; this research can classify the main efficient characteristics for the selected inheritance houses which act the Islamic inheritance houses as the following classification shown in the table 1.
### Table 1. Efficient characteristics for Bahraini inheritance houses.

| Elements Argument | Sh. Issa b/n Ali inheritance house | Seiady inheritance house | Sh. Salmaan inheritance house | Ahmed b/n Khallaf inheritance house | Yousuf Retha inheritance house |
|-------------------|------------------------------------|--------------------------|------------------------------|-----------------------------------|-------------------------------|
| Location          | Moharraq                           | Moharraq                 | Manama                       | Al Qudaibia                      | Manama                        |
| Year Built        | 1840-1869                          | 1850-1921                | 1790-1820                    | 1900-1925                       | 1930                          |
| Area              | 1890 m²                            | 440 m²                   | 1250 m²                      | 810 m²                           | 1150 m²                       |
| "Majlis"          | General                            | General                  | General                      | General                          | General                       |
| "Haram"           | Specific                           | Specific                 | Specific                     | Specific                         | Specific                       |
| "Wind tower"      | General                            | General                  | General                      | General                          | General                       |
| "Entrance"        | General                            | General                  | General                      | General                          | General                       |
| "Liwan"           | General                            | General                  | General                      | General                          | General                       |
| No. of courtyards | 4                                 | 2                        | 2                           | 1                               | 1                             |
|                  | courtyards                         | courtyards               | courtyards                  | courtyard                        | courtyard                     |

### 8. Conclusions

This research reaches to many social, environmental and economic characteristics in some of the Islamic inheritance houses in Bahrain that were founded. These characteristics will be as the followings:

#### 8.1. Sustainable Geno-type Efficient Features

a. Genetic features in the Islamic selected inheritance houses have three efficient spaces. The efficient spaces are "specific, specific- general and general". Those spaces are opened to a certain courtyard, or they are sharing the same one.

b. The efficient spaces of inheritance houses are: "Majlis" (General-space), "Haram" (Specific-space), services (General-Specific spaces), wind tower and courtyard (General-Specific space), entrance (General-Specific space), liwan (General-Specific space).

c. Some of the Islamic inheritance houses have many levels: ground and first levels: ground level spaces is less privacy from the first level.

d. There is strong separation for these efficient spaces in the Islamic inheritance houses, through the concept of the hierarchy from (Specific spaces) then (Specific-General spaces) then to the (General spaces).

#### 8.2. Sustainable pheno-type efficient features

a. The entrance could be as one of the followings:

   i. exposed entry

   ii. protected entry

b. "Liwan" in the Haram has a variety of forms and carrying ceilings on a series of arched and its vary in their patterns, sometimes "Liwan" floor has been increasing in the ground floor of the courtyard.
c. Wind tower contain many different ornaments which depend on the economic factor for the hose's owners. It could be designed with a geometric form with a square plan.

9. References

[1] Al nuaimi S Mohammed W Ismael N 2019 The Governance of Transportation and Urban Design in Bahrain According to the Fourth Generation Industrial Revolution International Journal of Technology Diffusion (IJTD)

[2] Kehily D 2011 Examines the question of what constitutes a ‘green building’ and explores the United States Green Building Council’s rating system – LEED, Surveyors journal Ireland.

[3] Al-Qeeq F 2010 Sustainability concepts as a comprehensive methodology for evaluating urban plans 3rd Int. Conf. on Engineering and Reconstruction (Gaza).

[4] King G Amoah S Kurup S and Harpende 2010 Genome 53(11) JQ UK

[5] Mohammed W 2014 Genotype And Phenotype In Architecture And Interior Design: Analytical Study Of Traditional Architecture In Arabian Gulf Cities Between 1850 To 1950 Theses of Architectural Engineering Department Kingdom University Bahrain.

[6] Braynen W et al. 2007 Geno-type or Pheno-type? The conflation of two concepts in evolutionary agent-based modeling”. http://www.u.arizona.edu/~wbraynen/papers/genopheno.pdf

[7] Lewontin R. 2007 Biology Under the Influence Dialectical Essays on the Coevolution of Nature and Society Retrieved from /z-wcorg/ database Retrieved from http://public.eblib.com/EBLPublic/PublicView.do?ptiid=1107513

[8] Farry K 2002 Gulf Islamic Architecture oriental press Manama Bahrain.

[9] British Council Bahrain 2001 The architectural features of traditional towns in Bahrain Urban renewal department Ministry of Housing, Bahrain.

[10] Yarwood J 2005 Al-Moharaq architectural Heritage of Bahraini City Sh. Ebrahim bin Mohammed Al-Khalifa Center for Culture and Research Bahrain national library listing p.60.

[11] Lockerbie J 2005 catnaps.org 2013, retrieved from http://www.catnaps.org/islamic/islamgraphics/badgheer01.png