

Adaptive Use of the Courtyard in Contemporary Residential Houses

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Abstract

Local architecture in many countries characterized by use of the courtyard in the buildings in general and the residential houses in particular. The purpose of use was to provide environmental and aesthetic comfort as well as the distributor of the movement while providing privacy to the spaces overlooking it.

Using the courtyard has been the cornerstone of residential design in Islamic and Arab countries, some aesthetic elements have been added to the interior design of the courtyard, such as water and green spaces for environmental comfort, as well as the use of decorative elements and manuscripts on the walls, with the addition of architectural elements such as Iwan and arches to provide aesthetic environment inside the space.

The **research problem** is the use of courtyard in modern housing has been reduced, especially after the entrance of new western structural patterns on traditional pattern (organic), and entrance of new building patterns on the local architecture, which reduce this central space to a secondary space or a group of spaces located in the back and side of the residential house only to provide lighting and ventilation.

The **research focuses** on how to reuse the courtyard in the contemporary houses in accordance with the functional requirements and modern building techniques to give the same positive values of environmental and aesthetic comfort and increase the richness of interior design elements used in the courtyard.

Keywords: courtyard, modern house, interior design elements, aesthetic value.

1. Introduction:

Courtyard is a building element that originated from the hot and dry regions (Edwards, Sibley, Hakim, & Land, 2006). It can be defined as an enclosed area surrounded by a building or wall and open to the sky. The use of inappropriate courtyard forms of some regions, such as the basic form of a courtyard in the centre of the plot does not perform well in the harsh climates of another region. In the tropic, the concept of courtyard form imported from the western countries rather than adapting and applying original and traditional concepts into modern courtyards, making the basic form, such as the doughnut shape, the dominant courtyard form in many Asian countries. In addition, many ancient courtyards in Arab countries have a clear indication that the design variants of courtyard have been designed and improved by the integration of social, cultural and environmental factors. The variations of the design variations such as area, number of floors, orientation, exposure, types of wall and many more were introduced to achieve successful oriented courtyard that respond to the human needs (Reynolds, 2002) (Almhafdy, Ibrahim, Ahmad, & Yahya, 6-8 September 2013).

The courtyard is a form of construction that have a presence since the humans started to build their houses (Bridson, 2012). Generally, this design familiar in the arid climate of the Middle East, gradually courtyards transformed as more and more of its area covered, so that activities that once took place outdoors begin to take place indoors. Courtyards are enclosed outdoor spaces but are normally open to the elements at their top; another definition of the courtyard is "An unroofed area that is completely or partially enclosed by walls or buildings, typically one forming part of a castle or large house" (Lea, Runcie, & (Eds.), 2002). A courtyard is a common design feature, which has been applied for thousands of years in many parts of the world particularly in houses. Courtyard used in basic as a gathering place for house users', and for daily particular purposes in another area it is used as encode (Edwards, Sibley, Hakim, & Land, 2006). Edward (2006) reveals in his book *The Past, Present and Future of the courtyard*, that the courtyards do not belong to one specific period of history; it seems that it had always been around. The idea of courtyards as a plan configuration goes back thousands of years to Neolithic settlements.

To deep understanding of court in all guises, it is useful to introduce the fundamental topological difference, between courtyard house (interior) and terraced house (exterior). The courtyard house a sign of urban pattern through the time, especially in hot region Middle East and North of African as an example, which offer an exclusive private function of the household. A terraced or (row) house always lies in road faces in it and is directly accessible to it from the outside (Petrucchioli, 2006). Guy Petherbridge offers an overall explanation for the dispersal of the courtyard house types by

distinguishing two varieties: “The interior courtyard house, where the house encloses a courtyard characteristic of urban areas, and the exterior courtyard house where the courtyard borders the house providing protected area, contiguous with the dwelling units but not enclosed by them” (Petherbridge, 1978) (Abass, Ismail, & Solla, Vol. 11, No. 4, February 2016, p. 2557).

2. History Evaluation of Courtyard Form

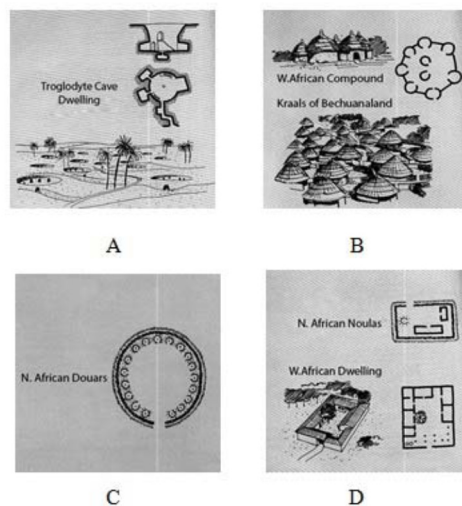
2.1. Introduction of the history of courtyard house

Courtyard housing known as the oldest form of residence. The historical evolution of courtyard form a cross the world showed in ancient civilization from excavated at Kahun in Egypt, which back to 5000 years old to the Chaldean City of Ur before 2000 B.C. (Oliver, 2003). The characteristics of courtyard housing depend on the environment and culture of a group of the specific region; for example, courtyards may use as an inner garden, or there may function as the focal point in the house. Through thousands of years different courtyard housing, planning demonstrated, Sumer and Pharaonic Egypt recorded as the oldest culture of the Middle East, which hold the oldest example of the courtyard (Ayhan & Neslihan, 2011). Later on, this type of building was seen in western cultures such as Greek and Rome (Abdulac, 1981). In Italy at 700 B.C, a new courtyard design which refer as atrium house, developed from the old form, the purpose of this type is to provide private outdoor space, atrium house met up with the Greek pre-style which has a different design, the design showed small courtyard enclosed by columns (Blaser, 1985). In the Middle East courtyard houses an architecture tool, hat are common in hot and dry climatic and endure in many ancient cities and attempts to generate private area for introversion (Al-Azzawi, 1994) (Abass, Ismail, & Solla, Vol. 11, No. 4, February 2016, p. 2557).

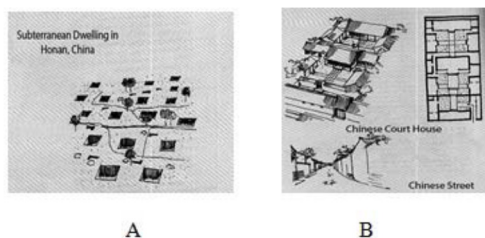
2.2. Ancient civilizations

A troglodyte village in Matmatas of Southern Tunisia the most primeval and homogeneous society to build courtyard houses, according to Schoenauer and Seeman “Each dwelling-unit is built around a carter open to the sky with slope wall and flat bottom” (Schoenauer & Seeman, 1962). Douars in North Africa, encampment of nomadic tribes in West Africa, the Kraals of Bechunaland in South of Africa and the first rectangular dwellings in Morocco introduced the first prototype of courtyard (Das, 2006).

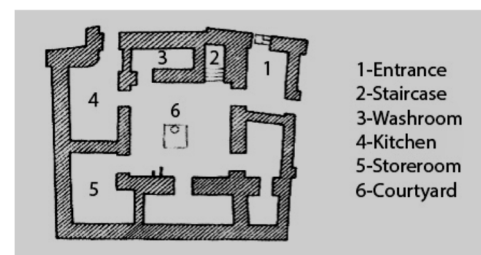
(Figure-1) shows different types of courtyard plans in Africa (Abass, Ismail, & Solla, Vol. 11, No. 4, February 2016, p. 2558).



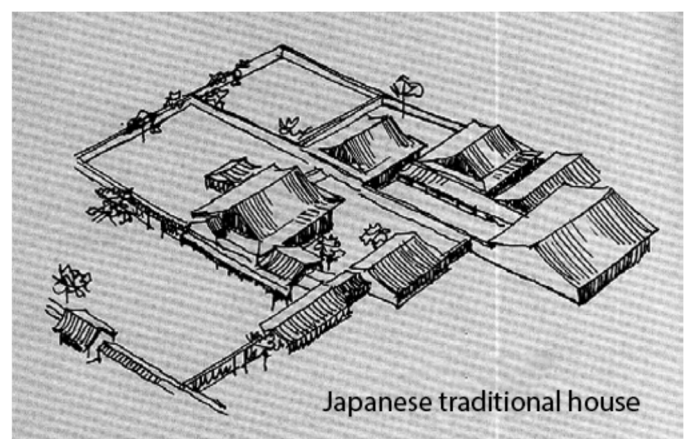
(Figure-1) (A-D) Different types of courtyard form in Africa (Schoenauer & Seeman, The courtyard house, 1962) .



(Figure-3) (A-B) Typical layout of Chinese dwelling and courtyard houses (Schoenauer & Seeman, The courtyard house, 1962)



(Figure-2) Plan of House at Ur, Mesopotamia (Al-Dawoud. 2006)

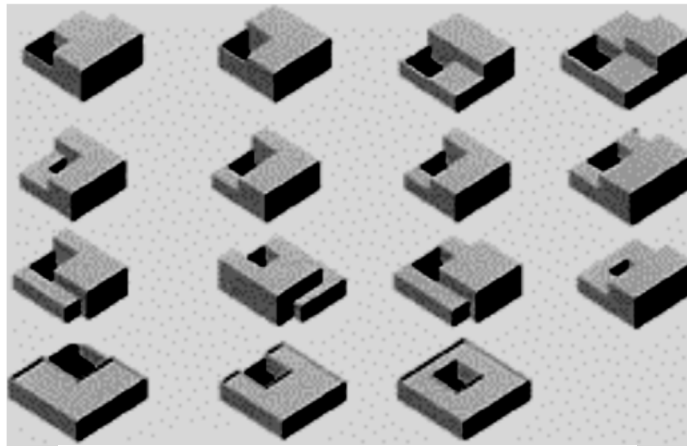


(Figure-4) Typical layout of Japanese traditional house (Schoenauer & Seeman, The courtyard house, 1962)

Another example that reveals in archeological survey found at Ur on the Euphrates River in Mesopotamia in 2000 B.C (Figure-2). The plan showed a square courtyard that surrounded by rooms in Ground floor, and the second floor of the house open to courtyard, the building material in that era mainly from fired brick (Blaser, 1985). In China (Figure-3), primary houses have significant influenced by religion and the philosophy of Yin and Yan (Schoenauer & Seeman, 1962), the purpose was different the courtyard used for privacy and meditation. Even the form has another attribute from the first example at Ur (Abass, Ismail, & Solla, Vol. 11, No. 4, February 2016, p. 2559).

3. Courtyard Configuration:

Courtyard does not have a specific plan, the first design of courtyard housing is usually rectangular, square and circle. These forms have been converting to accomplish ecological aspects such as site limitation, topography, building orientation and function to produce new forms [U shape, L shape, T shape, V shape, H shape or Y shape] (Figure-5) shows different possible forms for a single-family courtyard of one or two storeys. The scale and size of the courtyard can be adjusted from very close to expansive the space. Based on literature survey, it may say that the courtyard design can be fully or semi enclosed or surrendered by only two walls (Meir, Pearlmutter, & Etzion, 1995).



(Figure-5) Different possible forms for a single family courtyard of one or two storeys

(Edwards, Sibley, Hakim, & Land, 2006).

Different studies are carried out to examine critically the performance of courtyard forms and elements at both urban and architecture levels. This study helps to define the shortcoming, difficulties and the potential of future design development. Rectangular layout of courtyard studied by (Tablada, Blocken, Carmeliet, De Troyer, & Verschure, 2005); the study recommended this form to protect the building from solar radiation and dusty wind. Three side courtyard created preferable climate condition, especially when the orientation and ventilation sought during the design process (Meir, Pearlmutter, & Etzion, 1995). (Muhaisen, 2006) investigated rectangular form proposition to gain the extreme effect in summer and winter in four climates, while (Rajapaksha, Nagai, & Okumiya, 2003) developed ecological condition through natural ventilation in high-rise residential buildings by used internal courtyard. Orientation, wall enclosure and natural elements of the courtyard were investigated as an essential architectural element, within

each housing unit. The significant role-play by these elements proved their effectiveness with regard to climatic and social aspect that characterizes the building environment (Abass, Ismail, & Solla, Vol. 11, No. 4, February 2016, pp. 2560-2561).

4. Orientation

In many cases, orientation of courtyard depends on the building layout. Variables that can positively affect the microclimate condition within the courtyard are sun location, wind direction, shading performance and solar gain (Bagneid, 2006). The orientation has also direct effect with the ventilation or wind speed. For instance, (Meir, Pearlmutter, & Etzion, 1995) has concluded that the correct orientation of courtyard can improve their thermal comfort; however, orienting them irrespective of solar angles and wind direction may create thermal discomfort (Almhafdy A. , Ibrahim, Ahmad, & Yahya, 2013, p. 173).

5. Courtyard Benefits

Courtyard plays a significant part in determining climatic environment, physical and psychological in the courtyard house, over the time, many profits of courtyard cited by scholars in order to define courtyard social and ecological functions. These benefits are psycho-social benefits, cultural benefits, religious benefits, economic benefits, climatic benefits and architectural benefits. (Abass, Ismail, & Solla, Vol. 11, No. 4, February 2016, p. 2561)

5.1. Psycho- Social benefit

The basis of the profits of the courtyard is a finding of it is inner form, which offers a sense of confidentiality and enclosure to the form and residents of the house (Sthapak & Bandyopadhyay, 2014). However many theories' set the court acts as:

- Courtyard works as an extension of the kitchen during the morning and as living room during the evening to entertain the guests.
- A space for interaction for all family members, and encourage the family to act as a group.

- Visual privacy, when the court visually secluded, by screening or walled entrances.
- Sleeping area during the night when the climate is conducive to outdoor activity.
- Acoustical privacy, enclosure elements works as a noise barrier between the courthouse and outside area.

According to (Rust, 2010), courtyard can play a role in healing procedure, the architect could add courtyard features as a stamp of building design, Shade, water, trees and flowers an example of these features, also wind tower, pavement and colors all these could provide positive effects towards the five senses of the human body. Study at Hong Kong university campus by (Lau & Yang, 2009), to produce healing impact into university campus showed that garden within a courtyard that located normally at the entrance and the meditation garden found near the campus library, has specific purposes and should has a differentiate pattern and landscape design. The meditation garden is better for study environment, while the garden with in courtyard support public social interaction. (Toone, 2008) evaluated in his study the effect of healing gardens in order to reduce stress in children medical center in Austin, the finding revealed that the stress level is lower when patient sitting at healing garden more than the indoor area (Abass, Ismail, & Solla, Vol. 11, No. 4, February 2016, p. 2561).

5.2. Cultural benefit

Use of more than one courtyard found in many cases. This is usually to segregate the public and private spaces within the house. The public is mainly for guest and generally used by male (especially in Islamic countries). The inner court is more restricted to the family used as an outdoor area for activity and used by female (Blaser, 1985) (Abass, Ismail, & Solla, Vol. 11, No. 4, February 2016, pp. 2561-2562).

5.3. Religious benefit

The courtyard is both symbolically and religiously significant. This open-to-sky yet enclosed space within the surrounding walls of a house has been considered the central focus of interest in the house (Blaser, 1985). The courtyard may symbolize many things: the central focus of interest in the house; a concentration of light, wind, sand and water; a private, safe and life sustaining refuge.

5.4. Climatic benefit

Courtyards have been generally referred to as a microclimate changer, due to their ability to mitigate high temperatures, channel breezes and adjust the degree of humidity (Saxon, 1986). Courtyards also were acting as a source of airflow thermal comfort to the residence. With right position to the house and suitable material, it can also help to reduce the heat gain and this will act efficiently with the properties of self-shading and thermal lag. Finally, courtyard acts like a cool air reservoir, especially in hot-arid climates (Sthapak & Bandyopadhyay, 2014) (Abass, Ismail, & Solla, Vol. 11, No. 4, February 2016, p. 2562).

5.5. Architecture benefit

Courtyards generally function as a center in buildings and houses, connecting the different areas and functions. The significance of courtyard by it is the central position enclosed by various landscape and tree elements, which play an important role in our social and working life (Meir I. , 2000). Moreover, it fulfills visual and acoustic protection to the building as well as climatic, for this reason geometry of the courtyard and the properties of finishing materials should take priority during design the stage to afford a high level of thermal comfort (Meir I. , 2000).

6. Courtyard Natural Elements:

The natural elements within courtyard found that increase the thermal comfort, and have potential to reproduction environment benefits, as an, example shrubs, trees and flower plant by shaded areas, which sit up by. Thus, used water body, water spray and tent was found that the internal courtyard and surrounding area be cooler especially during the sunny hours (Almhafdy A. , Ibrahim, Ahmad, & Yahya, 2013).

Previous studies showed the significant effects of courtyard's elements to modify the surrounding environment through reducing solar radiation, lower the air temperature by landscaping shading and other function, which will provide thermal comfort for users' (Abass, Ismail, & Solla, Vol. 11, No. 4, February 2016, p. 2561).

6.1. Elements of traditional courtyard substance

In the traditional courtyard of the material components in accordance with the hierarchy of classification, it can be divided into independent elements and boundary elements. It is a simple point and surface elements. Independent elements in the organization of the garden space is often easy to become the visual focus. Traditional courtyard space boundary factors and their effect:

Boundary elements are divided into horizontal and vertical, vertical elements of the main walls, doors, windows and other architectural and screen wall, there are elements of level ground, grass, water and so on.

1. Walls:

Enclosure wall as the main elements in the courtyard space, enclosed in a continuous surface to produce a wealth of space.

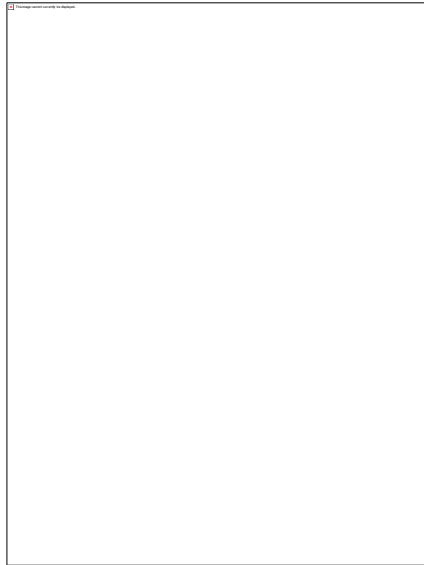
2. Construction of doors and windows:

Building doors and windows are essential elements of a surface contact with the indoor courtyard. Doors and windows open, you can naturally into the room, while traditional courtyard space through doors and windows make the building and the courtyard space with communication opportunities, indoor and outdoor space penetration, it is garden space agency complex features the perfect embodiment. In traditional houses doors and windows are made of wood, and sometimes they used colored glass (figure-6).

3. Al-Iwan:

It is a distributed space for other spaces and it is also used for seating and social activates, be on the level of one or two floors.

The structure of Al-Iwan is based on columns made of wood in different forms and aesthetic values (figure-7).



(Figure-6)

Construction of windows in
traditional courtyard houses

(<https://www.pinterest.com/pin/335377503495810631/>)



(Figure-7)

Iwan and traditional columns

4. Water Surface:

Water elements exist in the form of a traditional courtyard area features hydrostatic usually exists with traditional point and dynamic form of the fountain in the form of very different (figure-8).

5. Ground:

Traditional courtyard paving and more with bricks or tiles, which is very rich paving patterns, usually show aesthetic needs.

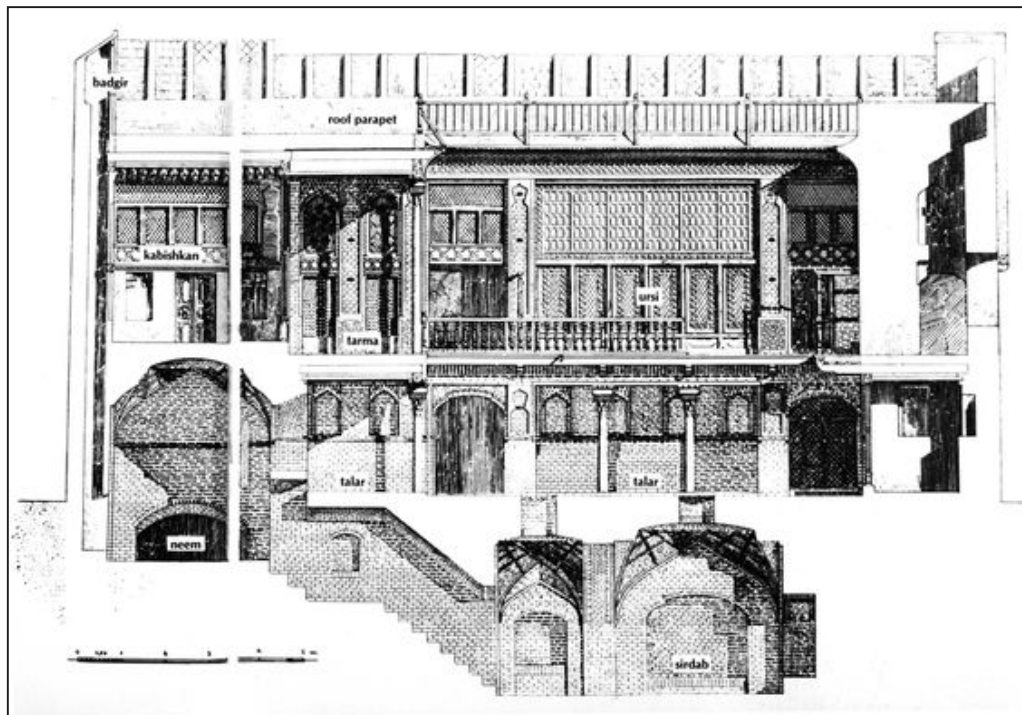
Sometimes grounds are planted with plants that help to improve the internal environment of the house (figure-8).



(Figure-8)

Water surface and ground in traditional courtyard house

(<https://www.pinterest.com/pin/181269953726479219/>)



(Figure-9)

Section shows the interior elements in traditional courtyard house

(<https://www.pinterest.com/pin/737323770217589569/>)

7. Stages of Change in the Courtyard:

- 1- The open courtyard is transformed into a middle space enclosed from the top and sides and transformed from an environmental function for ventilation and lighting to the space used for sitting purposes as a living room with distribution to other spaces associated with the living space.
- 2- The next stage is the process of setback that appeared on the residential lands as a result of streets development, and the entry of a car as a key factor in determining the main axes of movement in cities. As a result, the front garden appeared as an open space in front of the residential house and at the same time, the back garden has emerged as an alternative solution to provide an open space for lighting and ventilation.

- 3- As for the next stage, and with the change of the residential style, the concept of the middle space has been reduced and the internal courtyard has been replaced by relatively small secondary spaces used for lighting and ventilation purposes.

8. Reasons to Decline the Use of Courtyard:

8.1. Urban Planning

With the change of the urban system of traditional city, which is based on the urban fabric combined with the existence of a dynamic hierarchy of the spaces of this fabric to another system based on the grid iron system after the entry of the car to this system, that led to change the direction of the opening of houses from inside to the outside.

The new urban planning is based on the existence of plots of land with determinants with the residential street in addition to the neighborhoods where the new building laws require the setback from the sidewalk with a distance depends on the width of the street, as well as the building area requires a percentage of the land used as an open areas. All those planning factors led to the lack of thinking about the use of the internal courtyard as an important part of the residential system (Figures 10 & 11).



(Figure-10)

The modern urban planning



(Figure-11)

The Tradition urban planning

8.2. Building Pattern

Changing the traditional building pattern which was based on the existence of an open middle space based on the kinetic, visual and environmental system of the residential unit to a new construction style based on a group of spaces interconnected through the corridor of mobility and spaces distributed to the internal movement such as the hall behind the kitchen space and reception. The new structural style has changed the orientation of the residential unit from the inside to outside with the distribution of the open spaces to the front, back and sides.

8.3. Environmental Factors

The main function of the courtyard in traditional housing is to provide factors of solar lighting and natural ventilation of the spaces overlooking it. The courtyard helped also to provide environmental comfort for the inhabitants of the housing unit with another factors such as providing green areas within the yard to achieve positive environmental sustainability of the unit.

All the elements of the residential unit, such as basement, courtyard, arcades, and iwan worked as an integrated system provides all the factors of environmental comfort. The entry of the new structural system based primarily on the functional requirements and changing the orientation from the inside to outside.

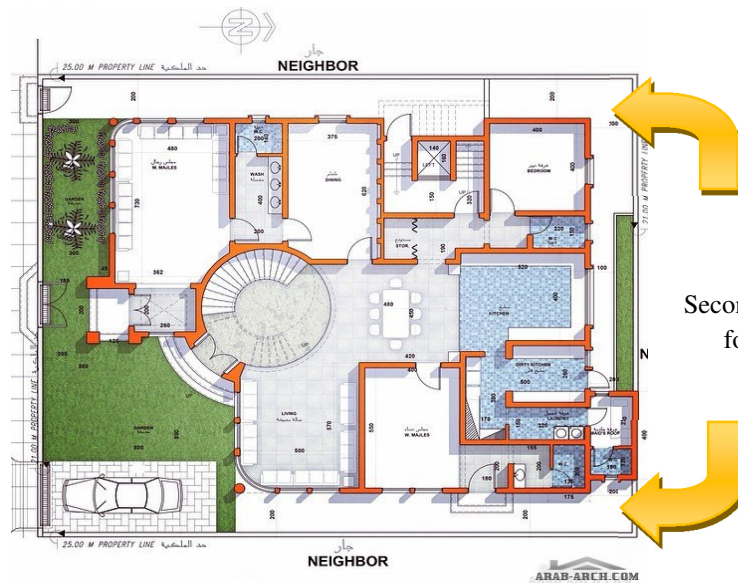
The modern housing unit lost all of the traditional elements, replaced by secondary spaces of the side or open back for ventilation purposes and provide natural lighting of the spaces overlooking (Figure-12).

This has been reflected in the distributed space (Hall), which is often without natural lighting and ventilation. From that it can be said that the central inner courtyard has transformed from a dominant positive space to a negative space as a result of the building block of the residential unit.

8.4. Social privacy factors:

The inner courtyard provides privacy in movement, visual and social, through a graded system in the privacy of the traditional residential unit. Thus, the inner courtyard works to connect the public and private spaces in a gradual system to ensure the privacy and

visual isolation of the spaces within the residential unit, which is associated to the religious beliefs of the Islamic community.



(Figure-12)

Secondary spaces in modern house
for lighting and ventilation.

In addition to the existence of high social value of the internal courtyard through the realization of social interaction between family members and those allowed to be present within this space, while in contemporary housing and with the change of the visual system and mobility space lost the link between public and private spaces as well as the loss of its functions and social interactional functions inside it and moved from this space to other spaces such as living or kitchen sometimes.

8.5. Aesthetic Factors

In addition to the social and environmental factors of the inner courtyard, this space works to achieve the interior design factors of the traditional residential unit through the presence of elements and vocabulary that give aesthetic values and enrichment of the middle space. Those elements are all the elements of decoration and geometric inscriptions on the space walls, such as arches, geometry decorating, and domes, which give aesthetic complexity to the visual scene of this space. In addition to the use of finishing materials for floors and walls that give richness to the internal courtyard such as marble, stone, glazed ceramic tiles.

In contemporary housing unit and with the absence of orientation towards the interior, there has been an interest in the exterior facades of the residential unit, the focus has shifted from the internal space design to the exterior housing unit design. This led to loss elements of surprise and beauty inside the housing unit that existed inside the inner courtyard (Figure-13).



(Figure-13)

The modern elevation - change of orientation in house form inside to outside

9. New Proposals for Roofs Over Courtyards:

Retractable roof is a kinetic architectural system protecting architectural spaces against extreme weather condition and at the same time can add to aesthetic and functional value of architectural spaces. Therefore, it is not just a covering system that is to be closed and opened on the basis of our requirements but it can also be considered as a piece of art by means of mechanisms it employs in its movement and transformation.

Retractable roof systems could be roughly classified into two types of rigid and flexible coverings. Rigid retractable Roofs are mostly used to cover large-scale spaces, while flexible ones are commonly applied in smaller spans (Asefi, Valadi, & Salari, 2018, p.1).

9.1. Examples of Existing Retractable Roofs for Building Courtyards:

9.1.1. Alden Biesen in Belgium:

In the retractable roof above Alden Biesen in Belgium, the objective of creating an adaptable cover in courtyard is fully obtained by employing an umbrella mechanism. In this courtyard due to the scale and application of the space, it has been possible to locate carrying columns. By dividing the covered surface in to four segments, the scale has been feasible to apply umbrella system.

In addition, each of these segments is independent in erecting. While this system could not provide complete sealing, it is proper for this design due to the weather condition. Translucent white PVC coated polyester which is applied in this roof fulfills required illumination. The redness of the brick façades is reflected and creates a warm colored ceiling (Figure-14) (www.tensinet.com/files/TensiNet.../TensiNews14p1.pdf).



Figure-14

Alden Biesen retractable roof in Belgium.

(www.tensinet.com/files/TensiNet.../TensiNews14p1.pdf , 2012)

9.1.2. City Creek Center retractable roof in Utah:

In City Creek Center project a six-panel retractable skylight on each block arches above the central walkway, creating an indoor shopping environment during Utah's snowy season. The panels open to admit sunlight and fresh air, and reduce the demand

for air conditioning in warmer months. Being located between two buildings, enables the skylight's segments to move above the adjacent buildings' roof. As the segments, move to the open position, five of the panels in each skylight bow down, moving their cantilevered arches out of the view of the public areas below. In this roof, a rigid retractable structure has provided precise movement and sealing of the segments (Figure-15) (<http://www.sfgate.com/business/article/Mormon-hurch-building-mega-mall-in-Salt-Lake-City-3414004.php>, n.d.) [3], [4].



Figure-15

City Creek Center retractable roof in Utah

(<http://www.sfgate.com/business/article/Mormon-hurch-building-mega-mall-in-Salt-Lake->

9.1.3. Town Hall in Vienna:

Bunching roof of Town Hall in Vienna with parallel movements cover a space in order to protect from dazzling sunlight while also allows having natural ventilation. Lightweight membrane cover of this roof enables the sliding mechanism move easily (Figure-16) (www.sbp.de/en/build/.../973Arkadenhof_Rathaus_Wien.pdf, n.d.).

10. Conclusions:

The need to adaptive use of the inner courtyard in the contemporary residential house:

For the purpose of adaptive use of the inner courtyard to become efficient in contemporary housing. This recruitment does not reach to the ideal situation in which this space was used in the old unit, considering that it achieved the total aesthetic, social,

environmental and functional factors, but it is possible to achieve the part of those factors to meet the needs of the inhabitant.



Figure-16

Town Hall retractable roof in Vienna
www.sbp.de/en/build/.../973Arkadenhof_Rathaus_Wien.pdf, n.d.)

There are a number of obstacles that hinder the re-employment of the inner courtyard:

10.1. Residential Area:

With regard to the area of residential, it can be re-employed in small residential units, which may reach 150-200 square meters. Thus, the inner courtyard of the house works as an internal garden of the house in which the provision of lighting and ventilation for the rest of the house spaces such as living room, kitchen, bedrooms, and the rest of the other services.

10.2. Environmental Factors

In contemporary housing we find direct connection between the spaces of the residential unit and the outside or the spaces that are open. On the other hand, in the traditional residential unit there is a semi-isolation between the courtyard and the other

spaces, and this is done through the iwan or the gallery surrounding the courtyard. This is clearly visible in the general structures, such as mosques and palaces in the Islamic era.

For the purpose of employing the internal courtyard within modern housing, despite the existence of environmental obstacles, the space between the interior courtyard and the spaces that overlooking on it such galleries, arcades and iwan, can be used to minimize the negative effects of wind and heat due to intense lighting.

It is possible to use the method of closing and opening between the spaces and the inner courtyard through the use of sliding partitions that use glass in the construction to maintain visual connection between the inner courtyard and spaces overlooking. It is also possible to use a movable glass roof to control undesirable environmental factors while at the same time achieving environmental and visual connection between the inner courtyard and the outside.

10.3. Functional Factors

Changing the direction of the opening of spaces from the inside to outside in contemporary housing and losing the courtyard which connected between public and private spaces, this has weakened the social privacy for the inhabitants.

In order to solve this problem, the inner courtyard can be used to achieve the visual isolation of private spaces such as bedrooms, at the same time, the unit can keep its openness to the outside for less private spaces such as reception and living, thus providing more dynamic and flexible solutions to the residential unit.

The inner courtyard can be converted to one side of the unit so that some spaces can be directed to the courtyard, such as the bedrooms.

All those design solutions for the inner courtyard help to achieve high value for the interior design of the residential unit through the addition of decorative elements and architectural elements of the walls and use of colors and different finishes for this space to achieve the elements of enrichment and aesthetic in addition to achieve the element of surprise and interesting to the recipient.

11. Recommendations

- 1- Inner courtyard an important element in the residential home must be taken in the design of modern housing units to meet the needs of residents in aesthetic, environmental and social aspects.

- 2- At the urban level, there should be coordination among the designers of the residential units to be the inner courtyards of the residential units being adjacent to achieving large open spaces for residential units and providing more natural lighting and ventilation.
- 3- Public awareness about the importance of the inner courtyard in the designs of residential units and this awareness at the level of members of the community or the elite of designers as well as in academic education.
- 4- The existence of a series of studies on the use of internal courtyard in the design of housing units at the level of Iraq and the Kurdistan region, especially studies relating to the dimensions of the appropriate yard and signed in the housing unit certified to study environmental aspects such as solar guidance and wind movement.

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