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Technological and behavioral aspects of perforated building envelopes in the Mediterranean region

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Abstract

Perforated building envelope presents a global contemporary architectural trend which is connected – in some circumstances – to the traditional perforated models, such as 'Mashrabiyya', 'Takhtabush', 'Qmariyyah', etc. This study focuses on perforated models that have archetypical perforated elements within buildings and have technological and behavioural functions reflecting socio-cultural values, economic situation, and environmental needs of the building's users. An analytical comparison (technologically and behaviourally) has been conducted between the selected contemporary cases of perforated buildings and the traditional models, by considering various aspects of the building's envelope, and taking into consideration the interaction between perforated envelopes and occupants. After discussing the global trend, an ultimate goal of this paper is to discuss the appropriateness and potentials of advanced solutions of contemporary perforated envelopes in the Mediterranean region in order for an appropriate integration of technological and behavioural aspects to be obtained in the future of this trend.

Keywords: Contemporary perforated envelope, traditional perforated models, appropriateness, technical and behavioral aspects, users interactions, Mediterranean region.

1. Chronological transformation of perforation

A historical reading of architecture is not the main focus of this study, but an important highlighting for the transformation of perforation ideas can be clarified briefly. The architectural and urban production of the old cities or villages stemmed from the nature of each society, and reflected the realistic image of life of each community [1]. The relationships between the traditional cities and the socio-economic and socio-cultural contexts are also connected to the climate and to the environmental context [2]. Many examples showed that the urban fabric of the old cities was derived from the dynamic synthesis of environmental, social and cultural factors. Streets, alleys, and squares played an integrative role on the environmental and socio-cultural levels. Furthermore, buildings were interlocked to each other (back to back buildings), as one system considering environmental role and socio-cultural connections. This was common in the tropical and in the temperate climatic regions (e.g. the Arab world and the Mediterranean region), a thermal balance was obtained in the traditional buildings to provide a thermal comfort for occupants in hot summer and cold winter, during the day and at night. The balance was evidential in the flooring system, in the underground floor, and in the setbacks of upper floors [3]. It is worth mentioning that the emergence of traditional perforated elements in the architecture of these contexts helped to: (a) enhance the integrative system, (b) allow the passage of natural air, (c) provide an indirect natural lighting, and (d) produce shade and shadows, in addition to its important role in achieving the privacy for occupants.

The use of perforation has endured later (in modern cities, in urban expansion zones, in urban fringes, or in rural contexts) as a functional response to the climatic conditions to some extent. Three different approaches synthetize the wide range of the accumulated experiences: an approach during the 20th century, which was disconnected from the past, by using the perforation slightly in a functional way (e.g., 'Notre dame du haut', 'Unité d'habitation de Marseille', and 'Maison de Jeunes' by Le Corbusier). The second approach was a disparity of perspectives between imitating, copying, or reshaping of the traditional architectural perforated models in their form [4], accompanying with other individual innovations that took both function and identity into consideration (e.g. 'Dar Assalam' by Hassan Fathy and 'Institute of the Arab World' by Jean Nouvel). Thirdly, by the beginnings of the 21st century, a new rising trend of perforation has emerged in the world, by a significant change of techniques, technologies, functions, materials, and other related aspects (e.g. 'Abbink X

de Haas House', 'Seville Ceramics Museum', 'San Telmo' Museum Extension). The new trend can be perceived to some extent as an architectural leap of perforation as it has emerged in conjunction with digital technologies. The contemporary concepts of buildings' envelopes reflect the complexity of themes focused not only on environmental design, where the external appearance of a building was recognized, but also on the relationships between indoor and the outdoor environments. Accordingly, the connection between the contemporary trend and the traditional solutions has the opportunities to rethink of the future advancements in building envelope in terms of shape, form and performance.

2. Types of the traditional perforations

There were several perforated elements or models in the traditional buildings, in different regions of the world, especially regions that have temperate or tropical climate. This is quite rational due to the appropriate motivations responding to the climatic conditions. Furthermore, the socio-cultural considerations have stimulated the use of perforation in certain regions of the world, especially in the conservative communities. Several types of perforation have emerged in the past and epitomized in models such as 'Mashrabiya', 'Takhtabush', 'Taqa', and 'Qamariya', in the perforated roofs or domes. These models can be shortly explained as follows:

1. 'Mashrabiya' is one of the leading attributes of the Arab-Islamic architecture; it can be observed in the old cities of Baghdad, Damascus, Cairo, Jeddah, Tunis, etc. (Fig.1). The 'Mashrabiya' has many functions; controlling the passage of daylight, controlling the natural air flow, cooling of the natural air, and assuring a considerable level of privacy that is essential in the conservative Islamic communities. According to Hassan Fathy [5], the south sunlight entering a room has two components: the direct high-intensity sunlight and the lower intensity reflected glare. The perforations of 'Mashrabiya intercept the direct solar radiation, and soften the uncomfortable glare. The 'Mashrabiya' provides security and its form is considered as an aesthetic value. It is covered by a wooden lattice (a structure consisting of strips of wood crossed and fastened together with a certain shaped spaces left between them). It is used as an archetypical element to provide privacy which is a main factor (visually, acoustically, and olfactory) in Arab-Islamic culture [6]. The latticed screen has openable windows which provides flexibility for the interaction between users and the envelope. As observed and mentioned there, the exhibited archaeological models of 'Mashrabiya' in the Louvre Museum, shows that the terracotta material was also used historically for the latticed screens in some regions such as Iran and India.

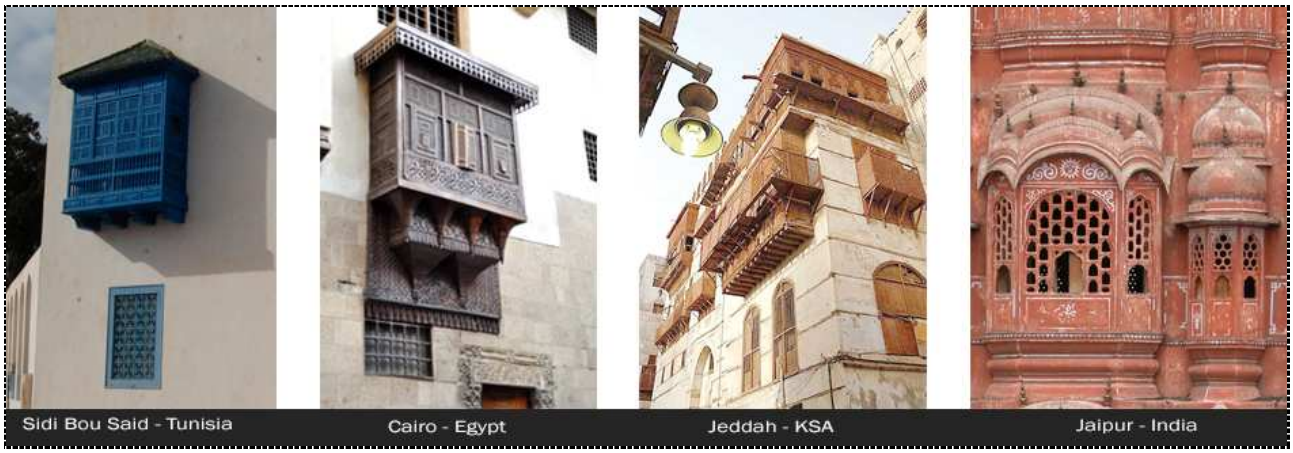

Figure 1: Examples of the Mashrabiya in different regions.
References from left to right: photo by M.L.G. 2013; http://www.sowarmasraya.com/ImageInfoPreview.aspx?PhotoId=21066>, (06/2015); <http://archive.aawsat.com/details.asp?section=54&issueno=12507&article=718475#.VYwg-htViko>, (06/2015); https://upload.wikimedia.org/wikipedia/commons/7/7a/Detail_Palace_of_the_Winds%2C_Jaipur.jpg>, (06/2015).

2. 'Qamariya' is a sort of nearly semi-circular openings. The first use of 'Qamariya' was before 4000 years ago in the era of the state of Sheba in Yemen [7]. It was mostly covered by a colored glass, and was located above an external window, or above the main door, to produce a colored daylight inside the internal spaces as an aesthetic value. The perforation of 'Qamariya' had several shapes (Fig. 2), decorations (foils or leaves patterns), colors, techniques, etc. Similar elements were used in the Gothic architecture, in another shape and with different meanings, to play a role in the symbolism of light [8].

3. ‘Taqa’ is a small simply-shaped opening (rectangular, square, etc.). It was used in a linear, in a diamond, or in hierarchical arrangement at the end of the building’s facades as clarified by Jihad Awad [9], or above windows and doors (Fig. 2). These elements played a good role in facilitating the natural ventilation, and in increasing the passage of natural light into the building.

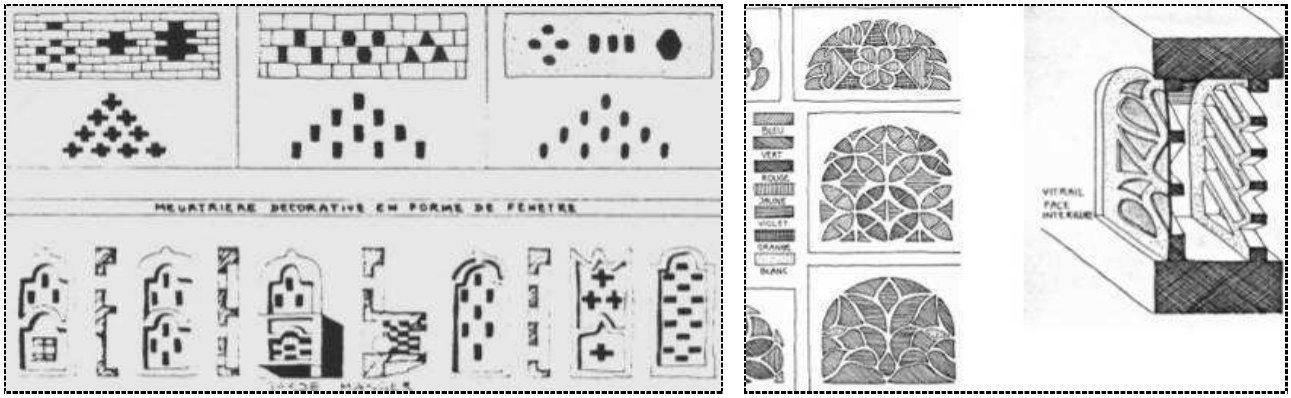

Figure 2: Taqa (left), & Qamariya (right), Yemen, <http://www.slideshare.net/Iman_Ahmed/105-archenv> (06/15).

4. The ‘Takhtabush’ is a setting area between the house courtyard and the backyard (type of loggia), with perforated panels that provide shade and increase privacy in the semi-outdoor setting area. As it is located between two open spaces, a stream of natural air permeates the place of setting by convection property [1], which offers a comfortable setting area for occupants.

Figure 3: An example of the Takhtabush in Suhaymi house - Egypt.
References from left to right: <http://archive.unu.edu/unupress/unupbooks/80a01e/80A01E13.gif >, (06/2015); <http://3.bp.blogspot.com/-op-35y6jkoc/T7MDMec2RfI/AAAAAAAAKZ0/XTeWgCJ3Q_w/s1600/20844100.jpg>, (06/2015).

5. The perforated roofs or domes (Fig. 4) are sometimes classified as ‘Qamariya’, but they were a perforation into the roofs or domes, by making small cylindrical holes, to enhance the passage of daylight to the interior spaces that require extra-lighting, without prejudice to the concept of privacy (e.g. Ayoubi Castle, Halab - Syria, & Turkish bath, Hebron - Palestine). Sometimes, glass bottles or something else closed the holes, to prevent rainwater from going inside (based on Hebron Rehabilitation Committee archives for the historical Turkish Bath).

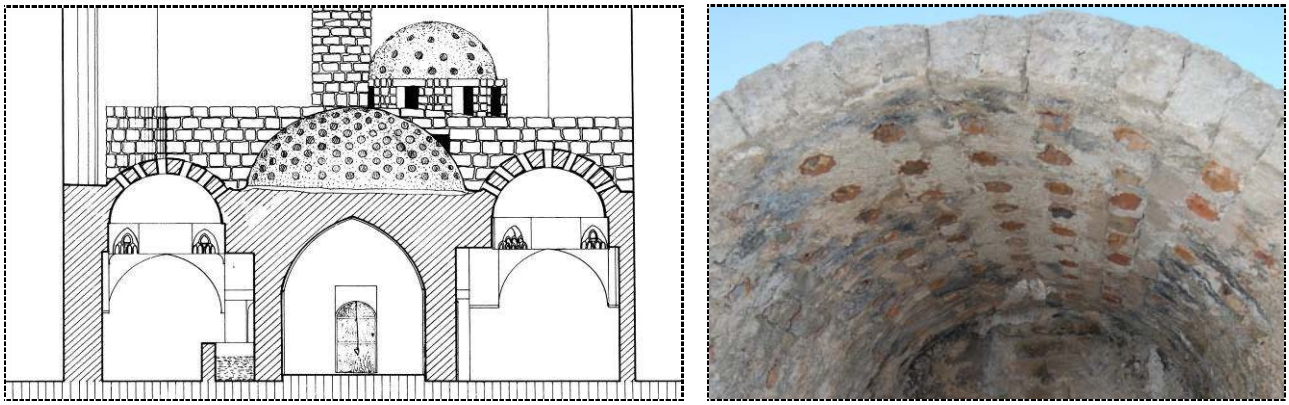

Figure 4:The perforated domes and roofs in traditional buildings, (Left: in Hebron - Palestine, Right: in Kelibia -Tunisia). Reference from left to right: Hebron Rehabilitation Committee, Palestine; photo by M.L.G. 2013.

Despite the multiplicity of types of the traditional perforated models, but some of them were used and spread more than others, where the most prevalent element in the past was the 'Mashrabiya', due to its important cultural, environmental and social values. Also the 'Mashrabiya' played a significant role in assuring the identity of the place. Some contemporary architects used the 'Mashrabiya' idea abstractly in various ways and means, but mostly they have focused on the environmental values (e.g., 'Masdar City residence' in the UAE, 'Mashrabiya house' in Jerusalem, 'The sea towers' in Abu Dhabi, etc.).

3. The contemporary trend of perforation

The contemporary perforated buildings (partially or fully perforated) represent an increasing phenomenon. In order to achieve the objectives of this study, it is important to select and analyse a certain number of the contemporary cases of perforated envelopes, to investigate the nature of the perforation, the purposes and functions of perforation, basis and rules of the new trend, and its relation to the local contexts (technologically and behaviourally).

3.1 Multi-cases selection criteria

The case study method is used as an empirical inquiry that investigates the contemporary phenomenon of perforation within its real-life context. The study is organized to include multi-cases from the world, to explore the technological and behavioural aspects represented in this trend. The selected cases are 57 as representative samples and were determined according to the following criteria taking into consideration the categorizations of cases were determined according to their percentages in the identified cases during the data collection and pruning phase (more than 200 cases were identified):

- Selecting cases from different climatic zones in the world (temperate and tropical zones), to identify the relationship between perforation and the local climates, and the relationship with different cultural values or behaviours in different geographical regions. The selected number of cases includes: 21 cases from the marine west coast zone, 12 cases from the Mediterranean zone, 9 cases from the dry arid or semi-arid zones, 2 cases from the highlands zone, one case from the humid continental zone, 7 cases from the humid subtropical zone, and 5 cases from the tropical wet & dry zones.

- The site location of each case (urban, rural, urban fringe, old city, etc.) was important to be considered as it plays a role in determining the relationship between the building and its surrounding context. 21 cases were located in suburbs, 19 cases inside cities, 5 cases in the cities centers, 5 cases in the urban fringes, 3 cases in the old cities, 2 cases in the rural areas, and 2 cases in islands.

- The site topography of each building was taken into consideration while selecting the cases (mountainous, flat, hilly, etc.), due to its effect on the way that the building was oriented or located. The selected numbers in these categories are: 48 cases located on flat lands, 7 cases located on mountainous lands, and 2 cases located on hilly lands.

- Different categories of buildings' uses were selected (residential, commercial, educational, cultural, offices,

et.). This is an indicator for what function and what type of users the perforated building envelope was designed. The selected numbers in these categories are: 17 residential, 6 educational, 11 cultural, 7 office buildings, 4 commercial, 2 industrial, 3 recreational, 2 medical, 2 religious, and 3 community centres.

All of the selected cases are already constructed and were chosen from the period from the beginnings of the 21st century until now, as the study focuses on the most recent cases.

Due to the comprehensiveness of collected description on the selected cases and the limited space available in this paper, then it comes beyond the scope to present all of these cases. However, an explanation is provided for one case as an illustrative example. The description includes three parts: (a) textual information: as a short paragraph description, (b) structured information: as a tabulated data (Tab.1), and (c) visual information: as an image illustration. The textual information is important to realize the contextual reasons beyond the design concepts and is considered as the initial base for the comparative analysis stage. The structured information is a tangible approach to deal with information explored indirectly and collected from diverse references and resources. The visual information offers image illustration with two or more images to clarify and graphically present the description of perforation.

Example: NYU Global Center for Academic and Spiritual Life					
Location:	New York , USA	Architect:	Machado & Silvetti	Site topography:	Flat Land
Dates:	2009-2012	Site context:	Inside the City	Climatic zone:	Humid Continental
Use:	Educational-cultural	Users group:	Public Users	Floors no.:	5 Floors

Table 1: Example of the description table as used for each selected case (the authors).

3.2 Analysis of the selected cases

The analysis of contemporary buildings relies on two aspects; firstly, the technological aspect which includes three main components (perforation, construction, and environmental issues). Secondly, the behavioural aspect includes also three main components (usability adaptability, and connectivity). These components have been divided to sub-sections to facilitate its utilization and the comparative analysis. The applicable inputs to each case are illustrated in bold text. The analytical aspects, components, or the sub-sections can be extended, but the focus here is on the aspects related only to the perforation, taking into consideration the accessibility and measurability of data for each selected case. Tables 2 and 3, show an example of analysis Tables for NYU Global Centre for Academic and Spiritual Life. Similarly to this example, the other 56 cases were presented using these Tables and structured as a database.

Technological components of the building's envelope		
Perforation data	**Construction data**	**Environmental issues**
No. of perforated faces of the envelope: 1\ **2**\ 3 \ 4\ More	Type of intervention of the perforation: Newly added \ **Previously built**	Perforated material resistance to moisture: Highly \ **moderately** \ Slightly
Orientation of the perforated faces: (S \ N \ E \ W \ SE \ SW \ **NE** \ **NW**)	Envelope faces shape: **Flat** \Deconstructed \Organic \ Composite	Perforated material resistance to heat gain and heat loss: **Highly** \ Moderately \ Slightly
Status of roof perforation: Perforated \ **Not perforated**	Type of perforated material: Glass\ Concrete\ **Stone**\ Metal\ Earth\ Wood\ Terra cotta \ Composite	Using insulations within envelope: Used\ Not used \ **NA**
No. of inclined perforated faces: **0** \ 1 \ 2 \ 3 \ 4 \ More	Type of material behind the perforation: **Glass** \ Concrete\ Stone\ Metal\ Earth\ Wood \ Composite	Drainage of rain penetrated behind perforations: **Considered** \ Not considered \ NA
No. of perforated layers: 0 \ **1** \ 2 \ More	Approx. thickness of perforated material: 1- 10mm \ **2-5cm** \ 5-25cm \ Over 25cm	Natural ventilation method: **Manually** \ Mechanically \ Smart \ NA
Perforation pattern shape: Geometric \ **Floral** \ Symbolic \ Organic \ Composite \ Changing	Approx. depth between perforated material and the main external wall: 0 \ **1-50 cm** \ 1m \ more than 1 m	Using smart envelopes: Used \ **Not used** \ NA
Approx. perforation ration in each face: 1-10% \ **10-35%** \ 35-50% \ Over 50%	The perforated material is common in the local context: Yes \ **No**	Using renewable energy systems within the envelope: Used \ **Not used** \ NA
Perforation pattern geometry is common in the local context? Yes\ **No**	Lightness of the perforated material: **Light** \ Slightly Heavy \ Heavy	Percent of natural light transmission to inside: 1-10% \ **10-35%** \ 35-50% \ Over 50%
Concept of perforation: Aesthetic \ **Identity** \ Environmental \ Else	Existence of windows beside perforation: **Existed** \ Not existed\ Few existence	Seasonal changes of envelope elements: **No change** \ Changeable
Preventing birds roosting method: **Considered** \ Not considered \ NA		Respecting the nature: Highly \ **Moderately** \ No respect \ NA

Table 2: The analysis of technological components of the perforated envelopes, example of NYU (the authors).

Behavioral components of the building's envelope		
Usability of envelope	**Adaptability with design**	**Connectivity to context**
Main users of building (age & gender): Children \ **Youth**\ old \ All Males \ Females\ **Both**	Physical security of envelope: **Secure** \ Not Secure \ NA	Pattern relation to the local culture and identity: Related \ Not related \ **Neutral** \ NA
Users physical relation to the perforation: Reachable \ **Not reachable** \ NA	Psychological security of envelope: **Secure** \ Not Secure \ NA	Occupants ability to contact adjacent buildings visually: **Able** \ Slightly able\ No ability \ NA
Seeing outside status: **Easy** \ Difficult \ Blocked view	Privacy on the visual level : Gained \ **Slightly gained** \ Not gained\ NA	Ability to contact occupants of neighboring buildings verbally: Able \ **No ability** \ NA
Open-ability of envelope windows: **Openable** \ Not openable \ NA	Privacy on the acoustical level: High \ Moderate \ Slight \ **NA**	Ability to contact the passing pedestrians visually: **Able** \ Slightly able \ No ability \ NA
Users ability to go between the main wall and the perforated envelope if a space is existing: Able \ **No ability** \ NA	Feeling of closure: High \ Moderate \ **Low** \ NA	Ability to contact the passing pedestrians verbally: **Able** \ No ability \ NA

Table 3: The analysis of behavioral components of the perforated envelopes, example of NYU (the authors).

3.3 Technological comparison (past and present)

Focusing on the changes of materials, techniques, concepts, constructions, and environmental issues of the perforated envelopes, a technological comparison is conducted. Starting by the material of perforated envelopes; the outcome of the 57 cases analysis showed that a noticeable change was happened to the use of perforated materials between the past and the present. In the past, wood, pottery, and terracotta were mainly used for 'Mashrabiya' and 'Takhtabush', the earth material and stone were used for other traditional models depending on the main construction material of the envelope itself. Therefore, the analysis showed that the perforated metals were used in 28 cases, the perforated concrete was used in 15 cases (in different regions), the bricks were used for 7 cases (mostly in the far east countries; e.g., Cambodia, Vietnam, Thailand, Australia). The stone was used for 5 cases, the terracotta was found in one case only, and the ceramic was used also for one case only. This indicates the considerable concentration on the use of metals, especially that the perforated envelope was mostly found in an additional layer in front of the main envelope of the building. This may seem to be technically as a rational change, due to the advantages of the lightweight materials. But, are metals efficient economically and environmentally, can they be used in different climatic zones? What about heat gain and heat loss? It depends on the climatic region and the insulation methods. In this case, a wider discussion can be raised on this point, especially in the case of the Mediterranean region.

Regarding the contemporary perforation patterns, they were mostly (50 cases) simple-shaped geometries (such as using circles, squares, rectangles, etc.). They have no significant relation to the patterns of the past, or to the local architectural identity. On another side, the perforation ratios were determined without any specific reference. The main reason behind determining perforation ratios was technological. Sometimes, the holes of perforation were large enough to the extent of reaching a window size, and sometimes they were very small holes, which prevent the ability to see outside, and to communicate with the outdoor community. On the contrary, the traditional 'Mashrabiya' for example, has unity in its perforation ratio, with a significant sign of the patterns to the local identity in each place (e.g., the Arab-Islamic identity), which helps the observer to distinguish their location and history.

The contemporary trend of perforation has a certain attention toward the environmental issues including provision of shades, control of light and air passage, etc. Furthermore, these models of perforation were designed sometimes to be kinetic and moveable, but in many cases were fixed layers in front of the main envelope like a protective fence.

Accordingly, the perforation become an architectural industry and a business issue for many manufacturing companies, due to the great interest in this trend within envelopes, interiors, or furniture. This helps easily to improve the product, and to have more technologically solved and economical products in the future.

3.4 Behavioral comparison (past and present)

Focusing on changes of usability of the perforated envelopes, the users adaptation, and the connectivity to the local context, a behavioural comparison is conducted. An emergence of a *Transitional Space* between inside and outside the building was noticed in several cases (16 cases). Where the space is accessible and

usable by occupants (Fig. 5). This *Transitional Space* is separated from inside by either fully or partially solid wall, or by a glass curtain wall. It is separated from outside by a perforated envelope and has variable width which makes it usable by occupants in the 16 cases, and it was unusable (little depth; less than 50 cm) or non-existent in other cases. On the other hand, this space was involved within the internal spaces in the model of traditional 'Mashrabiya' (no separation between the transitional space and the internal spaces). The separation was sometimes only by changing the level of the 'Mashrabiya' (raised from the floor level) to become a place to sit on (Fig. 6). Several contemporary cases have the concept of 'Mashrabiya', but no cases have the actual roles of "Mashrabiya". Very few paid attention towards the contexts where the 'Mashrabiya' had emerged. Despite all, there is a potential here to explore advantages of this *Social Transitional Space* to be developed and obtained in more advanced ways (relatively to the social contexts).

The flexibility and open-ability of the perforated envelopes provides a better interaction between the building's users and the envelope itself, as a way to communicate with the outdoor environment. The open-ability of the envelope facilitates the connectivity between inside and outside. Unlike the 'Mashrabiya' model, about 34 of the selected cases have fixed (immovable) perforated envelopes. Other 11 cases have fixed envelopes, but they have windows alongside the perforated panels (partially perforated). The other remaining cases have flexible (moveable or open-able) perforated panels, which positively provide comfort for users. Following the technological comparison, the flexibility is not the only important issue, the tiny perforations and the fixed perforated panels make the interaction, and the passage of daylight difficult or impossible in some cases. The climate plays a certain role in determining the ratio of perforation, but it shouldn't lead to the production of a physically environmental envelope.

Figure 5: Examples of the contemporary transitional space in different cases
References from left to right; http://www.archdaily.com/575463/b-b-house-studio-mk27/ (06/15); <http://www.archilovers.com/projects/151609/teresianas-school-extension.html>(06/15); http://www.arthitectural.com/sohne-partner-architekten-caldor-hotel/ (06/15). http://aasarchitecture.com/2015/02/residence-in-cape-town-by-three14-architects.html (06/15).

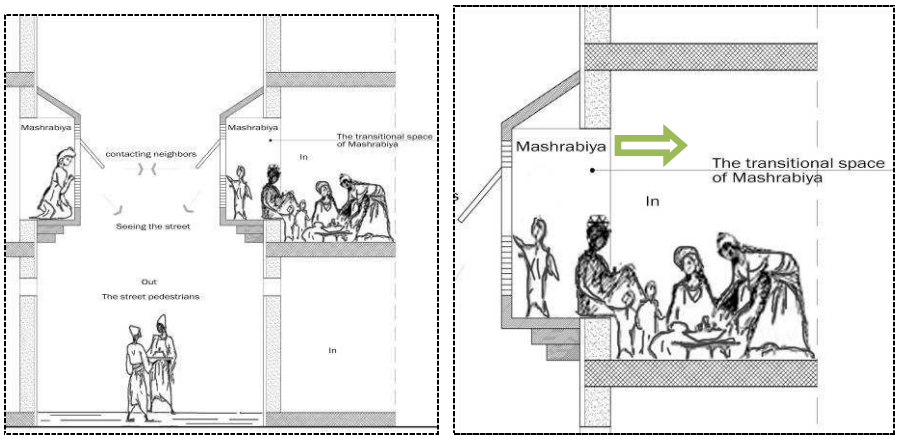

Figure 6:The Mashrabiya' section, and the transitional social space (the authors).

Following the categories of building use, the perforation can be found in the traditional architecture mostly in houses to obtain privacy and social integration within conservative communities, in addition to its environmental role. But for the contemporary trend, nearly all categories have been found as perforation cases, for several objectives, mainly for ornamentation and environmental considerations.

4. The appropriateness of perforation in the Mediterranean region

The Mediterranean region is considered as an example within this study because it includes several countries that have some or all of the perforated models in their traditional architectures (e.g. Turkey, Spain, Italy, Egypt, Palestine, Lebanon, Syria, Tunisia, Morocco, Algeria, etc.). The contemporary trend of perforation is global, but it is concentrated in some countries or regions more than others. For example, 19 of the selected cases are located in the Mediterranean; 8 of them in France, 5 in Spain, 3 in Palestine, 2 in Italy, and one in Lebanon. Some questions that can be raised include: why the countries where the traditional perforation was used widely, have less contemporary cases? Why France is the most active in using the contemporary perforation? Is it a figment of the fashion era? Or are there other reasons such as economic matters or the presence of the manufacturers of the perforated materials? What reasons stay beyond this trend?

For the case of Mediterranean region, it is known of many available conservative communities. Therefore, the necessity to provide privacy in the designed envelopes is evident and required. In addition, the environmental problems are still the main focus of the world researchers. This means that the architecture of today didn't meet yet the occupants needs for a comfortable living (this is a general hypothesis, excluding some innovative cases). The selected cases have approximately no focus on social issues to be considered in the future design of the perforated envelopes. Less focus was given to the economic aspect of the perforated envelopes, and costs of construction or maintenance. But more focus was on the basic environmental issues of the perforation, such as shuttering the facades, creating shades, eliminating or increasing daylight passage, preventing direct heat gain, and controlling natural air passage. Accordingly, there is a need to address ways and means wherein social and economic considerations can be improved.

Even though metal as a building material was used in many cases of the contemporary perforations, but there have been attempts in the Mediterranean basin to revive the earthen architecture which is newly active in some countries such as Palestine, Morocco and other countries, due to its economic, technological and technical values, and its contribution to provide an identity to the buildings. This is implemented using new ways and modern techniques that help to improve the quality of earthen building, by bringing it in line with the requirements of the present. These attempts have emerged recently due to the inability of people with average and low income levels to build their homes using the high cost natural stone or the concrete. On the other hand, the earth material can be re-used for both of the construction of new buildings and the refurbishment of the existed ones [10], to accommodate environmental needs, and even beyond that to exploit the possibility for the development of *Transitional Social Space,* which enhances the interaction between occupants and surrounding environment, socially, visually, physically, and psychologically.

Hot summer and a relatively cold winter characterize the Mediterranean climate. Metals that are actively used in the contemporary perforated buildings, are characterized by fast gaining and losing of heat, if their properties are not improved, or if the main external wall is not effectively treated. The use of metals in buildings envelopes is not common in the Mediterranean. Therefore, metals cannot be highly suitable materials for this climate if it is not modified and processed. Hence, there is a crucial need to identify alternatives for more appropriate materials.

Accordingly, the main questions are what and when the perforated envelope can be an appropriate solution for the Mediterranean region?. Nevertheless, it is highly appropriate because it is an inherited style that fulfils a cultural value. But the appropriateness of contemporary design methods and suitable materials has to be explored or innovated while social and economic needs should be taken into consideration.

5. The future extended research

There is a need to formulate design rules, introduce alternatives, and provide recommendations to derive the design of future perforated envelopes in the Mediterranean region. This study forms the basis for developing an extensive research in this field. This paper introduced comparison of technological and behavioural

aspects of the perforated building envelope in the Mediterranean region and reflected on its appropriateness. However, more extended results, discussions, and recommendations will be hopefully clarified in the near future. This includes the need to highlight advanced models or rules of designing the perforated envelopes (in the Mediterranean context, taking Palestine as an example) regarding the socio-cultural values, environmental needs, and economic situation of people in a certain context.

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