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## APPLYING THE VERNACULAR MODEL TO HIGH-RISE RESIDENTIAL DEVELOPMENT IN THE MIDDLE EAST AND NORTH AFRICA

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### Keywords

tall residential development;  
social sustainability;  
parametric design;  
courtyard;  
vernacular architecture

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### Abstract

*In the age of globalisation and continuous urbanisation, architects have a greater responsibility to design residential buildings with comfortable and sustainable environments. However, sustainable solutions should not concern themselves only with utilising technology, but also with creating synergies amongst a community's social, cultural, historical, and environmental aspects. This research focuses on the implications of this wider definition of sustainability within the hot-arid climates of the Middle East and North Africa. Most of the current high-rise residential buildings in these regions do not promote social cohesion as they have been constructed without consideration for local identity and lifestyle. In contrast, vernacular courtyard dwellings and neighbourhoods offer good examples of socially cohesive and healthy environments. Yet, vernacular houses might not be compatible with pressures of modern construction. The question then becomes how to maintain the relationship between the spatial, social and environmental aspects while employing the latest technologies and materials. This paper presents the different qualities of vernacular houses and neighbourhoods in the different regions of the Middle East and North Africa. Social and spatial relationships of different cases are assessed, through a typological analysis approach using a developed syntactic-geometric model, to trace the lifestyle and the cultural values of the society. The aim is a parametric exploration of appropriate sustainable solutions that facilitate the synergy of socio-climatic requirements, the well-being qualities of the residents, and the specifics of culture, time and people while designing sustainable high-rise developments.*

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Selected Paper From The Fifth Architectural Jordanian International Conference – 1-3 November 2016

## INTRODUCTION

Globally, statistics show that more people live in urban areas (54%) than in rural areas, and it is expected, by 2050, that the world will be two-thirds urban (66% = 5.2 billion) and one-third rural (34%), which is roughly the reverse of the global rural-urban population distribution of the mid-twentieth century (United Nations, 2015). The Middle-East and North-Africa (MENA) Region, which is currently home to 357 million people (Serageldin et al., 2015), has one of the world's most rapidly expanding population, with more than 60% (215 million) of urban inhabitants according to the statistics of the World Bank (2014). This number, which is expected to double by 2050, has been driven by several factors such as economic development, water shortages in rural areas, and displacement of people due to wars. These trends have a significant impact on the built environment and the building construction industry. For instance, global urbanisation, scarcity and high cost of land, increase the demand for affordable living and working spaces, and therefore push the emergence of high-rise and high-dense developments which could be considered as a hallmark of contemporary cityscapes, and the most viable solution for many urban centres (Hudgins, 2009; Yeang, 2012; Modi, 2014). More than 70% of high-rise developments in the world are located in Asia, the Middle-East and Africa (Kearns et al., 2012). Dubai, for instance, was ranked in 2015 as the ninth city in the world with more than 1025 completed high-rise buildings, while Abu Dhabi, Sharjah, and Doha ranked 32<sup>nd</sup>, 33<sup>rd</sup>, and 58<sup>th</sup> respectively (CTBUH, 2015).

### The Concept of 'Sustainable Vertical Cities'

The surrounding structures and context is a major factor for considering a building to be characterised as a 'high-rise' or 'tall' (Kloft, 2002). For instance, if an urban setting has an average of two to three floor buildings, then a five-floor structure could be considered as a high-rise. However, different bodies define this term in various ways. According to the Emporis database on Buildings and the Real Estate Industry (2015), a 'high-rise building' is defined as 'a multi-story structure between 35 and 100 metre tall, or a building of unknown height from 12 to 39 floors'. These structures are also called 'tall buildings' in some countries, and 'tower blocks' in Great Britain and some European countries (Craighead, 2009). In the United States, the National Fire Protection Association (2015) defines a 'high-rise' as being higher than 23 metres, or about seven storeys. In India, the building codes of Hyderabad indicates that a 'high-rise' is a building of four floors (15 metres) or more in height (Narayan Reddy, 1996).

All of these definitions indicate that a high-rise building is a mass of built up spaces on a small footprint. However, there is a requirement for the architect to design a 'contemporary' building that represents the current time, to think holistically about all aspects affecting the output, and at the same time take into consideration the latest issues of technological developments (Dalziel, 2012). Ken Yeang (2012), a Malaysian architect who is considered the father of the sustainable and bioclimatic skyscraper, claims that this huge volume could be defined as a 'vertical city', which requires designers to take into account the different dimensions of sustainability (social, environmental, and economic) during the design process in order to improve the quality of life (see Figure 1). Social and cultural sustainability is about combining the design of the physical environment (spatial layout and form) with the social needs of users (Woodcraft, 2012; Berkeley-Group and UK-GBC, 2012). Moreover, it seeks to preserve traditional social and spatial practices against the imposition of a modern built environment that lacks cultural relevance (Pomeroy, 2014). In residential buildings, designers could achieve this relationship through providing interactive spaces and supportive environments for residents that maintain their privacy and reflect their identity. In terms of environmental sustainability, architects and engineers should consider the different

conditions of local climate, to offer thermal comfort and consume less energy. Finally, low operating costs and the use of local materials are major issues that need to be considered to achieve economic sustainability.

## Benefits and Impacts of High-Rise Residential Buildings in MENA Region

High-rise developments create a challenging environment, with both benefits and impacts, as compared to other types of horizontal constructions (Ali and Al-Kodmany, 2012). Benefits such as preserving natural and green spaces in the city, and locating various services within suitable walking distances from units, could be achieved. Moreover, the small area of the envelope could reduce costs, materials, heat loss or gains, and the overall *heat island* effect (Yeang, 1999; Li, 2013). In terms of impacts, these buildings limit the contact views between users and the outside environment and sometimes create isolated and dull boxes. This is due to the marginal existence of nature and the limited hierarchy of open and semi-open spaces. Although there is a trend of inserting a central atrium, it is not exposed to the external daily life, so it seems to be lifeless, and as a result, these buildings depend on the use of cooling and heating mechanical devices in different spaces instead of natural resources such as wind and sun. Furthermore, most of the current developments are constructed as iconic buildings that ignore the specifics of the cultural context, lifestyle and living patterns, local traditions, or social and psychological effects on occupants (Wood, 2013; Al-Masri, 2010; Mitchel, 2010; Lotfabadi, 2014; Pomeroy, 2014) (see Figure 2). In addition, these contemporary buildings are more suitable for single-users than for families, the elderly, and children, and do not express the individuality and uniqueness of each family (Al-Kodmany, 2015; Losantos and Cañizares, 2007).

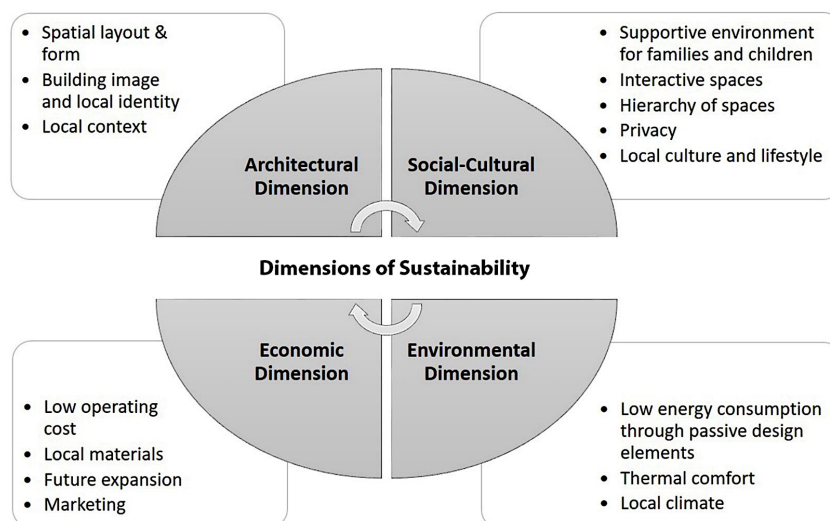


Figure 1. Dimensions of sustainability in high-rise residential buildings (Source: Authors).

Different scholars highlight the consequences and harmful effects of living in high-rise buildings (Wood, 2013; Kearns et al., 2012; Gifford, 2007). A major study, conducted by Professor Ade Kearns and his colleagues (2012) in Glasgow, examines the impact of living in high-rise buildings in comparison to other dwelling types. They measured different social outputs (such as cohesion, social contact with neighbours and friends, and social support), and concluded that high-rise flats have the highest negative impacts on residents (see Table 1). These impacts could be summarised in six categories:

- Fear, insecurity, and crime;

- Mental and physical health effects due to the small size of units and overcrowded spaces;
- Lower sense of community and familiarity with neighbours;
- Lower levels of social support and social development due to isolation;
- Impacts on families and children as parents keep their children indoors due to safety concerns and difficulties of supervision at a distance, which therefore causes psychological distress, behavioural and learning difficulties;
- Lack of identity for each unit due to the standardisation of floor plates.
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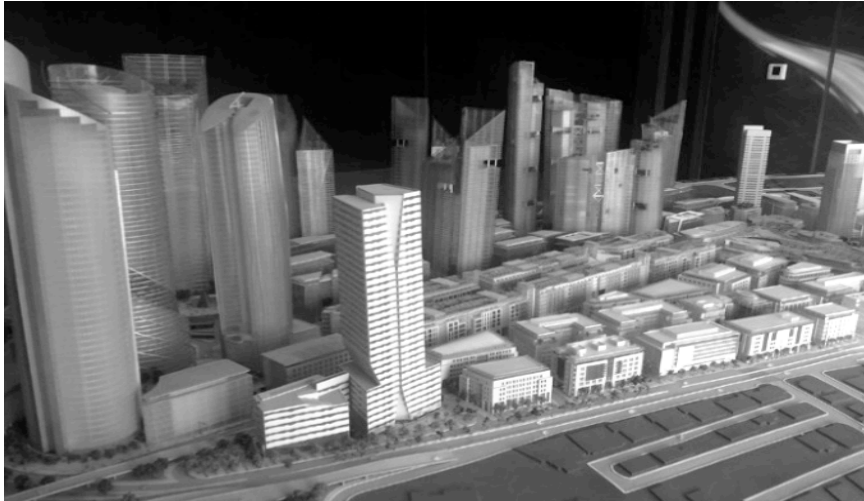


Figure 2. A model showing the suggested designs of high-rise buildings to be constructed in the downtown of Amman, Jordan (Photo by Authors, 2015).

Table 1. The impacts of living in high-rise in comparison to other dwelling types  
(Source: Kearns et al., 2012)

Social Outcomes	Dwelling Type	%
Poor cohesion	House	15.7
	Apartment buildings	15.9
	High-rise flat	26.3
Low social contact with relatives & friends	House	15.8
	Apartment buildings	16.5
	High-rise flat	20.3
Low social contact with neighbours	House	13.6
	Apartment buildings	15.5
	High-rise flat	29.3
No available social support	House	17.0
	Apartment buildings	18.0
	High-rise flat	24.2

## TOWARDS A 'CONTEMPORARY VERNACULAR' HIGH-RISE DEVELOPMENT: A 'CRITICAL REGIONALISM' APPROACH

Generally, a successful design means that achieving an 'identity', which relates to the design of all components in harmony with context, climate, traditions, needs, and requirements of both the modern and future times (Mehrpooya et al., 2015). Therefore, socially-sustainable high-rise housing needs a smart and sensitive approach associated with the ideals and expectations of its users, and the ability to deliver the local lifestyles for residents (Kennedy

et al., 2015). One approach to deal with these issues is to incorporate the local tradition and its unique responses to spatial arrangement, place, and climate, in the design of contemporary buildings and creative forms (Lim, 2004, as cited in (AlHaroun, 2015)). This generates a 'contemporary vernacular' architecture that has symbolic identities. Ken Yeang, for example, bases his works on the adaptation of regional architecture 'a critical regionalism approach', through understanding traditional values, as well as the importance of progress, without the direct use of traditional forms and materials (Pomeroy, 2013). This way of thinking, which leads design to respond to specific context, is a balance between two views: the 'traditional' perspective, where designers see the loss of traditional ways and values, and the 'modern' perspective, where designers declare the inevitability of change in the age of globalisation (Ragette, 2003).

To achieve this balance, and to provide a continuity to the existing world, a 'typological analysis method' for understanding the space-form language and the different characteristics of locality and environment, is adopted. This type of analysis for historical cases is a helpful strategy to understand the space-form language (for both dwellings and neighbourhoods) and the different characteristics of the locality (contextual, typological, morphological and cultural-social needs) in an attempt to incorporate local heritage in future developments. Therefore, the researcher sees that collecting data from multiple historical cases might answer the main question of the study with regards to 'how could the local culture, lifestyle, and traditional techniques employed in vernacular architecture, be maintained and translated into an interactive environment for children and families in contemporary high-rise buildings?'

## **LEARNING FROM THE VERNACULAR MODEL: ANALYSING THE NEIGHBOURHOODS AND THE TRADITIONAL HOUSES IN MENA REGION**

Learning from previous experiences is a good way to design with sensitivity as it provides continuity to the existing context (Assi, 2001), and the cultural roots of the society (Ragette, 2003; Rapaport, 1969; Ravetz and Turkington, 1995). Oliver (2003) expressed the vernacular environment as a '*theatre of our lives*', where different scenes of daily events are played out. With time, these vernacular dwellings became a 'tradition' and a 'philosophy of life' that passed on from one generation to the other within families and communities (Ragette, 2003). Most studies in the field of vernacular architecture have focused on describing the different patterns of houses, while studies on tall buildings have focused on energy consumption efficiency more than studying the social and cultural dimension, such as privacy and hierarchy of spaces (Galal Ahmed, 2011; Wood, 2013). However, linking the physical form of houses with all environmental, social and cultural aspects could be a useful way to achieve sustainable designs that respond to local context, community, and climate (Wood, 2008). Therefore, this study aims to understand, analyse, and encode such historical cases in the hot-arid areas of the MENA region, logically and mathematically, and then create a database with parameters and constraints that are useful for designing contemporary and sustainable high-rise residential buildings that trace the social and cultural values of the society.

### **Sustainability at the Scale of Residential Neighbourhood**

Most modern and contemporary towns are characterised by a rational and rigid grid of streets and open plazas. In contrast, the layout of traditional neighbourhoods in the study area (e.g. Cairo, Tunis, Aleppo, Medina, Algeria, Fez, and Marrakech) usually form an irregular pattern and have more than one focal centre. However, the organic spatial configuration of these quarters produces a homogeneous urban fabric and balanced



townscapes that are determined by specific social and religious principles (Bianca, 2000). The traditional public squares allow for a high degree of social interaction between people, and reflect their sense of community (Al-Masri, 2010). The access from public areas to residential quarters is usually broken into hierarchal sections to increase degrees of privacy, and at the same time maintain a balance between isolation and interaction (Crouch and Johnson, 2001). This pattern has been gradually controlled by different intermediate tools, such as dead-end alleyways and hierarchal sequence of gateways, to protect private family domains, and prevent conflicts with the public realm (Bianca, 2000; Mortada, 2003). Moreover, it reduces external heat gain or loss, and blocks excessive air movement which carries sand and dust (Ragette, 2003; Maleki, 2011; Crouch and Johnson, 2001; Moossavi, 2014). In terms of social benefits, disputes with neighbours are avoided and the privacy and security of families are preserved through visual barriers, such as the principle of staggered entrances (Mortada, 2003), the use of high walls and setbacks between houses, and avoiding window openings towards neighbourhood roofs (Ragette, 2003; Bianca, 2000) (see Figure 3).

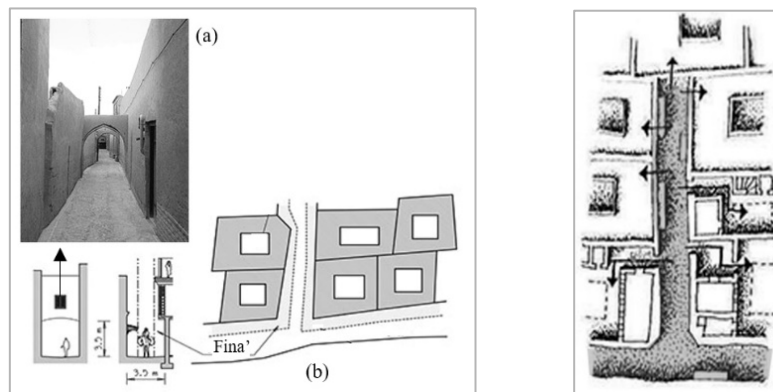


Figure 3. (Left) The use of covered pathways (*fina'*) in residential quarters (Source: (a) Moossavi, 2014; (b) Steyn, 2012); (Right) The principle of staggered entrances (Source: Ragette, 2003).

### Sustainability at the Scale of House and Residential Unit

Broadly, the spatial configuration of dwelling layouts may be varied in different periods, regions and cultures (Mustafa, 2010). Traditional dwellings in hot-arid regions are inward-looking houses with living spaces organised around a central space (courtyard) and open to the sky. Most dwellings have one courtyard (atrium house), and sometimes more (patio house). The main courtyard is usually for the family, and located on the ground floor. The other acts as an entrance open-space with a staircase leading to upper floors. Many dwellings have porches, galleries and balconies that spatially connect the indoor environment with the outside while preserving their purposes as extensions of the domestic living space. Moreover, spaces are dynamic through the use of different techniques such as changes in levels, directions, and degrees of openness (Ragette, 2003). This relationship between indoor and outdoor spaces and the use of transitional zones between public and private areas are key qualities in the spatial arrangement of the house to maintain social needs (such as privacy) and environmental qualities for family members (Oliver, 2003). The following illustrates briefly the different dimensions of sustainability (social-cultural and environmental) at the scale of the house, in an attempt to reflect these issues in the design of high-rise buildings.

On a basic level, the overall social and environmental qualities of such traditional horizontal quarters could have the potential of being transferred into vertical arrangements through dividing it into layers as a representation of neighbourhood in a traditional fabric. This solution could highly promote the concept of hierarchy and clustering that creates a mutual responsibility for common spaces as semi-public areas in each segment for encouraging interaction between neighbours.

### Social-Cultural Dimension

Several studies conducted by architects, planners and socialists outline that traditional houses afford many social rewards for people and families who occupy them.

- *Privacy and Spatial Hierarchy*: Spatial elements and treatments such as courtyards; arrangement of transitional spaces and internal circulation; proper distribution of openings; the bent entrance passageway from the street; hierarchy of spaces from public to private and from formal to less formal, are important considerations for family activities in residential units to attain maximum privacy (visual, acoustical and olfactory) (Mitchel, 2010; Taylor, 1985).
- *Social Interaction and Family Ties*: Social interaction between family members, and allowing children to play without disturbing their neighbours could be easily encouraged through courtyards and semi-private domains. In large houses, and in order to have strong family ties when offspring get married, the spatial arrangement could be extended horizontally in semi-independent sub-units, or vertically where each generation occupies a storey (Mortada, 2003).
- *Social Fairness and Integrity*: Most residential units are generally similar in their form and spatial arrangement. Nothing on the blank exterior walls of these houses shows celebration of the social or economic status, or the composition of the family inside (Mortada, 2003). Such a matter relates indirectly to the religious beliefs of the community which stresses the issue of not exhibiting differences between people.
- *Modesty*: Due to the small plot area, and to achieve the principle of modesty and humility, which is a prevalent cultural value in the region, spaces inside houses are modest in their sizes in relation to their actual use. The area of each space is neither small nor exaggerated. However, spaces with mixed-functions are the main feature in vernacular architecture. Rooms such as living and dining rooms serve different purposes at different times of the day and night. Moreover, eliminating excessive decoration in the house is another response to the principle of humility (Mortada, 2003).
- *Hygiene*: In most residential units, gates and thresholds define the private zones. This change in level protects houses from dust. Inside the house, steps that separate clean sitting areas from depressed floors where shoes and tools are placed, are also a response to that requirement.
- *Spirituality*: Sometimes, the orientation of spaces inside dwellings to 'qibla' (which is the direction that should be faced when a Muslim prays) has a symbolic and specific meaning of spiritual focus (Oliver, 2003).

### Environmental Dimension

In hot-arid regions, where harsh environment, high temperature, and scarcity of water and plants are common features, residents prefer to close their dwellings to the outside through introducing a courtyard, which embodies most of the missing aspects and achieves a balance between the body and the environment (Noor, 1991). In terms of spatial distribution, rooms are placed according to their use during the year. Summer rooms are located on the

south side of the courtyard and oriented to the north direction. This solution protects these spaces from solar radiation and heat absorption (Foruzanmehr and Vellinga, 2011), and acts as a barrier to the north winds to reduce heat losses for the northern part of the house; this is where rooms for winter use are located to capture solar radiation from the southern direction (Ragette, 2003). Spaces for spring and autumn seasonal use are usually placed on the east and west sides of the courtyard (see Figure 4). Other treatments for cooling and humidifying the dry air include: the use of water features and jugs at the lowest part of the house; cooling plates which allow the water to drop on a marble surface; soft and hard landscaping; and inserting semi-open rooms (*iwan*) (Oliver, 2003; Şerefhanoglu Sözen and Gedik, 2007; Crouch and Johnson, 2001). Furthermore, wind towers (*malqaf* or *badgir*), especially in the gulf area, are useful elements that prevent dust and noise from entering while encouraging the fresh, cool and clean air to transmit to the lower living rooms, and then pass to the courtyard.

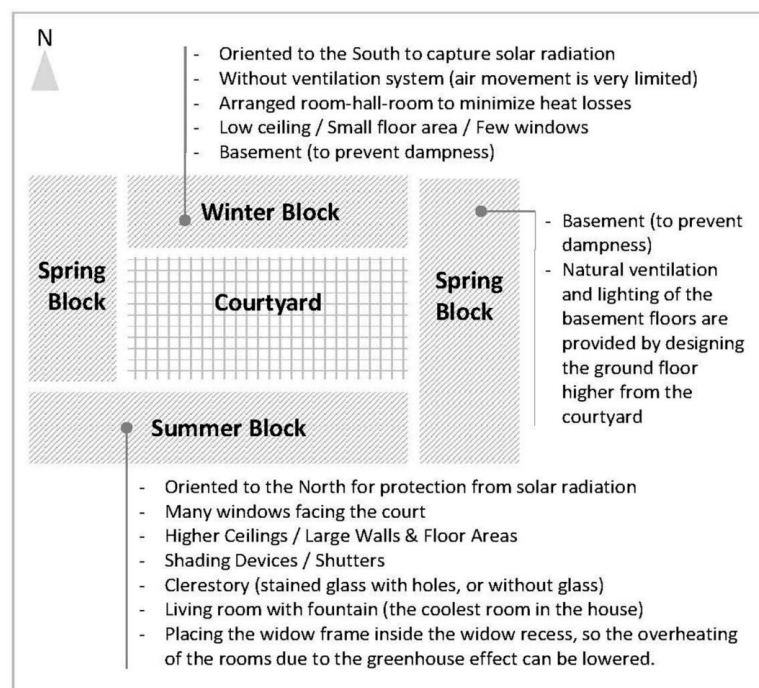


Figure 4. Zoning for a typical traditional courtyard house in hot-arid region  
(Source: Al-Jokhadar and Jabi, 2016a).

## Sustainability in Vernacular High-Rise Buildings

Historically, the need for preserving land in the city, achieving security for residents, and showing off prestigious status, are main factors shaping the trend of residential buildings with more than three to four storeys, and sometimes ten floors in traditional cities. One of the most notable old high-rise buildings in the world is found in *Shibam* in Yemen, South-Arabian Mountains, and Morocco (Ragette, 2003). *Shibam* is 'the oldest skyscraper city in the world' with more than 500 vertical houses, originating from the 16<sup>th</sup> century, and made out of mud-brick (see Figure 5). The whole building is a 'multi-floor family tower' and is occupied by one family. Each tower has a small yard at lower levels, and a vertical separation of functions. Storage areas and stables are located on the ground level with small windows, then a vertical sequence of kitchen and toilet on the first or second floors, then living spaces for the family, reaching to zones for men and their guests (Ragette, 2003; Abu Bakar and Abdul Razaq, 2012).



On each floor, there is one or two rooms with a semi-public stairway that segregates social and functional zones of the house. The roof contains a reception hall for men (*mafraj* or *majlis*) and an open terrace which is usually used for wedding ceremonies. As a transformation from a courtyard house to a vertical building, Ragette (2003) suggested that multi-storey buildings either share common green areas or have their own inward courtyards, with an L-shape form to achieve privacy (see Figure 6).



Figure 5. Vernacular tall residential buildings in Shibam, Yemen (Photo by Jialiang Gao, 1999) [https://commons.m.wikimedia.org/wiki/File:Shibam\\_Wadi\\_Hadhramaut\\_Yemen.jpg](https://commons.m.wikimedia.org/wiki/File:Shibam_Wadi_Hadhramaut_Yemen.jpg), accessed on 28/4/2016).

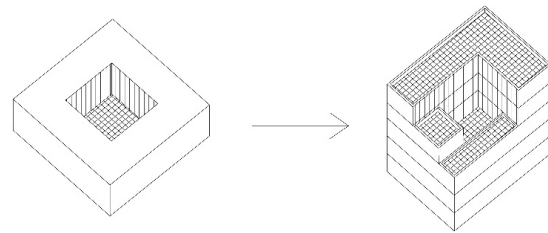


Figure 6. A proposal for inserting L-shape courtyard in a multi-storey building (Adapted by Authors, after (Ragette, 2003)).

## A 'SYNTACTIC-GEOMETRIC MODEL' FOR ENCODING TRADITIONAL HOUSES AS A TRACE OF SOCIAL-SPATIAL QUALITIES

To integrate all of these potentials of a socially cohesive and healthy environment of traditional buildings and neighbourhoods within the design of a contemporary and sustainable high-rise building, architects need to have a database that includes vocabularies, parameters and rules that trace the social and environmental dimensions of dwellings. A model, which is presented in the next section, helps the designer in analysing such cases. The output of this model will be used in future studies from this ongoing research for identifying design briefs and parametric rules for generating different solutions. The developed model for 'syntactic-geometric analysis' depends on combining the 'space syntax method' with three aspects of design: (a) analysing the geometric characteristics of spaces (e.g. shapes, areas, and proportions); (b) identifying social indicators (e.g. relationships, users, privacy, patterns of movement, and distances between spaces); and (c) specifying environmental solutions (e.g. orientation, and type of enclosures) (Al-Jokhadar and Jabi, 2016a). This model has five components (see Figures 7 and 8):

1. *As-Built Plan*: showing patterns of movement, and actual distances (in metres) between the centre of the courtyard and the centre of spaces passing through doors.
2. *Visual Analysis Diagram*: showing the spatial organisation of spaces with visual connections between public, semi-public, and semi-private domains.
3. *Space Syntax Analysis*: calculations with two diagrams, produced from AGRAPH software, which is an online analytical platform (Manum et al., 2005), showing spatial relationships between spaces, courtyard, and entrance. Calculations showing the following measurements:

- a. *Connectivity (NCn)*, which measures the number of immediate neighbours that are directly connected to a space.
  - b. *Integration value (i)*, which describes the average depth from a space to all other spaces in the system. The spaces of a system can be ranked from the most integrated to the most segregated. The highest value indicates the maximum integration.
  - c. *Control value (CV)*, which measures the degree to which a space controls access to its immediate neighbours taking into account the number of alternative connections that each of these neighbours has.
4. *Depth and Hierarchy of Spaces*: which are represented through its actual shapes and proportions, and arranged to show the hierarchy (public, semi-public, semi-private, private, and intimate); orientation (West (W), East (E), North (N), South (S), North-East (NE), North-West (NW), South-East (SE), and South-West (SW)); shared surfaces between adjacent spaces; the entry access of each space; and the actual distance between the centre of spaces and the centre of adjacent rooms.
  5. *Spatial and Geometric Relationships*: showing different calculations which include proportion of each space (X:Y); percentage of the area of a space from the overall area of the house (%All); proportion of that space relevant to the courtyard (1:C); actual distance (D1) in metres from the main entrance (N1) to the centre of the space; actual distance (D2) from the centre of the courtyard (N2) to the centre of the space; and the dominant users of each space (Male (M), Female (F), or Both (M+F)).

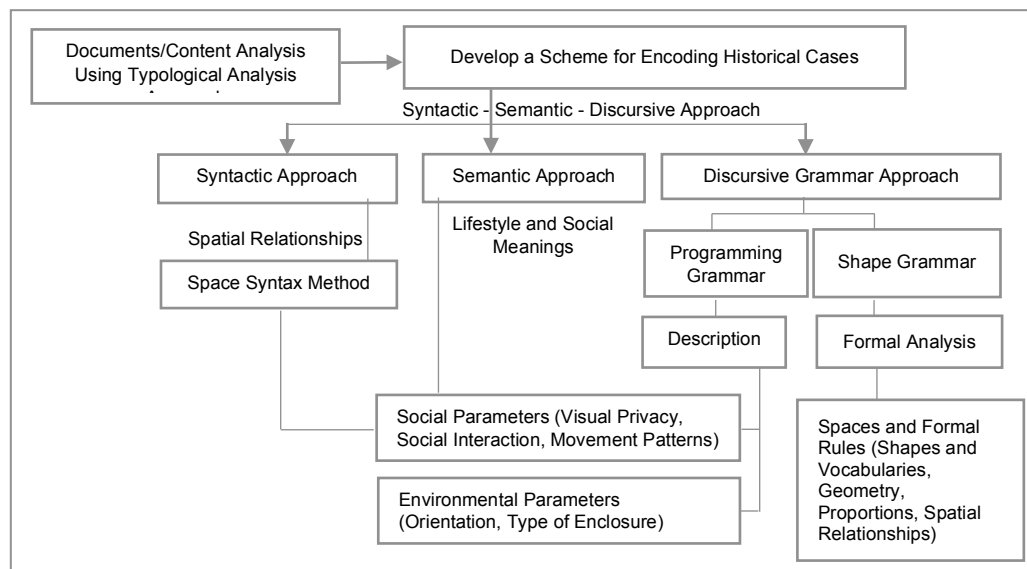


Figure 7. Components of the proposed 'syntactic-semantic-discursive' approach (Source: Authors).

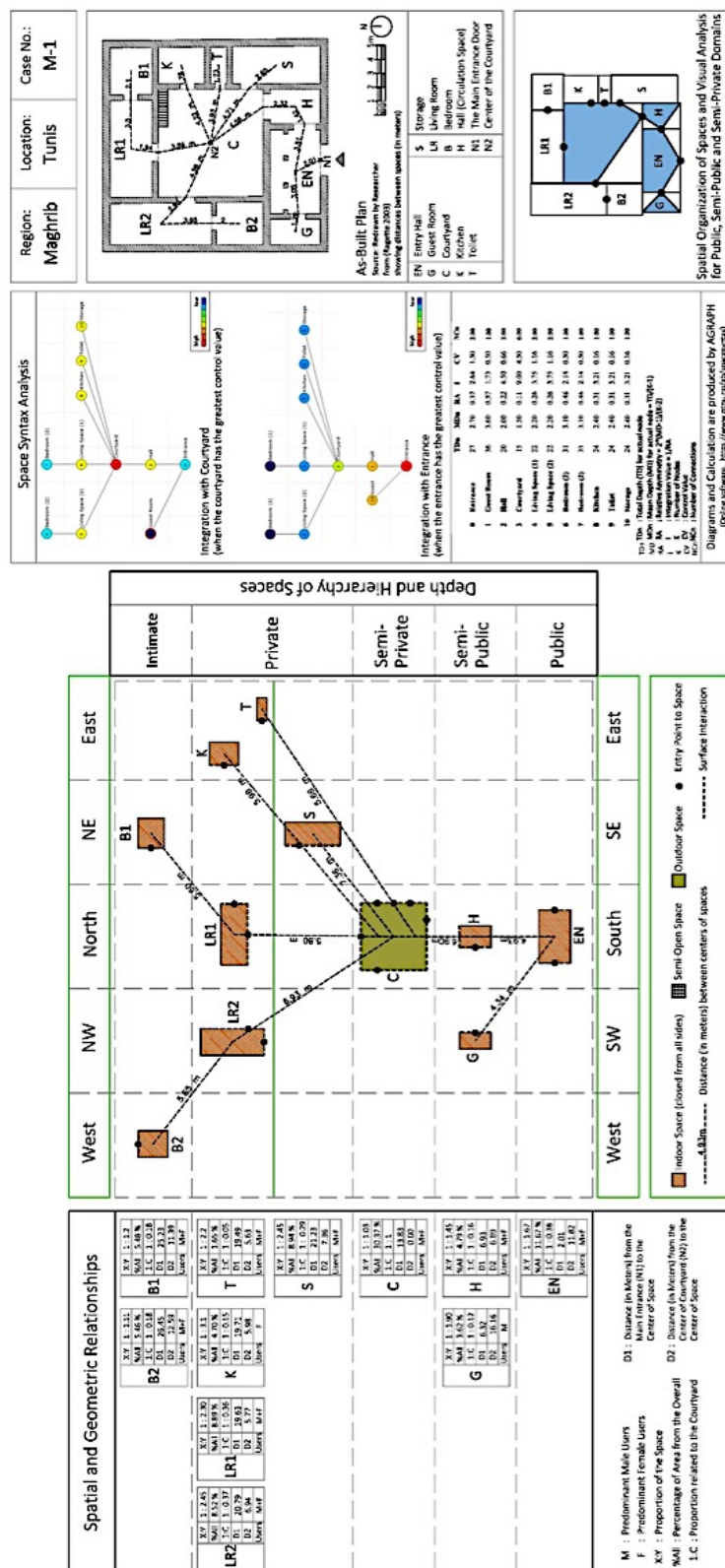


Figure 8: A syntactic-geometric model for analysing a vernacular house in Tunis  
(Source: Al-Jokhadar and Jabi, 2016a).

## Discussion and Interpretation of Results

Based on the syntactical-discursive model of analysis, it is obvious that the human spatial behaviour, the social life inside the house, the hierarchy of spaces, and the segregation and seclusion of family members from male visitors are regulated by a series of syntactic elements. After applying the analysis on a vernacular courtyard house in Tunis, different qualities are observed:

- The space syntax analysis shows that the courtyard, which is a semi-private space, has both the greatest control value ( $CV = 4.50$ ) and the greatest integration value ( $i = 9.00$ ), which means that other spaces, mostly private zones, are controlled and accessed through the central space of the house, where most of the daily functions are located. This arrangement provides a protected and suitable area for family gatherings.
- The hall (H), which is a semi-public circulation space, connects the entrance with the main courtyard. It is a mediator between the inside of the house and the outside world. However, the bent entrance passageway preserve the visual privacy of the family.
- Guest reception room is a shallow space used for male visitors, and it has the lowest integration value ( $i = 1.73$ ), as it is suited off the courtyard and next to the entry hall. There is no visual connection between this space and the semi-private and private domains, so the privacy of the family members could be achieved.
- Most spaces follow the geometric patterns of the courtyard with a symmetrical layout arrangement.
- All private spaces face the courtyard, and have approximately the same distance between the centre of the courtyard and the entry point of that space. This depth, which ranges between 5.65 and 7.30 meters, provides a suitable distance for the residents to live in a comfortable atmosphere.
- All intimate spaces (bedrooms) should be accessed through private spaces to give more privacy.
- Services (kitchen, toilet and storage) are placed on the east part of the courtyard, which protect other spaces from smells.

The results of analysis are translated into seven features (morphology, overall geometry, spatial description, geometric properties for each space, spatial topologies, social qualities, and environmental considerations) with 39 variables that will be used for constructing the grammar for vernacular courtyard houses in the study area (Al-Jokhadar and Jabi, 2016b). This type of grammar and model of analysis differs from shape grammar and space syntax method in many aspects. In terms of components, all geometric properties, proportions, functions, and type of enclosure are defined. Moreover, spaces are arranged according to the public-private hierarchal system and the solar orientation. In terms of relationships, the actual distances between spaces, the pattern of movement, and the physical-facial (wall-to-wall) relations are associated with rules. Finally, aspects related to the social dimension, such as visual privacy, interaction and the dominant users of each space are specified.

## CONCLUSIONS

In general, the design of buildings is a challenge for the architect to be sensitive in reflecting the needs of users that are specific for the context, and at the same time providing them with comfort conditions. This study aims to create a database that helps the architect in designing a high-rise residential building that promote social, cultural and environmental sustainability.



The study shows that most of the current high-rise buildings in the Middle-East and North-Africa lack the identity of the place, while most of the traditional houses are good examples of a socially cohesive and healthy environment. Many aspects such as hierarchy of spaces; different degrees of openness and enclosures; the courtyard; the use of soft and hard landscaping; the specific use of spaces; patterns of movement; and geometric properties of spaces, could help the architect in specifying the social, spatial and environmental parameters that should be integrated in the design process of contemporary sustainable buildings.

The typological analysis of such historical cases using a syntactic-geometric model is a useful tool for identifying the design brief and the parametric rules for generating different solutions with respect to the identity of the place. All of these analytical information need to be translated into rules and constraints that are useful for generating parametric solutions. This process will be conducted in the next stages of this ongoing research, which aims to construct a socio-spatial grammar for high-rise buildings in MENA regions. Such a grammar will include (1) shape grammars that reflect shapes, vocabularies, proportions, geometric properties, and formal rules; and (2) programming grammars that define design briefs and descriptions.

## ACKNOWLEDGEMENT

The authors would like to acknowledge University of Petra, Jordan for funding the study.

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