

Towards a ‘Contemporary Vernacular’ High-rise Residential Development in the Middle-East and North-Africa: Learning from the Socio-Spatial Qualities of the Vernacular Model

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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 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.

Keywords: tall development, residential, courtyard, sustainability, social interaction, parametric design, traditional houses, vernacular architecture

1. Introduction

1.1. The Emergence of Tall Buildings

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 reach the double by 2050, has been driven by several factors such as economic development, water shortage 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, the global urbanisation, scarcity of lands and high prices, 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 cityscape, and the most viable solution for many urban centers (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, 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 32nd, 33rd, and 58th respectively¹.

1.2. 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 have 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, 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’². 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 defines a ‘high-rise’ as being higher than 23 metres, or about seven stories³. In India, the building codes of Hyderabad indicates that a ‘high-rise’ is a building with four floors (15 metres) or more in height (Narayan Reddy 1996).

All of these definitions indicate that a high-rise building is a massive built up spaces on a small footprint. However, this development needs from the architect to design a ‘contemporary’ building that represents the current time, to think holistically with all aspects affecting the output, and at the same time taking into consideration the latest issues of technological developments (Dalziel 2012). Ken Yeang (2012), who is a Malaysian architect and 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, which 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.

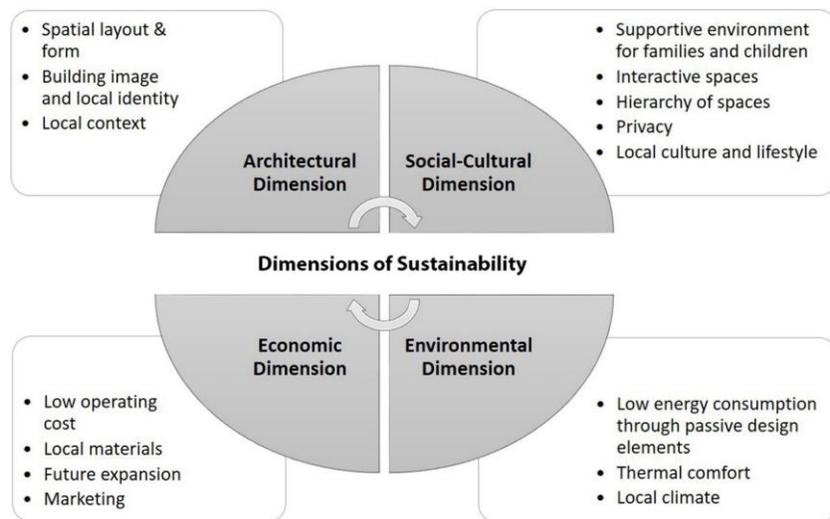


Figure 1. Dimensions of sustainability in high-rise residential buildings (Authors)

¹ <http://www.ctbuh.org/TallBuildings/HeightStatistics> (accessed on 1/12/2015)

² <http://www.emporis.com/building/standard/3/high-rise-building> (accessed on 14/12/2015)

³ National Fire Protection Association, USA (www.nfpa.org) (accessed 14/12/2015)

1.3. 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, the heat loss or gain, 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 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 occupancy users (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).

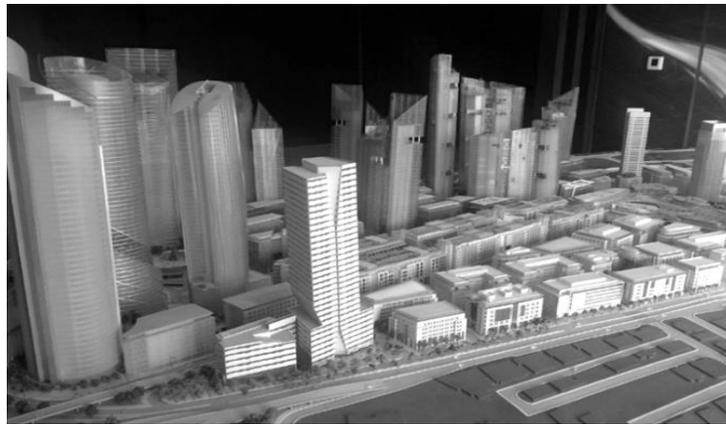


Figure 2. A model showing the suggested designs of high-rise buildings to be constructed in the downtown of Amman, Jordan (Authors 2015)

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:

- (1) Fear, insecurity, and crime;
- (2) Mental and physical health effects due to the small size of units and overcrowded spaces;
- (3) Lower sense of community and familiarity with neighbours;
- (4) Lower levels of social support and social development due to isolation;
- (5) Impacts on families and children as parents keep their children indoor due to safety concerns and difficulties of supervision at a distance, which therefore cause psychological distress, behavioural and learning difficulties;
- (6) Lack of identity for each unit due to the standardization of floor plates.

Table 1. The impacts of living in high-rise in comparison to other dwelling types (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

2. Towards a ‘Contemporary Vernacular’ High-rise Development: A ‘Critical Regionalism’ Approach

Generally, a successful design means that it has an ‘identity’, which relates to the design of all components in harmony with context, climate, traditions, needs, and requirements of the modern and future time (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 have 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 one of the helpful strategies to understand the space-form language (for both dwellings and neighborhoods) and the different characteristics of the locality (contextual, typological, morphological and cultural-social needs) in an attempt to incorporate the local heritage with future developments. Therefore, the researcher sees that collecting data from multiple historical cases might answer the main question of the study about ‘how could the local culture, life-style, and traditional techniques employed in vernacular architecture, be maintained and translated into an interactive environment for children and families in contemporary high-rise buildings?’

3. 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 passing on from one generation to the other within family and community (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 for achieving 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 MENA region, logically and mathematically, and then create a database with parameters and constraints that are useful for designing a contemporary and sustainable high-rise residential building that traces the social and cultural values of the society.

3.1. Sustainability at the Scale of Residential Neighbourhood

Most of 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 rewards, 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 opening towards neighbourhood roofs (Ragette 2003; Bianca 2000) (see Figures 3 and 4).

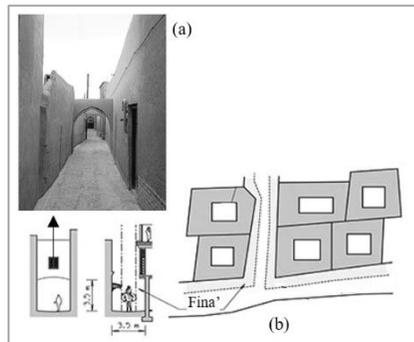


Figure 3. The use of covered pathways (*fina'*) in residential quarters (a: (Moossavi, 2014); b: (Steyn, 2012))

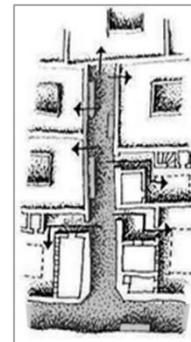


Figure 4. The principle of staggered entrances (Ragette 2003)

3.2. 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 opened 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 one acts as an entrance open-space with a staircase leading to upper floors. Many dwellings have porches, galleries and balconies that connect spatially the indoor environment with the outside while preserving their purposes as extensions of the domestic living space. Moreover, spaces are dynamic through using 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 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

neighborhood in a traditional fabric. This solution could highly promote the concept of hierarchy and clustering that create a mutual responsibility for common spaces as semi-public areas in each segment for encouraging interaction between neighbors.

1.1.1. 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 (Al-Jokhadar and Jabi, 2016).

- i. *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).
- ii. *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).
- iii. *Social Fairness and Integrity*: Most residential units are generally similar in their form and spatial arrangement. Nothing on the exterior blank walls of these houses shows the social or economic status celebration, 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.
- iv. *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 is the main feature in vernacular architecture. Rooms such as living and dining rooms served different purposes at different times of day and night. Moreover, eliminating excessive decoration in the house is another response to the principle of humility (Mortada 2003).
- v. *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, is also a response to that requirement.
- vi. *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).

1.1.2. 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 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 court (see Figure 5). 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 to enter while encouraging the fresh, cool and clean air to transmit to the lower living rooms, and then pass to the courtyard.

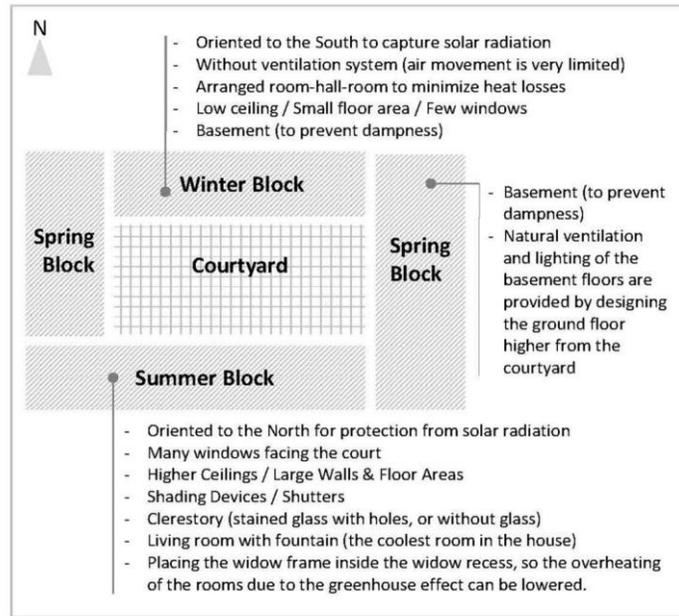


Figure 5. Zoning for a typical traditional courtyard house in hot-arid region (Al-Jokhadar and Jabi, 2016)

1.2. Sustainability in Vernacular High-rise Buildings

Historically, the need for preserving lands 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 stories, 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 16th century, and made out of mud-brick (see Figure 6). 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).

In 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 used usually for wedding ceremony. 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 L-shape form to achieve privacy (see Figure 7).



Figure 6. Vernacular tall residential buildings in Shibam, Yemen (Photo by Jialiang Gao 1999)

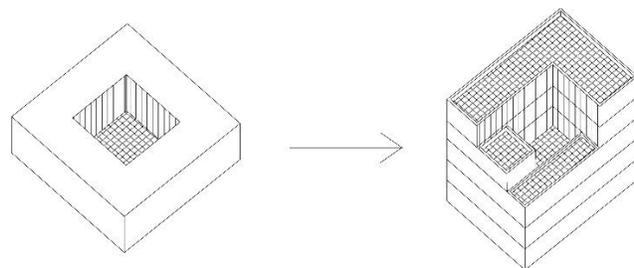


Figure 7. A proposal for inserting L-shape courtyard in a multi-storey building (Adapted by Authors, after (Ragette 2003))

4. 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 with 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 (shapes, areas, and proportions); (b) identifying social indicators (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, 2016). This model has five components (see Figures 8 and 9):

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 space.
 - b. *Integration value (i)*, which describes the average depth of 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 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 related 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)).

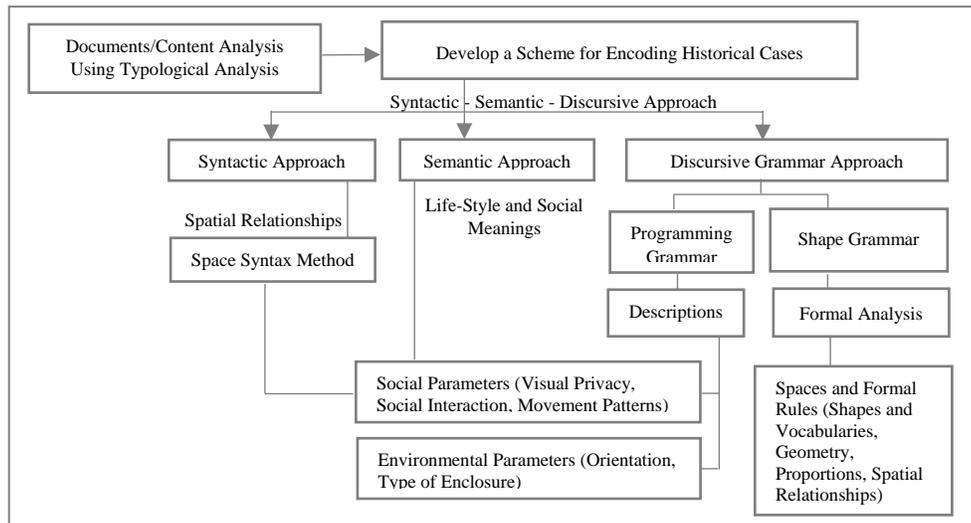


Figure 8. Components of the proposed ‘syntactic-semantic-discursive’ approach (Authors)

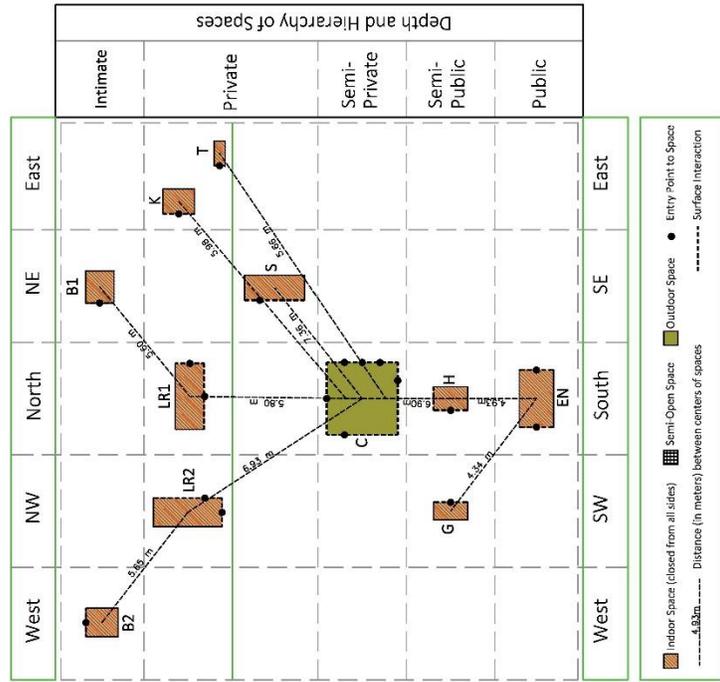
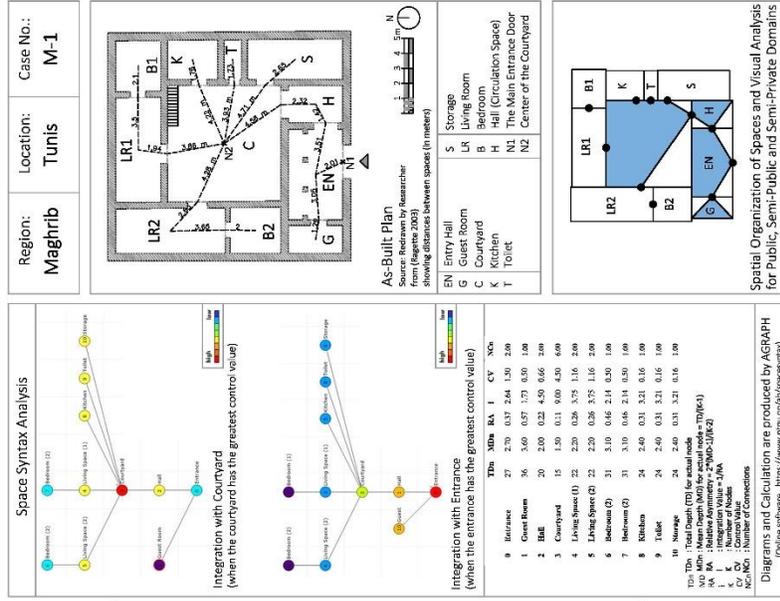


Figure 9: A syntactic-geometric model for analysing a vernacular house in Tunis (Authors)

5. 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.

6. 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.

References

- Abu Bakar, A.H. and Abdul Razaq, A. (2012). Sustaining the Desing Elements Influence on the Comfort and Spatial Function in Traditional Yemen Houses in Old City of Sana'a. In: *International Conference on Innovation and Technology for Sustainable Built Environment (ICITSBE 2012)*. Perak, Malasia.
- AlHaroun, Y. (2015). Contemporary Attitudes to Vernacular Elements in Kuwait's Domestic Architecture: A Mixed Method Study. University of Sheffield, UK.

- Al-Jokhadar, A. and Jabi, W. (2016). Enhancing Social-Cultural Sustainability in Tall Buildings: A Trace from Vernacular Houses. In: *CTBUH 2016: Cities to Megacities - Shaping Dense Vertical Urbanism*. An International Conference managed by the 'Council on Tall Buildings and Urban Habitat'. (Unpublished paper to be presented in China (October 16-21, 2016)).
- Ali, M.M. and Al-Kodmany, K. (2012). Tall Buildings and Urban Habitat of the 21st Century: A Global Perspective. *Buildings* 2(4), pp. 384–423.
- Al-Kodmany, K. (2015). Integrating tall buildings in the sustainable city: Toward a comprehensive approach. In: *Eco-Towers: Sustainable Cities in the Sky*. Southampton: WIT Press, pp. 387–434.
- Al-Masri, W. (2010). The Courtyard House in Kuwait Today: Design Approaches and Case Studies. In: Rabbat, N. ed. *The Courtyard House: From Cultural Reference to Universal Relevance*. Surrey, England: Ashgate Publishing Limited, in association with the Aga Khan Program for Islamic Architecture, pp. 203–222.
- Assi, E. (2001). Typological Analysis of Palestinian Traditional Court House. In: *International Congress of UNESCO-ICOMOS, Paris*.
- Berkeley-Group and UK-GBC (2012). *Practical How-to Guide : How to Use a Social Sustainability Framework*. London.
- Bianca, S. (2000). *Urban Form in the Arab World: Past and Present*. New York: Thames and Hudson Inc.
- Craighead, G. (2009). High-Rise Building Definition, Development, and Use. In: *High-Rise Security and Fire Life Safety*. 3rd ed. Elsevier Inc., pp. 1–26.
- Crouch, D. and Johnson, J. (2001). *Traditions in Architecture: Africa, America, Asia and Oceania*. Oxford: Oxford University Press.
- Dalziel, R. (2012). The Idea of an Archetype. In: Battle, T. ed. *A House in the City*. London: RIBA Publishing, pp. 10–13.
- Foruzanmehr, A. and Vellinga, M. (2011). Vernacular architecture: questions of comfort and practicability. *Building Research & Information* 39(3), pp. 274–285.
- Galal Ahmed, K. (2011). Evaluation of social and cultural sustainability in typical public house models in Al Ain, UAE. *International Journal of Sustainable Development and Planning* 6(1), pp. 49–80.
- Gifford, R. (2007). The Consequences of Living in High-Rise Buildings. *Architectural Science Review* 50(1), p. 2.
- Hudgins, M. (2009). High-Tech Engineering Helps Skyscraper Developers Reach Record Heights. *National Real Estate Investor*.
- Kearns, A. et al. (2012). ‘Living the high life’? Residential, social and psychosocial outcomes for high-rise occupants in a deprived context. *Housing Studies* 27(1), pp. 97–126.
- Kennedy, R. et al. (2015). Residents’ Experiences of Privacy and Comfort in Multi-Storey Apartment Dwellings in Subtropical Brisbane. *Sustainability* 7(6), pp. 7741–7761.
- Kloft, E. (2002). Typology. In: Eisele, J. and Kloft, E. eds. *High-Rise Manual: Typology and Design, Construction and Technology*. Basel, Switzerland: Birkhauser, pp. 10–23.
- Li, C. (2013). Liveability of High-rise Housing Estates – Case studies in the inner city of Tianjin, China. Welsh School of Architecture, Cardiff University, UK.
- Losantos, A. and Cañizares, A. (2007). *Highbises Social Living*. Paredes, C. ed. Barcelona: LOFT Publications.
- Lotfabadi, P. (2014). High-rise buildings and environmental factors. *Renewable and Sustainable Energy Reviews* 38, pp. 285–295.
- Maleki, B.A. (2011). Traditional Sustainable Solutions in Iranian Desert Architecture to Solve the Energy Problem. *International Journal on ‘Technical and Physical Problems of Engineering’ (IJTPE)* 3(March), pp. 84–91.
- Manum, B. et al. (2005). AGRAPH, Software for Drawing and Calculating Space Syntax ‘Node-Graphs’ and Space Syntax ‘Axial-Maps’. *5th International Space Syntax Symposium Delft 2005*, pp. 97–101.
- Mehrpoya, H. et al. (2015). A comparison of ‘identity’ in vernacular (traditional) and contemporary (modern) houses. *WALIA Journal* 31(S5), pp. 69–75.
- Mitchel, K. (2010). Learning from Traces of Past Living: Courtyard Housing as Precedent and Project. In: Rabbat, N. ed. *The Courtyard House: From Cultural Reference to Universal Relevance*. Surrey, England: Ashgate Publishing Limited, in association with the Aga Khan Program for Islamic Architecture, pp. 223–238.
- Modi, S. (2014). Improving the Social Sustainability of High-rises. *CTBUH Journal (Council on Tall Buildings and Urban Habitat)* (Issue II).

- Moossavi, S.M. (2014). Passive Building Design for Hot-Arid Climate in Traditional Iranian Architecture Climate of Iran. *Green Architecture and Arts Magazine* (1), pp. 1–20.
- Mortada, H. (2003). *Traditional Islamic Principles of Built Environment*. Oxon: RoutledgeCurzon, Taylor and Francis Group.
- Mustafa, F.A. (2010). Using space syntax analysis in detecting privacy: a comparative study of traditional and modern house layouts in Erbil city, Iraq. *Asian Social Science* 6(8), pp. 157–166.
- Narayan Reddy, K. (1996). *Urban Redevelopment: A Study of High-Rise Buildings*. New Delhi: Concept Publishing Company.
- Noor, M. (1991). The function and form of the courtyard house. In: *The Arab House*. University of Newcastle upon Tyne, School of Architecture, Centre for Architectural Research and Department Overseas, pp. 61–72.
- Oliver, P. (2003). *Dwellings: The Vernacular House World Wide*. London: Phaidon Press Limited.
- Pomeroy, J. (2013). Internal Environment and Planning. In: Parker, D. and Wood, A. eds. *The Tall Buildings Reference Book*. Oxon: Routledge, pp. 123–132.
- Pomeroy, J. (2014). *The Skycourt and Skygarden: Greening the Urban Habitat*. First Edit. Routledge.
- Ragette, F. (2003). *Traditional Domestic Architecture of the Arab Region*. Sharjah, UAE: American University of Sharjah.
- Rapaport, A. (1969). *House Form and Culture*. Englewood Cliffs, New Jersey: Prentice-Hall.
- Ravetz, A. and Turkington, R. (1995). The High-rise Estate. In: Lane, B. M. ed. *Housing and Dwelling: Perspectives on Modern Domestic Architecture*. 2007. Oxon: Routledge, pp. 354–360.
- Serageldin, M. et al. (2015). World Migration Report 2015 [Online] Available at: <https://www.iom.int/world-migration-report-2015> [Accessed: 11 April 2016].
- Şerefhanoglu Sözen, M. and Gedik, G.Z. (2007). Evaluation of traditional architecture in terms of building physics: Old Diyarbakır houses. *Building and Environment* 42(4), pp. 1810–1816.
- Steyn, G. (2012). Ideological and topological parallels in pre-colonial Tswana and Swahili architecture. In: *3rd Global Conference: Space and Place*. Oxford, United Kingdom: Mansfield College, pp. 1–19.
- Taylor, B.B. (1985). *Contemporary Houses Traditional Values: Tunisia, Egypt, and Morocco*. London: Zamana Gallery.
- United Nations (2015). *World Urbanization Prospects: The 2014 Revision*. New York.
- Wood, A. (2008). Green or Grey? The Aesthetics of Tall Building Sustainability. In: *CTBUH 8th World Congress 2008*. Dubai: Council on Tall Buildings and Urban Habitat (CTBUH).
- Wood, A. (2013). The Future of Tall. In: Parker, D. and Wood, A. eds. *The Tall Buildings Reference Book*. Oxon: Routledge, pp. 353–361.
- Woodcraft, S. (2012). Social Sustainability and New Communities: Moving from Concept to Practice in the UK. *Procedia - Social and Behavioral Sciences* 68, pp. 29–42.
- Yeang, K. (1999). *The Green Skyscraper: The Basis for Designing Sustainable Intensive Buildings*. Prestel.
- Yeang, K. (2012). A Vertical Theory of Urban Design [Online] Available at: <http://www.buildingfutures.org.uk> [Accessed: 7 November 2015].