

**Studying the Impact of Height and Unified Design model in
Housing Communities on Micro-climate condition in Dubai
Case Study of Mohammad Bin Rashid Housing Establishment
Project**

دراسة تأثير الارتفاع و توحيد نموذج البناء في المجمعات السكنية على البيئة المحيطة

نموذج الدراسة: مشروع مؤسسة محمد بن راشد للإسكان في دبي

by

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Dissertation submitted in fulfilment

of the requirements for the degree of

MSc SUSTAINABLE DESIGN OF BUILT ENVIRONMENT

at

The British University in Dubai

November 2018

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Abstract

This research investigates the impact of Building heights and unified building form over the microclimate variables within a residential community located in Dubai . The research begins by conducting a literature review to establish a profound base in which this research can develop by analyzing and understanding similar cases for other researchers that tackles similar subject.

The research set number of questions in which the answer to those questions would contribute to the ongoing research that focus on sustainable practice in United Arab Emirates on an individual building scale and master urban scale. Since the national agenda and UAE Vision 2021 sets the goal of being a regional and international role model for sustainable Urban development revolution that responds to the United nation Goals and ensure prosperity for future generations

The research selected one of Mohammad Bin Rashid housing establishments in Dubai located in Oud Muteena district on the border line with Sharjah at a residential area with low rise buildings since building standard at theses area allows Ground plus one floor only for residential individual unites called (villas) in local terminology. The aim of the research is to investigate the potential impact of height increase and using unified layout design for all unites within the site on outdoor microclimate condition at the community, This is to contribute to the United nation goal of Sustainable Development as well as UAE Vision 2021 for sustainable society.

Research methodology uses field visit and observation beside Literature review to build the base of the research and validate input data that are used in computer simulation program for virtual model analysis where different scenarios are proposed for each parameter in order to evaluate and understand the impact of these parameters and conclude with scientific prove recommendations to enhance sustainability within housing communities in Dubai.

المخلص

يدرس هذا البحث في تأثير الارتفاع و توحيد شكل المباني على متغيرات المناخ المحلي داخل مجتمع سكني يقع في دبي. يبدأ البحث من خلال إجراء مراجعة لنماذج شبيهة و دراسات سابقة تناولت نفس المتغيرات و نفي العوامل بهدف إنشاء قاعدة علمية صلبة يمكن لهذا البحث تطويرها من خلال تحليل وفهم النتائج و التأثيرات في حالات مماثلة للباحثين الآخرين الذين يتناولون مواضيع مشابهة و في نطاقات اقليمية مشابهة.

حدد البحث عددًا من الأسئلة التي تسهم الإجابة عليها في اثراء البحث الذي يركز على الممارسة المستدامة في دولة الإمارات العربية المتحدة على نطاق البناء الفردي وعلى المستوى الحضري. حيث تم وضع الأجندة الوطنية ورؤية الإمارات 2021 بهدف تكوين نموذج إقليمي ودولي يحتذى به في مجال التنمية الحضرية المستدامة تلك التي تستجيب لأهداف الأمم المتحدة وتضمن الرخاء للأجيال القادمة.

تم اختيار إحدى مشاريع مؤسسة محمد بن راشد للإسكان في دبي و الواقعة في منطقة عود المطينة على الحدود مع الشارقة و التي تمثل منطقة سكنية ذات مباني منخفضة توافقا مع النظم و القوانين التي تسمح ببناء طابق أرضي و أول فقط للوحدات السكنية الفردية المسماة (الفيلات) في المصطلحات المحلية. الهدف من البحث هو دراسة التأثير المحتمل لزيادة الارتفاع في هذه المنطقة بمقدار طابق واحد إضافي واستخدام تصميم موحد لجميع الوحدات داخل الموقع في حالة المناخ المحلي الخارجي في المجتمع ، كمساهمة في تحقيق هدف الأمم المتحدة للتنمية المستدامة وكذلك رؤية الإمارات 2021 لمجتمع مستدام. أعتد البحث على منهج الزيارة الميدانية والملاحظة بجانب مراجعة نماذج سابقة محلية و اقليمية لبناء قاعدة البحث والتحقق من صحة بيانات المدخلات المستخدمة في برنامج المحاكاة بالكمبيوتر لتحليل النماذج الافتراضية حيث يتم اقتراح سيناريوهات مختلفة لكل معيار من أجل تقييم وفهم تأثير هذه المعايير على النتائج في النموذج الافتراضي.

ACKNOWLEDGMENT

This thesis is dedicated to my Beloved Father

Ghassan Azhar Issa Al-Khalaf

who believed in me and support me with his wisdom and love

He was a great Dad and a devoted father, who taught me to have critical thinking, and determination to pursue my dreams and above all he set a great example for having strong Faith in Allah.

May Allah bless him and reward him with Janna

I would like also to thank my Mother for her encouragement and thrust through all hard times.

I would like also to thank Dr. Hanan Talib for her stellar support and all the academic staff and colleagues at the British University in Dubai

Table Of Content

Chapter 1: Introduction

1.1 Urban Design and Development	1
1.2 Sustainable Urban Development	4
1.3 Profound Heritage vs. Expanded Modernity	8
1.4 Global warming and Climate Change	11
1.5 United Arab Emirates overview	15
1.5.1 Geographical and climate Background	15
1.5.2 Urban Community and social fabric	17
1.6 Research motivation and exclusiveness	20
1.6.1 Research Background	22
1.6.2 Scope of Work	25
1.7 Aim and Objectives	23
1.8 Research Questions and Hypothesis	23
Chapter 2: Literature Review	
2.1 International Sustainable Urban Development Movement	24
2.2 Local Sustainable Development Initiatives	28
2.3 Housing Development in UAE (Past , Present and Future)	32
2.3.1 Bastakia, Glimpse to the past	35
2.3.2 National Agenda and UAE vision 2021	37
2.4 Microclimate Parameters in Urban Design	39
2.4.1 Building Height Impact on Urban microclimate	40
2.4.2 Building Form Impact on Urban microclimate	42

2.4.3 Inner Courtyard Impact over indoor thermal comfort	43
2.5 Summary	46
Chapter 3: Methodology	
3.1 Introduction	47
3.2 Similar research topics specifications	47
3.3 Literature Review method	48
3.4 Field measurements and Observation method	49
3.5 Software Simulation Program and virtual model	51
3.6 Research Case Study	52
3.7 Methodology Selection	59
3.8 Methodological Chart	63
chapter 4: Case study virtual model setup	
4.1 Introduction	64
4.2 Software validation and readings calibration	64
4.3 Virtual Model development	70
4.3.1 Research Variables and parameters	71
4.4 Phase one - Building Base case Virtual Modeling	73
4.5 Phase Two - Buildings Height impact Analysis	77
4.6 Phase three - Buildings Forms Impact Analysis	79
Chapter 5: Results and Discussion	
5.1 Introduction	81
5.2 Phase One - Base-Case Analysis	82
5.3 Phase Two - Software simulation Result	85

5.4 Phase Three - Software simulation Result	89
Chapter 6: Conclusion	
6.1 Research Inference	94
6.2 Future recommended researches	96
Chapter 7: References	97

Chapter 1: Introduction

1.1 Urban Design and development - UD&D

Christopher Alexander the Austrian architect and design theorist wrote under the title - Timeless way of Building- The individual is a formation of the surroundings where a state of harmony cannot be established independently from the surrounding harmony. (Alexander, 1980) later Kevin Lynch described the city as a construction within the space, Therefore the design of the city can be seen as a temporal art but unlike other temporal art it cannot be controlled or limited since it is preserved over a long period of time where it will be cut across in sometimes or reversed and interrupted by different people some other times (Lynch, 1990). Both Alexander and Lynch highlighted the interrelationship between the surrounding environment and its users. The Built environment that both writers are referring to is defined once as all constructed elements by a human being (Collinsdictionary.com, 2018). While in Cambridge dictionary the built environment is identified as the place with many buildings (Dictionary, 2018) In Dubai as per building design code, the built environment refers to both the External and internal spaces and all elements included or fittings that are designed, constructed and managed for the use of public and individuals. (Government of Dubai, 2017). And back in 1994, Jon Lang stated that in the late 1960s Urban Design Term was used as a replacement for the term "Civic Design" at least in the United States of America representing the name of the field. But in the UK and Europe, the term Urban Design refers usually to the human settlements through antiquity. However the Urban Design Associates that was found in 1964 points to Urban design as the building of a city where a number of methods and design guidelines shall be followed (Gindroz, 2003). This could be the seed for Lynch, (1990) perspective toward Urban Design.

On the other hand, the City of San Diego (2008) describes the Urban Design as the physical elements that define the identity or perspective of a road, clusters or the city. It is the interaction between public users of a space and the built environment or natural features within.

looking for more specific definition results to the fact that the theory behind planning systems plays a role in the definition of Urban Planning which is a subject that cannot be overlooked while studying Urban design. As Lissa Horelli states; the definition goes from studying physical components only by saying; Urban Planning is where Architecture is responsible for designing and organizing the urban space and linked functions as per Commin (2013) to more holistic perspective as Sandercock (2004,134) described Urban Planning as an Unfinished social project that is responsible for managing our existence on the share spaces of cities, communities while seeking continues justices within social, work and environmental human life aspects. (New Approaches to Urban Planning, 2013)

The definition of Urban Design will possibly vary from one writer to another and one association or community to another since it is a Multi-Dimensional and very compound subject. (Bahrainy and Bakhtiar, 2016). Urban Design can be expressed as the Making of Space by forming the connection between users of space, movement forms, nature elements, and artificial built fabric elements. Urban Design merges and links different entities such as Architects, Landscape Designers, City planners as well as Decision makers and Transportation Designers. (Urbandesign.org, 2018). Another definition stated that Urban Design is a collaboration of different disciplinary in order to shape the physical layout and appearance of cities and towns, It is the ultimate Art of making the life in space. (Udg.org.uk, 2018).

Definitions might also vary according to date and development over the timeline. this, in fact, indicates that the topic is very rich and considered a heavy subject for researchers and writers over the past years and probably will continue to attract different studies and analysis over the upcoming years.

As unfold from previous, different terms are widely used to describe different aspects of the topic such as Urban Planning that refers to professionals who deal with policies and developments in coordinates with Authorities and decision makers. on the other hand, Urban

designers are professionals dealing with design forms and physical appearance of urban elements as streets, parks, public spaces, and building blocks. while Urban Development is the result of the overall process that combines Urban planning and urban design for a city or a town or even on a smaller scale as communities and neighborhoods.

In order to understand Urban Development, it is essential to have a historical glance on when this term was used first?. Jonathan Harris worked in 2000 on a publication with the title of Basic principles of Sustainable development. In which a brief history of Development initiatives introduced throughout the historical linear timeline.

Harris wrote; In the second half of the 20th century the concept of Development in the frame known today hardly ever known. The economic prosperity was based on general ideas of modernization, especially in rich regions such as North America, Japan, and some countries in Europe. This vision and progress goals have relatively little concern for social justice or equity. But after the end of the 2nd World War, the vision and regulations had shifted drastically. Socioeconomic issues for the majority became a primer topic over a governmental level. (Harris,2000). Moving to 1960 W.W. Rostow Published (The stage of economic growth) with adding an attractive subtitle (Anon-Communist Manifesto) this was an aspirant vision for financial development, Rostow joins others at that time and encouraged a superior vision of social and economic development that is following a linear concept. (Rostow 1960).

In the 1970's the focus on social issues was increasing and attention was given to basic needs such as Education, health status, Nutrition awareness, Sanitation and increasing percentage of Unemployment. This perspective generated the formation of United Nation Development programs, "Human Development Index" that depends on Health, Education and GDP (Gross Domestic Product) to evaluate and calculate the overall success and fulfillment of the development strategies that were adopted earlier. (Harris,2000)

Later in 1980's the attention was shifted toward (Structural Adjustment) that includes liberalization of Trade on one hand and eliminating government deficits and the overvalued exchange rates on another hand. But it was found that these so-called Structural Adjustments were not meeting the basic needs that were raised earlier in the 1970's, A tension between basic needs priorities and market-oriented perspective remains obvious. However Harris (2000) clarifies that the overall record of development worldwide since taking initiatives in 1970's was open to two main criticisms; First, the benefit of Development was not distributed equally, As the global number of extremely poor individuals remain high and in some regions, an increase was recorded in the statistics. Second is the major negative effect on the environment and the existing social structure. Harris warns since eighteen years back that the environmental deterioration if unchecked may undermine all recorded contribution of developments and even lead to a major, wide collapse of the essential ecosystem. Harris (2000)

The growing attention to the challenges of traditional development has led to the general, wide adaptation for a new concept that is sustainable design and sustainable development.

1.2 Sustainable Urban Development

In 2008 DESA (Department of economic and social Affairs) listed three aspects for a sustainable development starting with Economic Aspect; where a sustainable economic system must be capable of producing goods and services continuously and to preserve a controlled level of government and external Dept.

Second is the environmental aspect; where the system must keep a stable resource base, which means avoiding over-utilization of renewable resources, and also sink function, and depleting non-renewable resources. The sustainable development shall include the protection of biodiversity and atmospheric stability and other ecosystem elements and functions.

Finally, the social aspect where a sustainable social system must achieve fair distributional equity, provision of social services that include health and education as well as gender equity. (Rostow 1960) and (DESA 2008).

These aspects are addressing the challenge Urban expansion is facing today as it has reached highest levels over history, The General Secretary of the United Nation Ban Ki-Moon stated that today's cities are accommodating 54% of total population over the world and by the middle of the century this number is going to increase to 66% (Moreno, Clos & Ki-moon 2016). The UN Department of Economic and Social Affairs (DESA) reported in 2012 that Urban areas are growing fast and increasingly covering larger land areas. The Urban population already surpassed the rural population in 2008 and yet the numbers are increasing with this expectation in 2050 the total urban population will be 70% of the total global population. (UN,2012). As result cities are expanding to accommodate these numbers while keeping low-density central areas by unplanned urban sprawl that is setting a challenge on achieving sustainable patterns of Urban Development . (UN, 2017)

The United Nation report highlights the fact that cities are reporting increasing difficulties related to Air quality, soil pollution and water demand since population growth is forcing increasing demand on food and fresh water which indeed increases the demand for agricultural water sources in addition to fresh drinking water. (UN, 2017) the figures show that in 2050 the required agricultural water will be 13,500 km³ compared to 7,130km³ in 2016. This increase in demand is parallel to the decrease in global sea level that was noticed by WMO (World Meteorological Organization) as in 2016 the second lowest extent was recorded globally (UN, 2017). The Urban expansion and land use cover change will lead to natural resources degradation that impacts the low-income population the most since they are heavily counting on natural resources and agriculture as an income source. this will create another dimension to the existing problem since these farming communities will drop out their lands and farming in order

to move toward the city for a better life quality. which ends up adding additional load to the urban population and decreasing natural resources and food supply at the same time (UN,2012).

On the other hand, the urban growth sets a huge pressure over the electricity demand. The united nation economic and social council report on 2017, that between 2012 and 2014 electricity supply has increased by 0.3% point in comparison to global population growth for the same period of time. It was found that 1.06 billion people are still without electricity. However, the report also indicates that for the same period of time the renewable energy share out of the final energy consumption increased from 17.9% in 2012 to 18.3% in 2014. (UN, 2017).

Ban Ki-moon stated that these Urban issues including Urban growth, changes in family pattern, increasing percentage of slums occupants and other challenges are enormous and unlike any other difficulties that were presented during the last 20 years (Moreno, Clos & Ki-moon 2016).

The humankind has created an environmental change that is rapidly increasing in geometrical dimension in both quality and extent, the situation has reached a point where it is not guaranteed anymore if the planet can recover or will not be able to sustain as per Gonzalez & De Lazaro (2011) as they raise a red flag; let us just face the truth; natural capital will not continue to dissipated and the potential plans for maneuvering are becoming narrower by time. Unfortunately, environmental responsibilities are still overlooked in developing countries while the deterioration is severe and accelerating due to their impact on the natural resource production where the demand is still increasing as well by the developed countries (Gonzalez & De Lazaro 2011). In fact cities and developed urban areas are responsible for 70% of worldwide CO₂ emissions (Moreno, Clos & Ki-moon 2016) while these same urban areas are consuming 90% of planet resources out of which 50% related to the high consumption of building and infrastructure, while the rest is shared equally between industrial production and transportation. Gonzalez & De Lazaro (2011) stated the ironic fact that the American cities have increased

energy dependency which has a stronger negative impact over the environment acids more than the time of 1973 crises - where members of (OAPEC) the organization of Arab petroleum exporting countries proclaimed an oil embargo- this indeed represent the irresponsible urban development strategies toward environmental friendly development that protect humankind existing on earth. It was reported by the United Nation that a significant sustainable challenge emerged from the long un-thoughtful nor sustainable consumption and production behavior of the developed countries that was replicated by the developing countries at this stage. therefore without a universal agenda, the high-income households in both regions will continue to practice unsustainable behaviors that will result in social, economic and environmental unsustainable communities and cities (DESA 2013).

Over the past years, sustainable development initiatives were facing new challenges and global barriers that are related to different global issues such as the demographical change that impacts social pattern and social sustainability, Financial crises and the change in business model worldwide, the rapid improvement in technological trends and applications. these elements in addition to poverty, population growth, food security, jobs opportunities as well as other climatic changes and depletion of natural resources sets a pressure on the need for an urgent sustainable development vision that will help to reduce the social and economic impact beside the environmental over future generations. (DESA 2013).

The World Economic and Social Survey on 2013 reported that in numbers of regions the damage in the environment is getting to critical points and it threatens to break irreversible changes in the international ecosystem. the report elaborates that the rapid Urbanization, all over the world, especially in developing countries, requires major movement and changes in the methods of urban planning and design as well as urban development management. in addition to a substantial increase in public and private investments that covers urban infrastructure and services. Since energy and drinking fresh water are likely unmet for hundreds of millions of

households which requires a significant infrastructure and service progress achievement. As per DESA (2013) within 1950 to 2010 around 1.3 billion people moved to small cities which is double the number of people who moved to medium size cities that were around 632 million while 570 million moved to large cities. This explains the continues urban areas expansion as a result of population density increase that will impact mobility, natural population growth, socioeconomic development, environmental changes and local policies to govern those of numbers of residence (DESA 2013).

1.3 Profound Heritage vs. Expanded Modernity

Dr, Mohammad Makiya once stated that the city is a reflection of the deep integration between human being within the space over the time. In fact Dr, Makiya believes that the cities true identity lay in the harmony and connection of these three elements.

New Urban management regulations are found to ignore the connection between human scale and the original traditional city pattern that was generated over long period of time in the middle east countries since as per Ogaily (2015) it is found that vernacular architecture is linked to specific cultural and economic fabric that goes against modern lifestyle concepts and space share. despite the fact that High rise buildings are rooted in the culture of the societies in this region as per Ogaily (2015) however it is not always the answer to local residential needs as contemporary planned " car cities " are the centers of population density that is disconnected from cultural and social growth and relying more on roads and infrastructure systems in its urban development. (Ogaily, 2015).

An earlier study by Abdulmonem and loehlein meets Ogaily interest in exploring the historical urban development pattern. Abdulmonem and loehlein (2007) believe that historical area within the existing built environment in current cities sets a clear proof that responsible sustainable

architecture exists within the communities and it is achievable since home and other residential structure sets the core for sustainability. once the household units is a sustainable pattern of behavior will expand within the community out to the region and creates a sustainable nation. (abdulmonem and loehlein, 2007).

Relatively Hadjri and Boussaa published in 2007 their research and studies about urban Heritage conservation initiatives in UAE. The paper explains that over the mid of 20th century, new conservation methods are adopted that complies more with the modern systems.

This was a reflection of the paradigm shift in values perspective among contemporary societies toward valuable historical sites and urban projects. Modern conservation initiatives demand more thoughtful human development that can be entitled as a sustainable development that does not lead backward to the past and blocks all modern technologies and materials but rely on the human force existing as well as material sources available locally (Hadjri and Boussaa 2007). But since modern cities became a population hub that focuses mainly on technology and the artificial environment that is created in order to sustain the existing of these societies. (Ogaily, 2015) Therefore any conservation approach will not succeed without complying with the physical improvement that brings residential usage, social and cultural activities besides economical investments to the area. This will secure the sustainability of the area as it provides permanent positive activities and public interaction (Hadjri and Boussaa 2007).

Different other studies are addressing the connection between modern building design and construction systems with vernacular architecture and heritage designs. It was noticed that in UAE for example new construction highlights some traditional local physical elements in the design of the facade only, keeping its limited to the visual impact over the architecture style rather than inspiring the space and functionality of the mass itself as noticed by Abedi and soltanzadeh (2014), while they also agree with Al-Zubaidi (2007) in relating the wide adaptation and importing of western international architectural designs to the lack of knowledge in

traditional construction methods that leads to lack of trust in heritage designs with the assumption that western modern concepts are more reliable and successful examples of urban planning and architectural systems.

This interaction between worldwide urban views and traditional regional or local aesthetic values was addressed by different architects like Rifat Alchaderchi the Iraqi architect who believe that this interaction should get the chance to be investigated and studied to explore different possibilities that can be utilized for maximum social and environmental advantages within new cities (Ogaily, 2015). Another view for Architectural design and construction was introduced by Hassan Fathi the Egyptian Architect who adopted more detailed attempts to revitalize the vernacular architecture design elements as well as material and construction systems. This was shown clearly in the design of New Gourna (Fig. 1.1 a,b) village located on the west side of the Nile river in Luxor that was built between 1946 and 1952 and served as a residential new location for Gurnii residents. The design highlights the implementation of local construction techniques and the wide use of local material beside depending on traditional Urban layout and Architectural details such as orientation and mass setting beside openings dimension and characteristics. Aiming to set an example of an existing sustainable human scale project that responds to local needs as well as complies with modern function requirements while maintaining deep roots to traditional heritage and local culture. However, the project did not receive the expected acceptance and appreciation where Fathi left after that and kept investigating in ancient regional building material especially that the proposed designs were all depending on Mud Brick as the main construction material used overall the project. This leads to recent serious concerns regarding its status since it is the permanent residence for people who demand safety and proper infrastructure supply (unesco.org 2018).

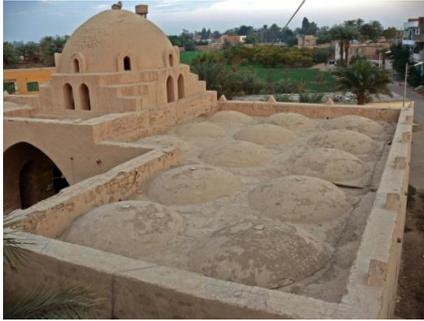


Figure 1.1 (a) New Gurna residential roof.
image source wmf.org,2018



Figure 1.1 (b) New Gurna landscape material .
image source wmf.org, 2018

1.4 Global Warming and Climate change

We are dealing with a very deep threat of climate change and the deterioration of natural resources, said Ban Ki-moon U.N general secretary, I believe that if it was not addressed timely and adequately, this threat will bring all our development theories and strategies efforts to an end. (DESA 2008). Ki-moon added: Many islands may cease to exist if the consequences of global warming were not taken seriously, Particularly rising of sea levels and the increase of natural disaster number and overall intensity. (Ki-moon, DESA 2008). Five years later in 2013, the world economic and social survey indicates that climate change is threatening to escalate in the absence of well-designed strategies. Supporting Nordhaus (2007) who found that climate change is believed to occur as a result of Green House Gases (GHG) building up at the atmosphere. The most significant (GHG) is CO₂ that its emission is rapidly increasing as the concentration in 2005 reaches 380 part per million that is far beyond the range for the last 650,000 years since it was estimated to range from 180 to 300 PPM. This will result in an increase of earth surface temperature by 3 C° on an average. (Nordhaus 2007). In fact, this view was supported with the findings of the world bank (2012) was it was concluded that the concentration of GHG and most Importantly CO₂ is leading toward an overheating the globe. The concentration has increased in the atmosphere from 260-280 PPM during the pre-industrial era to 391PPM in September 2012 and the global mean temperature is already 0.8 C° above Pre-industrial records. (World Bank, 2012). In 2013 the red flag was raised high by the DESA (2013)

Statement " Current emission rate of GHG will likely drive to further increase in global temperature increase with expectations of catastrophic consequences." The report explains that Climate change sets numerous challenges for sustainable development and the effect will be noticed in all regions around the globe although the intensity of exposure to the risks will vary. The degree of vulnerability will not be the same. as in developing countries that contribute the least to global warming, the impact will be at its peak. For example, the coastal communities and some small islands or mountain settlements and other highly vulnerable communities since the impact will tackle Agriculture, Human health, ecosystem, biodiversity of species and water resources. These effects will raise the vulnerability of poor communities and societies as well as risks the resilience and adaptation ability of cities and communities in rich countries. (DESA, 2013).

As an example for vulnerable communities, Bosnia and Herzegovina (BH) were exposed to extreme weather conditions causing serious incidents during the last couple of decades which was reflected on economic loses. and as per the available information and climate projections, the exposure to climate risks will remain existing and might accelerate and increase intensity. It is important to note that the population in these countries are highly vulnerable to climate change since they are highly depending on agriculture and other climate-sensitive livelihood activities (Zurovec, Cadro & Sitaula, 2017). Unlike developed countries where the adaptive capability to change is higher. similarly, Frank Bainimarama, the President and prime minister of FIJI said at COP 23 " If the world did not decisively begin to remedy the greatest challenges of our human lifetime, then the Pacific will not remain the way we knew it." (United Nation, 2017). Yet the world economic and social survey back in 2013 debated that developing countries cannot withdraw from being responsible for global environmental problems since without their participation with an effective role, there will be no chance to solve the international problem (DESA 2013). Even though they were not part of it at the first place as shown below in (Fig. 1.2)

where the fact that developed countries were contributing to environmental problems and CO₂ emission since 1990 as the records shows just around 4 Peta-grams of carbon emission was the total of Production and consumption at the developed countries while at the same time the developing countries were barely recording 2 Peta-grams of carbon for production and consumption. and it was not until 2004 were developing countries start catching with developed countries and record similar result however asking developing countries to share similar responsibility in reducing carbon emission will not be accepted since the developed countries had their share of production and consuming for a long time and made all possible benefit out of it up to date.

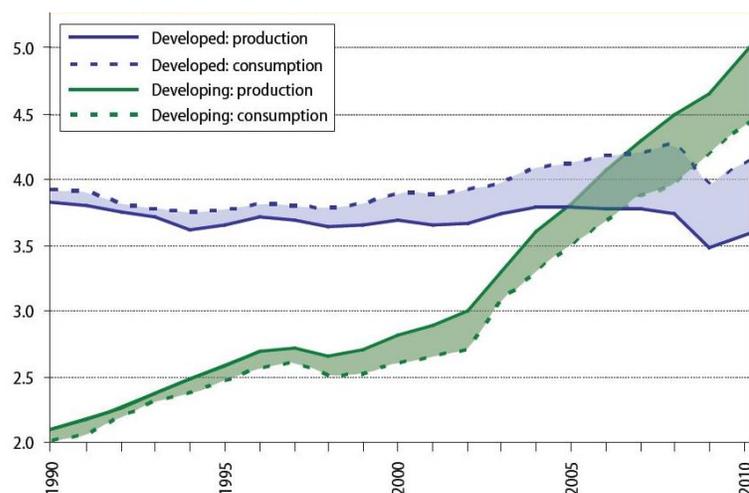


Figure 1.2: CO₂ emission in petagrams of Developed and developing, over 20 years.

source: DESA 2013/ Peter & others 2012

Ban Ki-moon statement in 2008 was essential as he declares the fact that only by keeping a long-term vision we can ensure the well-being of future as well as present generations. As defined by the U.N. Human Settlement Program in 1991; the sustainable city is where achievement in social development, economic progress as well as physical improvement are made to last (UNCHS, UN-Habitat,2002). It is now more important to put into practice the concept of Sustainable Development (SD) that integrates Economic growth with social development with the protection of the environment. Since climatic change also adds a pressure

on natural resources like land, water and energy are critical resources for human survival and global warming and other indications of climate change risks this natural resource and the use percentage as well as fair distribution among the population of different countries. Another recent study that meets previous results was done in 2012 by Atkins, Department of International Development in United Kingdom (DIFD) and University College of London (UCL) where it agrees that cities in developing regions are facing a significant threat by climate hazards, resource depletion and the ongoing rapid vital damage to the ecosystem. These threats cannot be studied and looked at individually since these are interlinked, multiple problems and it is continuously growing. The report emphasizes the importance of taking urgent steps toward future proofing the development process while tackling the environmental risks to their sustain and prosperity.

Future proofing succeeds when dealing with risks in an integrated method that will help develop solutions that benefit social and economic sectors as well as maximize money value and set the base for broader urban transformation. (Atkins, DIFD, UCL, 2012). It was concluded one year later by (DESA) that Sustainable urbanization provides the opportunity to meet socioeconomic improvement with more environmentally responsible sense (DESA, 2013). It was also stated that Sustainable development methods share many features such as; first, the sooner the implementation of a regulation or policies start the less costly actions will be since the technology is still flexible. Second Policies will upgrade efficiency in energy distribution and the world will control emission in a better way. Third scenarios that target the end-use efficiency percentage improvement tend to comply with sustainable development goals requirement such as maintaining air quality is going at the same time to limit Global temperature increase eventually (DESA, 2013).

1.5 United Arab Emirates overview

1.5.1 Geographical and climate Background

This research covers the United Arab Emirates (UAE) and specifically Dubai city. The UAE is located in the Arabian peninsula with a long coastal line on the Persian Gulf from one side and Gulf of Oman on the other side. UAE is having land borders with Oman, Saudi Arabia as shown in the map below (Fig.1.3). The government is a constitutional federation consist of seven cities (Emirates). The land area is covers around 71,023.6sq km (Government 2018).

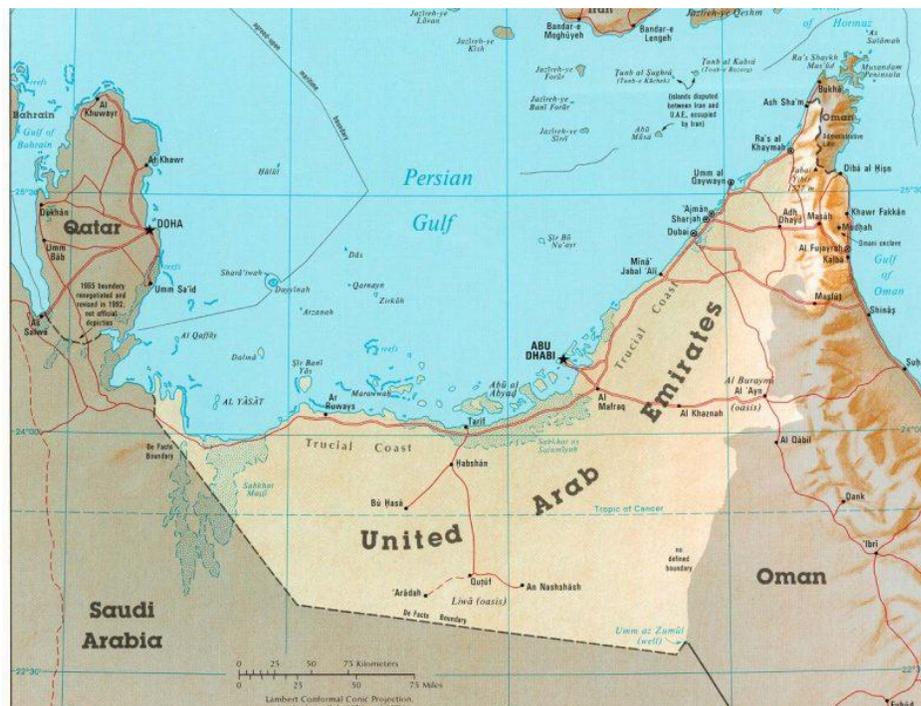


Figure 1.3: United Arab Emirates Map with border lines. (Geographical Map 2018)

The UAE topography as seen in the map above is diverse between mountain areas on the east side that forms 2.6% of the land area where the highest point is Jabal Yibir at 1,527 m and desert area of around 74% at south. including what is known as (Al-Rub Al Khali) one of the international recognized deserts in addition to coastal flat lands where population

concentration is found mainly since 1950 as it was close to the sea where traders from India would meet local traders to exchange goods such as pearls and fabric since this was the main income source for local communities back then. (UAE Annual Book 2016 2016)

When it comes to climate and according to Köppen-Geiger Climate classification System that identifies five main climate regions that are divided into different groups based on annual rainfall percentage and temperatures records as shown in the map below (fig. 1.4) (Köppen-Geiger 2018). The map indicates that UAE code of climate regions is B.W.H where B refers to the Main climate that is Arid and W refers to the precipitation level that records UAE as a dry winter area and finally H that refers to the temperature records which sets UAE in a hot arid zone.

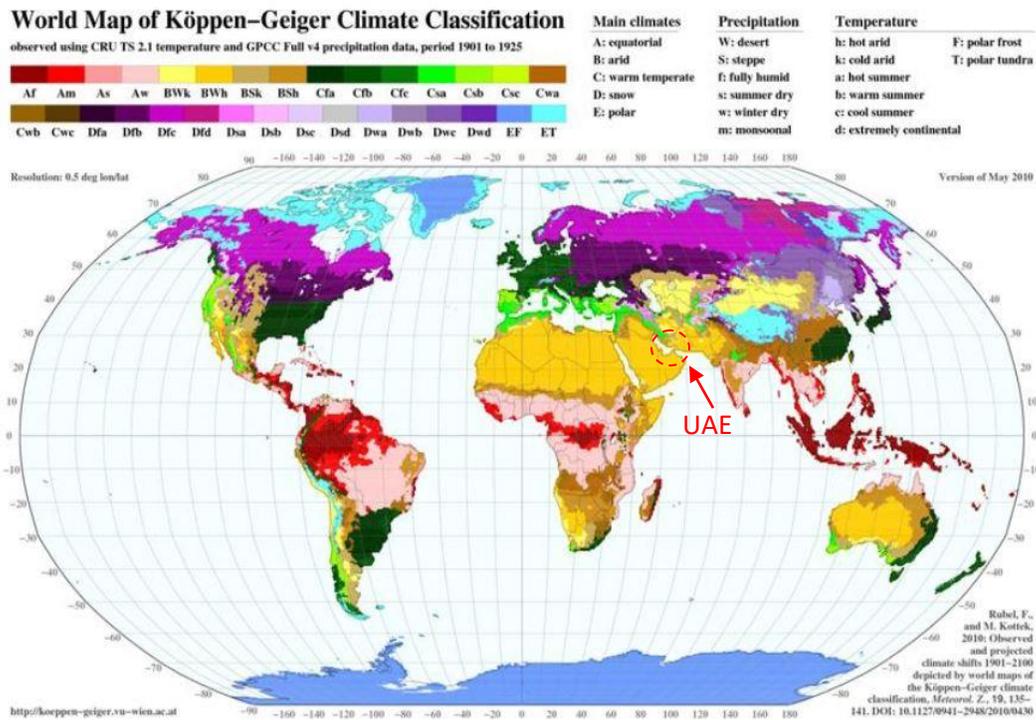


Figure 1.4: World map of Köppen- Geiger climate zones- Köppen-Geiger 2018

In general, UAE has hot weather during the year and cool dry winter months. Peak summer temperatures in UAE were recorded this year in July where it passes 45 °C in two days within the month (ACC Weather 2018). Note that UAE regulations apply working band hours during summer session starting from June to September where any labors who are assigned to do work

on an exterior locations as a full job for 8 hours a day such as constructions staff and farmers and other labors will not be allowed to work between 12:00 and 16:00 during these peak summer months to ensure their safety and well being.

1.5.2 Urban Community and Social Fabric

The United Arab Emirates is an Arabic cultural community where the national language is Arabic while the official religion believes is Islam, However, it is a multi-nationality community where the constitution protects the rights of other religions to practice their beliefs in a secure atmosphere such as Christians and Hindu where there are special worship licensed locations. The total population recorded in December 31st, 2016, was 9,121,167 person where 69% are male and 31% female, Since UAE population includes more than 200 nationalities living and working in UAE, this, in fact, explains the dominant percentage of male against female. The government estimates that UAE national (Citizens) in 2010 were 947,997 people to 7,316,073 people as non-nationals (Residents) (Government 2018). The society in the UAE inherits the identification of the family throw generations in co-ordinance with the Arabic cultural background as a group of people related by blood and having an unbreakable bond according to the Islamic doctrine, (Salem 2009). Since the Author of this research lived more than 30 years in UAE and comes from an Arabic, Muslim family it is well known that family plays an essential role in the formation of the community. Unlike western culture ; the Arab and Muslim communities do not encourage children after 18 years old or 22 years to leave family home and it is unlikely to meet an unmarried individual either a lady or a gentlemen living solo in a house permanently at the same city where her or his family is living, In fact some residential buildings will not allow bachelors to rent an apartment since owners of the project prefer to keep family atmosphere within the building. On the other hand, Extended families are still found in many cities within UAE, where grandparents are sharing the same residential unite with grandkids, and in some cases brothers and sisters in low are sharing the same residence with their parents in low. Emirati

(UAE citizens) are very proud of their family relationship, in fact, this relationship forms and identify many religious events such as Eid holidays where all brothers and sisters should meet and gather in the same home with parents and that includes sons and daughters-in-law since the relationship does not stop by establishing new family but indeed it expands to cover the in-laws and their families too. Even some cultural events will take place only at the grandparents home or elder brother resident and it is important to note that UAE families are strongly connected by tribe background and each citizen is proud of the strong community connections with other families within the tribe or other local tribes.

Studying the Population Growth charts below in the graph (fig.1.5) generated from given information by Dubai Statistic center (DSC, 2018) for the period between 1994 and 2014.

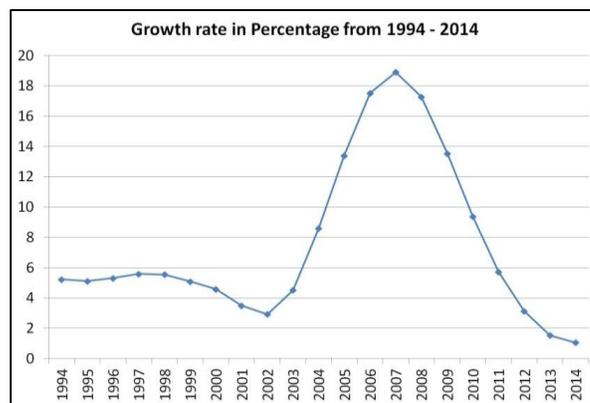


Figure 1.5: Growth rate percentage 1994-2014 - Source DSC, 2018 - Graph designed by Author

The chart indicates an increase in the Growth rate percentage started by 2002 until 2007 wherein parallel to the international financial crises the growth rate dropped remarkably and continue to decrease to even lower rates than 1994. On the other hand, statistics show a mild recovery in population growth reflected on the number of households and number of people that generates the average size of the household as shown below in the graph (fig. 1.6) that was generated from data given by Dubai Statistic center (DSC 2018).

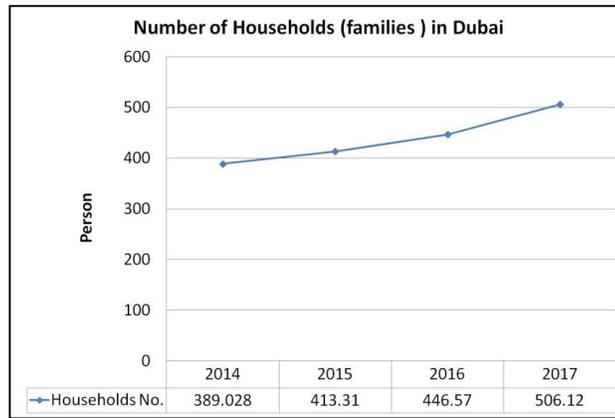


Figure 1.6: Number of households in Dubai from 2014-2017 - Source DSC,2018- Graph designed by Author

Statistics show also an increase in families number as well as the average size of households as it was 4.2 by 2014 and 2015 and became 4.3 by 2016 and 2017 (DSC 2018). This was aligned with an increase of recorded marriage number within both residence and citizens sector which added an extra load over housing requirements. The United Arab Emirates provides bachelor citizens (Local Emirati) and newly married couples with ready built home or a loan with a 25% coverage for construction fees in addition to the land that is designated and distributed to them after applying for the request by an average time of 2.5 years after meeting all conditions and requirements. However, Ogaily (2015) stated that the urban fabric of Dubai has extended rapidly since 1950 in about 400 times up to date. As per Ogaily, this rapid urbanization was not dictated by population growth but it was economically titled since the city is attracting foreign investment looking forward to developing a sustainable economy. This was aligned with the Dubai 2020 Urban Master Plan prepared from 2010 to 2012 by Dubai Urban Planning Committee with the support and consultation of AECOM.

This master plan focuses on the environmental future and current challenges and the socio-economic drift that is seen as the key to future urbanization management. (Ogaily, 2015)

The current Urban development pattern in Dubai is seen through the data collected from Dubai statistic center presented below in Table 1.1 which compares between 2015 to 2017 construction of Villas - detached residential unite for a single family- in term of location and developer (DSC

2018). Clear alignment between the international urban development process and Dubai urban development is found where the concentration is driven toward urban communities however the expanding toward rural areas is taking place through investors who are developing housing settlements that replicate the idea of urban sprawl but with a managed system. Keeping in mind that Private villas are built by citizens who were given the land by the government represented by housing establishment in Dubai and Abu Dhabi. But the investment villas are constructed by developers who get to buy the land or sometimes get into partnership with specific landowner so that they invest in the land with the maximum investment return based on feasibility studies and market demand indicators as well as some local regulations that classify heights and land use of each district.

Table 1.1: construction of villas between 2015 To 2017 type & location - Source of Data DSC,2018.

Year	Building Type	Rural	Urban
2015	Investment Villas	————	38,208
	Private Villas	1,142	46,098
2016	Investment Villas	582	43,321
	Private Villas	1,144	43,567
2017	Investment Villas	2,432	55,581
	Private Villas	1,527	36,682

1.6 Research motivation and exclusiveness

Since Buildings are responsible for third global greenhouse gases production and around 30% of final energy consumption, during the last 20 years an extensive effort in sustainable development and environmentally friendly business was recorded. The efforts proved that going green can be good for business and green building, in particular, can really be much more rewarding than conventional building systems as shown below in Table 1.2. were a comparison

between both systems were executed by Dubai's land department in 2014 and as a result Dubai green building code became mandatory for both private and public sector in the construction industry and real estate department starting 2014. (Government of Dubai Land Dept. 2014).

Green Buildings	Conventional Buildings
<ul style="list-style-type: none"> • Reduce energy use by 24-50% • Reduce CO2 emissions by 33%-39% • Reduce water usage by 40% • Reduce solid waste generation by 70% • Reduce operational costs by 8-9% • Consume less than 100 kWh/m2/year 	<ul style="list-style-type: none"> • Consume 41% of global energy • Responsible for 35% of global GHG emissions • Consume 40% of raw materials and 25% of harvested timber • Contribute to 28% of MSW and 40% of land fill • Consume about 200 kWh/m2/year

Since Dubai is aiming to identify the city as a smart and sustainable place to live in, Number of sustainable communities were launched and constructed in aligns with Dubai aims and UAE Vision 2021, such as Desert Rose, Dubai Silicon Oasis, Sustainable City and Dubai South District. (Government of Dubai Land Dept. 2014). However, it is found that the housing construction industry is an ever growing sector in Dubai (The second largest city in UAE), Due to the growth rate within national citizens and the overall increase in population in general. As the local government is responsible for providing residential units for those who are eligible according to the requirements and conditions. This sector is entitled to meet the increase in market demand since the number of families is increasing as presented earlier. In compliance with Vision 2021 and the national agenda that were discussed earlier Dubai is aiming for solid Sustainable Urban Development (SUD) that will meet the target pillars with scoring high in all indicators.

This research is Focusing on the residential communities designed and built by Mohammad Bin Rashid Housing establishment in Dubai and working on improving the design standards in lighted by UAE Vision 2021 and national agenda on one hand, and international reports and studies of future proofing cities on the other hand. This strategy shall respect local cultural and social demands paving the path for an elite sustainable model of Urban communities that can be

replicated all over the city and inspire private developers to implement same standards at the real estate market.

1.6.1 Research Background

In this research, the case study was selected from different housing communities designed and constructed by Mohammad bin Rashid Housing Establishment. Which is responsible for the development of residential communities designed for citizens as per their needs that were submitted earlier in the application form.

The research focuses on these communities since it is considered a model design that is copied and adapted in different locations within the city, therefore, the outcome recommendations of the research would be applicable to different locations within the same project. Also, users of the project are end-users, not investors with different cultural backgrounds who are trading in real estate with these residential units, But they are local citizens who are living permanently in these villas which will help in studying the social aspects and requirements for users.

1.6.2 Scope of Work

This research paper localizes the study of passive design strategies for outdoor and indoor spaces within a specific housing community project located in Dubai at "Oud Al Muteena" area. The research targets Summer season over seven hours during daytime since winter is known to have cool weather and comfortable chill breeze at night. This study was concentrated on day time period from 10:00 to 17:00 since observation on site showed that residents tend to use outdoor spaces at this time and therefore the research is conducted in summer were schools are closed and there is no school at a walking distance within the community hence early daytime was eliminated from the research. and the study starts at 10:00 were some young men were found practicing jogging and speed walking around the plot while babysitters were noted at 16:00 to 18:00 either escorting kids riding their bikes around the block or playing at the front yard of the house

1.7 Research Aim and Objectives

The study attracts attention to the impact of housing communities design within the city of Dubai since it is an ever growing project in different locations managed, designed and financed by government authorities. Considering the efficient implementation of sustainable Urban Development strategies on a smaller community scale will encourage other communities and surrounding project to follow the lead. That will result in a major social, economic and environmental enhancement on the city Urban Development. The target of this study is to evaluate passive design strategies inspired by local heritage residential design and assess the impact of these passive strategies on outdoor comfort condition within the housing community.

The Objectives of this study are as followed:

- 1) Study Local traditional Architectural characteristics and understand their compliance with local weather conditions.
- 2) Conduct a profound Literature review to explore recent similar research and benefit from their conclusions and findings.
- 3) Select a case study and conduct a site visit to understand and document notes about weather condition on site and architectural details, city planning details and regulations.
- 4) Propose and Examine different scenarios of passive design strategies on a selected site.
- 5) Evaluate the improvement of thermal comfort in each scenario and select a final optimum case that meets local weather conditions as well as connects to the heritage and traditions for users and residents.

1.8 Research Questions and Hypothesis

The research was built on the conceptual Theory that traditional Architecture in Dubai can support the efforts to mitigate climate change challenges and set the base for sustainable design guidelines for architects and urban designers.

By the end of this research, Author aims to conclude with a solid base answer that is proven through scientific research approved methods for the following questions.

- 1) Does Dubai Heritage Architecture design respond to current requirements in social, financial and environmental sectors?
- 2) Is it possible to mitigate current environmental condition with Heritage design principles?
- 3) Is passive design strategies for buildings efficient on an Urban project scale?
- 4) Does building height contribute in enhancing surrounding environment?
- 5) Can courtyard be efficient in mitigating current climate conditions?

Chapter 2: Literature Review

2.1 Sustainable Urban Development movement

In 2002 the United Nation commissioned what was called Millennium Project that aims to develop and achieve global, solid plans to face Poverty, Hunger, Epidemics and child mortality in addition to other international issues that were categorized in eight goals referred to an (MGPs) see (fig. 2.1). In 2008 reports of DESA estimated that each 1% increase in food cost will add 16 million "newly hunger" people and if these results continue by 2025 more than 1.2 billion people will be suffering. (DESA, 2008).The efforts were gathered by United Nation General-Secretary Ban Ki-moon on 2008 at a high-level event that exceeded the most optimistic expectations as 16 billion dollars were generated to fund the program (Un.org 2018). An in 2013 again the General-Secretary of the United Nation hosted a special event to follow up with the progress in achieving the (MPGs) as the seventh goal is titled "Ensure Environmental Sustainability" and by 2013 the reports indicated that global CO₂ emission was increased by 46% compared to records of 1990. And it was found that the growth in international emission rate is accelerating (United Nation 2013).



Figure 2.1: Millennium development project Goals, Source Un.org 2018

The Threat was found to be bold and requires serious coordinated international efforts to strengthen emission mitigation actions. therefore the meeting was concluded with an agreement

to complete negotiations by 2015 and take conclusive actions toward irreversible global climate change. In September 2015 a historic U.N Summit adopted the 17 Sustainable Development Goals (SDGs) from the 2030 Agenda designed for Sustainable development. But it was officially in action on January 2016. The 17 sustainable Goals shown in (fig.2.2) covers different aspects of international problems and for a successful international sustainable development, it is crucial to creating harmony between the three pillars of sustainability starting with the environmental protection and second the social inclusion and finally the economic growth. These pillars are all connected and crucial for societies in general as well as individual members within the society. Therefore these goals target all three pillars in all countries (UN.org 2018).



Figure2.2: Sustainable development goals, source: UN.org 2018

These goals are not legally binding nevertheless countries around the globe are expected to take responsibility in facing challenges related to social, economic and environmental aspects. these challenges are threatening the prosperity of this generation as well as future generations. Therefore countries should set a national framework and dedicate funds and resources to meet these goals and ensure progressive successful plans that incorporate these goals and vision. (UN.org 2018). It was found that sustainable development and climate change phenomena are

interrelated and investing in sustainable development will support efforts in reducing greenhouse gas emissions which will help in mitigating climate change phenomena. On the other hand, actions and efforts addressing climate change will support the sustainable development goals (UN.org 2018).

Among the 17 goals listed for sustainable development, The eleventh goals are titled "Sustainable cities and communities" where the united nation set a number of targets to guide countries in setting their framework and strategic time frame. As for example, the united nation aims by 2030 to have more integrated, sustainable urban settlements in all countries in order to enhance inclusive urbanization as described in target 11.3. also, U.N. aims to safeguard cultural and natural heritage around the world as explained in target 11.4. that in fact meets the Urban Design association vision that insists that an development or redevelopment of cities should respect the historical pattern of that area. (Gindroz, 2003). another statement by Gonzalez & De Lazaro (2011) related to basic sustainability objective insist on the need to reduce the impact of cities both historic centers and urban expansion areas over the environment and energy consumption however the progressive design shall not destroy the existing elements and spaces but create and find new dimension for these spaces since Tradition is the low of progression (Gonzalez & De Lazaro 2011). In addition to that United Nation (SDGs) includes having safe, access with a universal design to green and public spaces. especially for woman and kids as well as elderly people. within the goal of sustainable communities. The design of these spaces, as well as location and function included, should be user-friendly for all genders, ages, and disabilities of all kinds as target 11.7 indicates (UN.org 2018). This recommendation and guidelines shall all be implemented by 2030 which gives all countries fifteen years as a time frame to plan and execute these principles within its master planning strategies and agenda

As mentioned earlier sustainable development and climate change strife are interconnected. The U.N Sustainable development goals set the thirteenth goal to address urgent actions needed

to strife climate change and its impact. The record presents an increase in average global temperature by 0.85 C° from 1880 to 2012 and if the current concentration percentage of greenhouse gases continue as well as the on-going emission rates then by the end of the century the global temperature will rise above 1.5 C° compared to 1850-1990. Since all these numbers are challenging any urban development plans, It was important to set list of required actions that all countries shall implement within current ongoing plans. Starting with integrate measurement tools and method for climate change into national policies, second re-evaluate the adaptive capacity and emergency plans for natural disasters. third, enhance public awareness and improve education programs related to climate change mitigation (UN.org 2018). However the world economic and social survey of 2013 addressing the sustainable development challenges clearly presents the " Post-2015 U.N Development Agenda) that was announced in 2012 where the united nation added a fourth dimension to the Sustainable development pillars to conclude that achieving sustainability in Urban development cannot be fulfilled without inclusive economic development, environmental sustainability, inclusive social development and effective governance and peace of security (DESA 2013).

Also in 2012 a study was done by Atkins, DIFD, UCL indicated that it is important for cities to continue tracking and monitoring urban risks overtime as future proofing initiatives should not be considered an end state but rather a continues to process for better realization of risks facing cities beside solutions that are needed to eliminate risks and get socially, economically and environmentally desirable outcomes. The report also suggests that carbon emission and energy consumption per capita are well known effective tools to measure urban development impact on the environment. therefore implementing these measurements tools into annual national reports as well as raise public understanding to these measurements and create strategies to reduce these records will help in building focused effective climate change mitigation strategies as well as

successful, sustainable urban development planning system (Atkins, DIFD, UCL, 2012). (Gonzalez & De Lazaro 2011).

2.2 Local Sustainable Development Initiatives

Around the U.A.E efforts are set to meet SDGs on a local level and to present a role model for regional countries. U.A.E has implemented United Nation sustainable development goals within its 2030 national agenda and set special teams in all federal entities to follow up and monitor the execution of these goals and strategies on short term and long term deadlines (Government.ae 2018). As for the eleventh goal that focuses on sustainable cities and communities U.A.E is committed to providing sustainable infrastructure and it is indeed one of the six pillars listed in U.A.E National Agenda as explained earlier in chapter one. The aim as described on the official government online page is increasing the contribution of clean energy to total energy supply and preserve freshwater resources as well as monitor and protect air quality and that was done by setting 46 monitoring stations all completed by 2013, also increase forest and green cover from 245 thousand hectares in 1990 to 318.36 thousand hectares in 2011. The 2030 national agenda also focus on upgrading infrastructure facilities such as airports, roads, electricity network, and port in order to rank among the top best infrastructure facilities worldwide (Government.ae 2018). U.A.E is also paying special attention for preserving national heritage and rich culture since it was one of the fundamental roles that were set by His Highness Late Sheik Zayed Bin Sultan Al-Nahyan, described by saying " Those who do not have a past, won't have present nor future". (Bukhash, n.d). Therefore, U.A.E set a project called "UAEPedia" that is an online encyclopedia related to UAE culture, heritage, rich history and other information presented in the Arabic Language that is the national official language of the country and regional countries too. This project is the outcome of 15 federal government entities collaboration where each entity has assigned " Knowledge Ambassador" to update and add articles to the online library. (Uaepedia. ae 2018). Also, In allegiance with U.N Sustainable Development Goals, the U.A.E is building

several communities with sustainable planning and designing strategies to save energy and incorporate renewable energy resources and technologies. Such as Masdar City in Abu Dhabi, a Sustainable city in Dubai, Dubai Silicon Oasis as well as Dubai South District. These are all mixed-use projects where land use varies from commercial to residential and industrial areas with special attention given to energy conservation and water consumption as well as green public open spaces and other sustainable urban development criteria.

Besides that, U.A.E has passed number of policies and regulations related to environmental protection from 1993 to 2013 complying with international protocols and agreements since U.A.E has attended and signed different world-recognized environmental agreements such as Kyoto Protocol, Montreal Protocol, Vienna Convention for Protection of Ozone Layer and many other meetings and summits (Government.ae 2018).

In addition to that, all private and semi-private companies and organizations are requested by the government to present social and environmental sustainability activities and initiatives under its Community Social Responsibility (CSR division) programs and annual activates.

And to supervise, track and evaluate these initiatives and activities as well as bring it to public awareness, An online platform called "The Green Emirates" was established where all local companies and associations are listed and categorized according to activity and business sector first and Alphabetic order second. This platform allows the public to access annual sustainability reports of any company or organization and get an idea about green initiatives within its activities over the year and review their CSR reports for other social initiatives. On the other hand this platform support companies, investors, business owners to develop green strategies and assess them in setting sustainable systems that meet their business model and financial goals (Greenemirates.org 2018).

Government Utility suppliers on the other hand like DEWA (Dubai Electricity and Water Authority) and DM (Dubai Municipality) are also setting different public programs targeting

households and different society entities to encourage them in following environmental sustainable practices as for example " My Sustainable Living Program" is a service designed and presented by DEWA for different household owners to help them compare their consumption pattern monthly to nearby, similar houses. while keeping all information private and confidential this program encourages users to conserve electricity and water usage and support them with tips and detail recommendations on how to meet green living standards (Dewa.gov.ae 2018).

Also, Dubai Municipality which is the Authority responsible for all construction permits and involved in different business establishment permits and activities licensing is also following UAE Vision 2021 and raising the bar in environmental responsibility. As it launched in August 2018 the Technical Guideline part (1) that was designed and Environmental department within the Municipality as it explains the " Environmental Impact Assessment" required by the authority. This guideline shall be used by all Construction consultant companies as well as Urban Planners, Architects, Project owners and also Environmental consultant companies.

This Guideline sets the exact definition and understanding procedures required by all business stakeholders to ensure environment protection procedures by obtaining an "environmental clearance" from DM by following the required procedures mentioned. It is important to note that this document supersedes previous similar document introduced in January 2017 since Dubai Municipality is seeking continues to progress and improvement in services and regulations and aiming to ensure that any project development should be sustainable and adequate to future generation well being (Environmental Dep. 2018). In addition to other initiatives that were launched by different entities in Dubai to ensure meeting sustainable development goals such as "Dubai Program for renewable energy" that was launched in 2012, "Dubai Green transport" initiative that was launched in 2015 for sustainable transportation plan which is believed to reduce 19% of total city carbon emission. "Dubai Integrated Energy Strategy 2030" That was launched in 2011 and followed by announcing " Dubai Clean energy strategy" by November

2015 that aims to provide 75% of the city energy from clean energy sectors. It is important to notice that out of the 748 LEED registered Projects in UAE, 627 are in the city of Dubai while 102 LEED Certified projects are also located in Dubai out of 122 total Certified Projects in UAE. The city government has announced its future targets starting by reducing energy and water consumption up to 30% by 2030 while utilizing solar energy by 15% out of total fuel mix. and finally, in 2050, the city aims to cover 75% of its energy demand from clean energy sources.

However, since recent studies indicate that people in Dubai spent approximately 80% of daily hours within indoor spaces either homes, education facilities, offices or even other shopping malls and entertaining centers. These buildings are responsible for around 80% of Dubai energy consumption (emiratesGBC.org 2016). It is important to enhance indoor thermal comfort as well as outdoor public spaces in order to save energy load demand over the year.

2.3 Housing Development in UAE (Past, Present, and Future)

In 1960 Dubai population was around 40,000. The city was expanding and late Sheikh Rashid bin Saeed Al-Maktoum had a great vision for the future, Therefore, John Harris the British Architect was assigned to propose a master plan of the city to guide the expected Urban Development and population growth back then. And by 1963 the work accelerated since The international airport was already built and the bridge crossing the creek was completed. (Hadjri and Boussaa 2007). However, the design was revised after Oil discovery in 1966 that results in the more ambitious master plan by 1971, where another crossing bridge was added and a tunnel under the creek was designed as well as the initial concept of Rashid port was introduced. Finally, in 1979 eight years after the united of the seven emirate rates, John Harris himself designed the world trade center that remains the tallest building in Dubai up to 1999 (Prakash, 2011).

Nevertheless, these master plan proposals and design kept developing since it was found that the population growth and urban development surpass all expectations which set the demand for

continued enhancement and re-assessment. Dubai Government engages different international experts in bringing latest standard and successful Urban strategies to the city master plan such as Doxiadis who designed a comprehensive development plan during the 1980s followed by "Parson-Hartland Bartholomew" in 1990s where Dubai Municipality picked up the responsibility in 2003 and amended the design. Finally starting from 2010 to 2012 after the global economy rescission Dubai Urban Planning committee and AECOM "introduced Dubai 2020 Urban Master Plan" that incorporates environmental responsibility and future economy goals as well as responds to population growth and social pattern development (Ogaily 2015).

Observing Urban develop, met in Dubai and analyzing Real estate market will show that Dubai has committed big land areas for mega development projects since 2000, Some are considered as "City within a city" since it is planned to in-house more than one million resident with different land use and proposed activates within the project boundaries. These projects are reshaping the housing industry in The country in general and in Dubai in particular since these projects are designed, constructed and managed by private investors or semi-private developers.

However Abdelmonem, & Loehlein (2007) insists on the fact that UAE urban expansion through new communities and de-centralize services should follow sustainable development guidelines for it to sustain and preserve long-term successful model plan as well as social prosperity over future environmental and economic challenges facing generations worldwide.

This vision meets Stang & Hawthorne point of view that was published in a book earlier in 2005 under the title of "The Green House" where it was highlighted that most experts come to an agreement that planning, designing and constructing any project should follow a flexible and holistic process where decisions are made carefully with environmental conscious assessment at each phase of the development. Also, it is important for any residential project of any scale to relate and connect with the local context and regional conditions. (Stang & Hawthorne, 2005).

According to Ogaily (2015), the approach of Stang & Hawthorne (2005) was not implemented in Dubai residential communities development for the past 15 years were focusing on a high-income sector by providing the market with luxurious standard projects targeting elite customers either in large residential flats or spacious villas. These project neglected the wide spectrum of expat majority with relatively low income compared to other managerial business level individuals who are covered for the residential expense by their companies. this creates a socio-economic segregation where small expatriate families or even single individuals are located away from local citizens or high paid employees communities as per Ogaily (2015). It is important that project stakeholders and the urban planning sector consider cultural values and local environment as well as human behavior within the city in order to comply with the existing context in planning and developing project details and designs as per Stang and Hawthorne (2005) and Abdelmonem, & Loehlein (2007) and as Ogaily (2015) elaborated on the fact that most recent high-rise buildings are neglecting the basic principles of sustainable building forms and comfortable outdoor urban spaces. This is seen as a result to the speed and quantity operated urban expansion and the evergrowing demand for infrastructure development that is dissolving the transitional period that helps cultures and community values to formulate and rooting deep to strengthen its own identity over time. These periods are overlooked in modern city growth and the result is an international style where the latest technologies are implemented but lacking any historical depth or cultural identity (Ogaily, 2015). This approach that is focusing on eliminating the past completely when designing residential new communities in particular and any other buildings in general mainly in Dubai is based on the attempt to impose prestige portray of successful international architectural style image that is more suiting its original location rather than this region, however it is believed to some that importing international methods, forms or planning strategies is the best way of progression and development , As per Abedi & Soltanzadeh (2014) and Ogaily (2015) this mentality is resulting from lack of knowledge and

deep understanding of local heritage and culture which will drive the architectural movement in the city toward western industrial society that lacks traditional cultural aspects and detached from social lifestyle characteristics and values. However, Abedi & Soltanzadeh (2014) recapture that new approach in architectural design is evolving in Dubai which encourages the use of some vernacular elements in the design and exterior facade. despite the inspiration of these forms are the historical buildings but combining these elements is limited to the exterior visual aspect only without incorporating the details related to climate responsive passive design strategies that were gained and generated through these elements such as Barajeel (wind catcher) and Mashrabia (windows screening system). Comparatively, Stang and Hawthorne (2005) insisted that the cradle of sustainable residential designs is the ageless vernacular architecture monuments that captured the most of national history and can be seen in the historical city within any city fabric around the world. Stang and Hawthorne believe that past generation practiced sustainability by responding to environmental condition demand and relying on local building construction system and material, without importing foreign styles and making it adapt to the current situation which indeed results in poor living environment quality and shallow cultural identity over generations. This explains Ogaily (2015) recent conclusion that Local Municipalities like Dubai Municipality, for example, are responsible for developing suitable urban management policies and guidelines that ensure sustainability over the three pillars - Social, environment, economy_ and protect human-friendly development and retain demographic identity. (Sechante, 2014).

2.3.1 Al-Bastakia, a glimpse to the past

The Architecture of any city in the past usually emerges from three main factors, First the climate restrictions and demands, second the social pattern and lifestyle and finally the available materials for local construction methods. In order to understand the special characteristic of housing design and detail in Dubai, it is important to understand the history of the city and its unique urban growth evolution.

Rashid M. Bukhash, The director of architecture heritage department in Dubai municipality explains that Islamic architecture has a deep influence on the region where its main features are reflected on the courtyard house design in term of simplicity, functionality, and compliance with climate conditions as well as the respond to social values and lifestyle (Bukhash, n.d).

According to G.G Lorimer who is known to be among best historians, recorded in 1908 his statistics about Dubai by saying that annual revenue is around \$51,400 generated from pearls trading. The city is having three sectors starting by Deira where 1600 houses are constructed and served by 350 shops, then Shindagha area where 250 houses are located and finally Bur-Dubai where 200 houses are constructed served by 50 shops. The total number of palm trees is about 4000 date tree while there is 155 diving and trading assigned boats and another 20 smaller boats that local is calling it (Abra) which transit passengers from one side of the creek to another. However by 1930 and up to 1940 the population in Dubai dropped from 38,000 in late 1940s to 20,000 in 1953 due to departure of many pearl merchants and other traders to nearby countries since pearl industry was changed by the production of cultured pearl in Japan by 1930 in addition to the second world war that impacts the trading exchange with India, Iraq and other countries. But the production of oil in Dubai by 1969 increased the city income and raised infrastructure and master planning activities subsequently (Sechante, 2014)

By studying the architecture aspects of Islamic architecture in the region it becomes clear that Islamic vision has impacted local architecture urban design, as an example privacy and modesty are clear characters of traditional local architecture. Similar to other countries within the region, courtyard house design was found in Dubai since the early 1900s (Hadjri n.d.) This design provides rooms with in-ward openings to avoid exposure to public narrow alleys (Sikka). The design of the courtyard house will be discussed in detail in an upcoming section of this Literature review. Sechante,(2014) elaborates that these allays were designed to ensure maximum shade during daytime as well as harness north wind crossing from creekside since these allays are

aligned on the north to the south axis with a small width that increases wind velocity between buildings which will enhance microclimate thermal comfort. Hadjri adds that the width of alleys between the buildings did not exceed 4 meter and minimum dimension was 2 meter as seen below in (fig.2.3). Another main feature of traditional architecture in Dubai seen in Bastakia is the wind towers that rises 15m from ground presented in (fig. 2.4) below. These towers catch wind breeze on high levels and channel it down to different rooms through chimney effect. Hadjri and Sechante explain that these elegant, climate respond system was preferable in bedrooms and main living rooms where residents can enjoy cool wind penetrating the space through this carefully located and designed tower (Sechante,2014).



Figure2.3: Allays in local traditional urban design. (Author photography)



Figure 2.4: Wind catcher in traditional architecture housing design (Author photography)

2.3.2 National Agenda and UAE vision 2021

United Arab Emirates government initiated the National Agenda and UAE vision 2021 in 2014 to provide a pathway for future development strategies and policies all over the country that focused on people and society as a first priority. The vision is designed to reflect the national agenda pillars starting with solid society and conserved identity, Then safe nation and fair

judiciary, followed by strong knowledge economy, the fourth pillar is leading and competitive education system, then world-class healthcare system and infrastructure and finally Sustainable environment and infrastructure. These pillars are examined by six main development indicators presented in (Fig.2.3) below starting by World class health care system where the government is aiming to reduce the prevalence of smoking and encourage smokers to quit while raising the awareness of healthcare importance and health risks and expanding the high standards health facilities in both private and public sector.



Figure 2.3: Vision 2021 indicators, ("National Agenda 2021" 2018)

Second is aiming for a competitive knowledge economy since it is expected that business models and economic strategies will change and UAE want to lead and be in the heart of this shift therefore young and youth citizens shall be prepared to become leaders in innovation, research, and development besides being at the top list of worldwide countries in income per capita while not only scoring high numbers on international reports but actually provide a strong and knowledge -base economy in private and public sector as well.

Third indicators focus on safe public and Fair judiciary system, Since the latest survey done in 2017 record public sense of security to be 96.8%, The government aims to raise these results and improve security services such as response time to emergency call and upgrade the reliability of law enforce team including police services and judicial staff. ("National Agenda 2021" 2018). Third is the intention to secure a cohesive society and ensure identity protection while integrating all community segments and opening cultural and communication channels with other international communities with preserving the deep roots of UAE cultural background among youth and children to build a strong individual personality that is exposed to globalization with solid local roots ("National Agenda 2021" 2018). The fourth indicator is related to the global concern about sustainability and environmental infrastructure where the government is targeting sustainable development that preserves the environment while keeping a balance between social and economic sector and this shall be implemented by taking steps toward raising the contribution of clean energy resources within the energy supply and raising the awareness among society members to the importance of reducing consumption. also, the government is aiming to raise the quality of air within dense urban areas, and preserve drinking water resources to face future challenges.

The final indicator that Vision 2021 is aiming for, is the First- Rate education system. The government targets youth and children knowledge base in order to ensure that UAE students rank among top lists internationally in reading, Arabic language, science, and mathematics exams for that school's shall upgrade their staff and build an exceptional talent focus programs to meet future mentality requirement and prepare undergraduate for entrepreneur and leadership positions ("National Agenda 2021" 2018).

This vision and agenda are taking place in all federal sectors besides many private institutions where it was adopted and encouraged to ensure perfect fulfillment of all targets. for that reason, UAE was the first regional country to announce by the end of 2016 the five years budget plan for

the period between 2017 - 2021 that is 248 billion AED. so that each sector will know exactly what to plan for and what is the fund expected and build its strategies accordingly (UAE Annual Book 2016). It is found that some modification is needed on an urban planning level as well as architectural design is needed to meet these guidelines presented in U.A.E vision 2021 and the National Agenda. This will be discussed in details in the site analysis section of this research.

2.4 Microclimate Parameters in Urban Design

The Micro-climate terminology is used to express the climate at a small zone that may vary from the larger surrounding region such as urban communities or green, vegetated communities (Dictionary,2018) while in another word it is an area were weather conditions might feel different from surrounding areas (cambridge.org,2018).

Most cities around the world are becoming heat centers due to the structure of Urban areas as per Thani, Mohammad and Jamaludin (2013) who link the morphological factors of the urban landscape areas to the records of different micro-climate parameters. Also, Peng and Jim (2013) agree that designers are requested to be more climate-conscious when it comes to city design. As energy efficiency should be taken as a priority in order to meet urban sustainability goals and participate in global efforts to prevent climate change on micro-climate local level. similar to the vision of Thani, Mohammad and Jamaludin (2013) who insist on the importance of understanding the surrounding environment of building and putting an effort in enhancing the environment condition within the project site as this will impact the energy consumption either in winter by using heating systems or in summer by spending additional cost for cooling systems.

2.4.1 Building Height Impact on Urban Micro-Climate

Researchers are continuously examine the effect of different building heights over surrounding environment. The common phrase that is known in Urban sustainable literature as "Go higher not Wider" is still investigated and questioned for its efficiency. In this research the interest is

directed toward the impact of building height over micro-climate condition similar to the research executed by Kakon et. al (2010) where the impact of building height at a specific dens area in Dhaka, Bangladesh was studied and evaluated in term of the impact over Air temperature, relative humidity and wind speed. The results indicates that both air temperature and relative humidity were reduced with the increase of building height while wind speed readings increased at same area. The study concluded that encouraging policies to some limits can enhance micro-climate condition (Kakon et. al ,2010). Similarly Hayati and Sayadi (2012) stated that tall buildings can encourage intense wind flow in urban spaces. but also it can block wind from penetrating some other urban areas therefore understanding the urban context is important to decide the preferable impact since for example in polluted areas with high CO₂ concentration increasing wind flow is recommended however in some areas high wind speed can be annoying for pedestrian (Hayati and Sayadi ,2012) This indeed meets Kakon et. al (2010) who mentioned that height of buildings in an unplanned urban communities like for example some areas in Pune, India results in uncomfortable urban condition for public users. But since the demand of tall buildings increasing for many different reasons such a population growth, commercial values and social cluster attraction and many other. It is important to study carefully the characteristics of each urban area and pattern to understand its impact over microclimate variables including best building heights proposed at this area. Also Pandaya and Botros, (2014) noticed that the percentage of solar radiation can be remarkably reduced in urban communities where overshadowing strategies are used. this meets findings in the case of Colombo, Sri Lanka where low-rise buildings over both sides of a wide street causes worst atmosphere that other zones with narrow streets that are shaded by relatively tall building on both sides (Kakon et. al ,2010). And in a recent study carried in in Dar Assalam, Tanzania by Yahia and Johansson (2015) the results indicated that areas with low building height were more ventilated with minor difference that other surrounding areas. However the impact of building height was more notable when

combined with proper orientation of street aligned toward privilege wind which enhance air circulation through the area (Yahia and Johansson, 2015). These studies proves that fact that sustainable living cannot be achieved by environmental friendly building design only but it demand extra attention to micro-climate impact over indoor and outdoor spaces generated by Urban master layout and design. (Pandaya and Botros, 2014)

2.4.2 Building Form Impact on Urban Micro-Climate

During last years the form of residential units has changed , social interest in high-rise building that ensure low maintenance demand and provide nice view in addition to relatively high sense of security generated the market demand to go higher while mid-rise buildings are preferable in some area and guided by Authority planning regulation in many times. However the low rise detached residential Unite that reflects tradition still exist in some areas and in demand by individual plot owners with extended families as per a research done by Dalman and Salleh in 2011 where it was found that variety of construction building forms that is found in Bandar Abbas urban design has generated a string effect microclimate condition and thermal comfort statues, since this variety in built environment forms replicates the various topographical pattern of the city which indeed impacts weather condition in general (Dalman and Salleh,2011)

Similar to the characteristics presented earlier in section 2.3.1 related to traditional architecture in Dubai also historical district in Bandar Abbas reflects building forms that are twisted and compacted around narrow alleys where the ratio of width to height is 1:8. This results in a drop in air temperature by 1-3 C° compared to another part of the city where the ration is 2:1 with wider street spaces. This indicates the strong impact of building form and height over

microclimate parameters, which meets previous research discussed in section 2.4.1 as Hayati and Sayadi (2012) , Pandaya and Botros, (2014) and (Yahia and Johansson, 2015) agrees to the conclusion that Dalman and Salleh,(2011) presents indicating that shading level plays a vital role in microclimate conditions that vary by building geometry and Built volume in addition to the density percentage of the area. Also, Kakon and Mishima, (2012) concluded that less ground coverage and higher construction units can provide a better thermal condition in comparison with the opposite proposal where the maximum footprint of the building is creating highly dens built environment which reduces the vegetation coverage within the city (Kakon and Mishima, 2012).

Following Kakon and Mishima, (2012) conclusion, Kushol, et al (2013)adds that orientation and available open spaces with green coverage that reverse the impact of building density are factors that contribute to the improvement of microclimate statues around residential buildings as the result of the research done in Dhaka city, Bangladesh where it was concluded that Floor area ratio regulations should be activated and added to building code for better outdoor environment of Gal, (2014) also highlighted that the form of the built environment and the percentage of vegetation converge fabricate fundamental impact over microclimate condition. Similar to Kushol, et al (2013) also Gal, (2014) found that the thermal condition between building is driven by density, configuration layout for example courtyard opening within the mass and distribution of building which indeed impacts sky view factor that will result in microclimate alteration.

2.4.3 Inner Courtyard impact on Urban Micro-Climate

The concept of Courtyard house design is found thousands of years B.C in the architectural designs of Mesopotamian civilization. Despite it is linked to Arab region nowadays, The fact is it is a common feature found as far as India from the east all the way to Morocco from the west.

This design complies socially with the local culture in this region which is influenced with Islamic Ideology related to privacy and family protection against stranger introduces, besides the

fundamental religious teachings of segregation between ladies and gents in private rooms and relaxing spaces.

Al-Zubaidi, (2007) explains that traditional cities in United Arab Emirates urban planning is recognized with two main characters first is privacy that clearly traced through the hierarchy of zoning going from public spaces of market and trading areas (Souq) to the semi-public narrow alleys of each residential cluster, up to semi-private home entrance and Guests suite (Gents Majlis) ending at the private zone of the central courtyard that links all other rooms of the house through a passageway (Veranda) as seen in figure 2.4 below where a floor plan (on the left) for traditional house and real image of inner courtyard space (on the right) are presented.

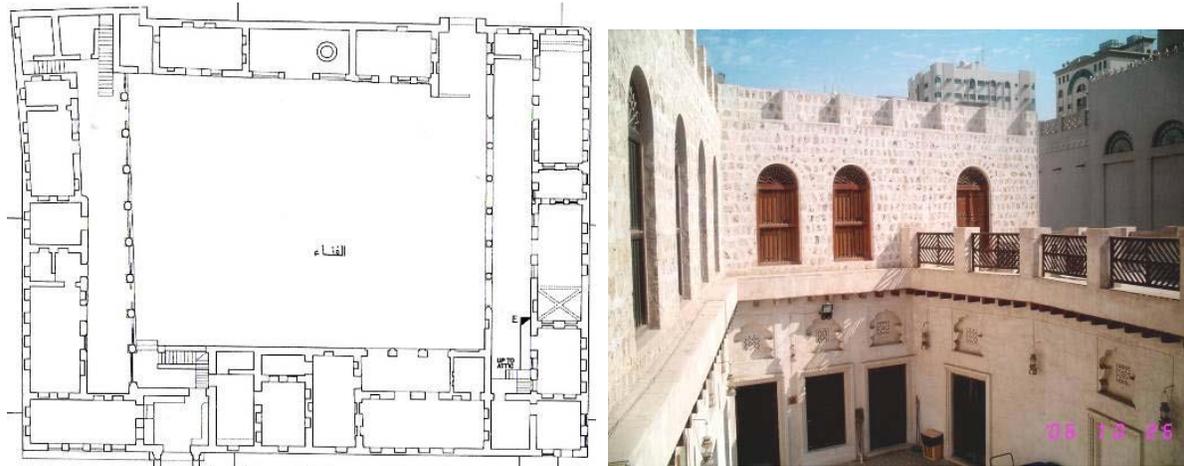
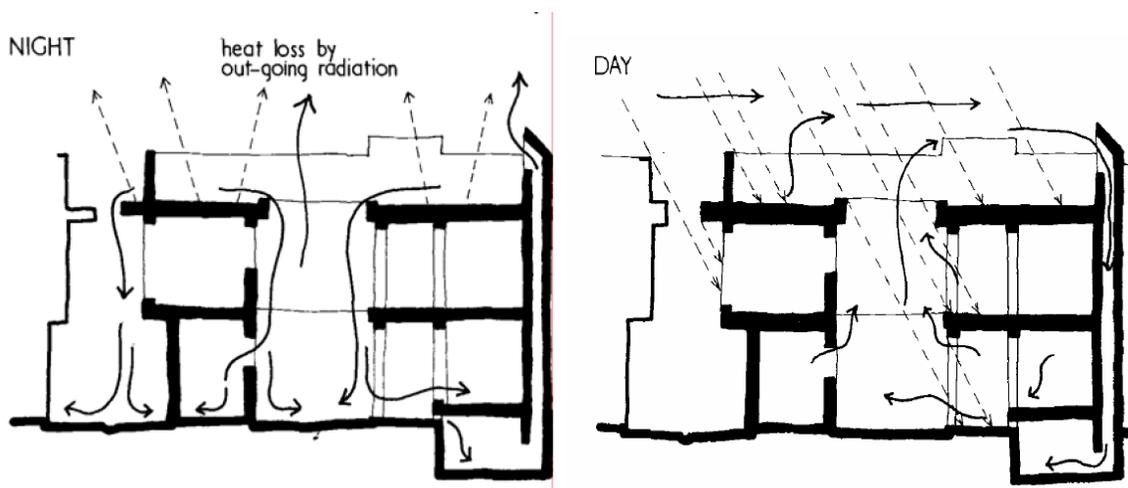


Figure 2.4: Traditional local courtyard house design. Source Al-Zubaidi, 2007

The second main characters are a climatic response and environmentally friendly construction materials and design. Al-Zubaidi, (2007) agrees with Abdulmonem and loehlein, (2007) as well as Stang and Hawthorne (2005) and Ogaily (2015) who concluded that heritage and historical regional architecture sets a clear example of successful harsh environmental tolerance and adaptation methods within the built-up environment. Al-Zubaidi, (2007) elaborates that central courtyard space plays a vital role in the cooling system in hot- arid climate zone since the majority of regional countries fall under this category. The courtyard was designed to act on three different phases during the day starting by night time where heavy cool breeze shifts

downward into the open space of the courtyard and penetrate all rooms surrounding the central court, resulting in cooling all furniture and interior that captures cool sense up to the early afternoon of the next day. During daytime the courtyard is semi-shaded but the sun is hitting floor area and partial external walls surrounding the court which creates pressure differences that encourage circulation of breeze through house structure where inner walls and furniture gain heat and a cool breeze is released from interior spaces toward the courtyard, as shown in fig. 2.5 below Al-Zubaidi, (2007).



Not to ignore the role of thick walls and small openings that prevent fast heat transference through walls or spaces. In the final third phase after sunset, the temperature drops rapidly and courtyard areas release all extensive heat since heavy cold air starts to descend again toward interior spaces. This mechanism is well studied and applied by carefully designing the courtyard proportion and rooms openings as well as the orientation of allays within the master urban layout. so that all passive design strategies cumulate and work to enhance microclimate conditions. Al-Zubaidi, (2007) and Ahmed, (2016). Despite that fact that Abdulmonem and loehlein, (2007) believe that vernacular architecture cannot respond to a recent requirement in term of environmental control and it will not be sufficient as it was ages before, Stang and Hawthorne (2005) insist that learning from the past can save effort and time and most important

save environmental resources since it concentrates on passive systems and smart basic theories such as optimum orientation and minimum openings and conservative footprint that will indeed save cost and reduce energy consumption. However, it was proven through research and different case studies that there is no such an idea as but it shall be applied in modern terms and after deep research.

2.5 Summary

The literature review conducted in this research indicates that Housing communities in United Arab Emirate are considered an ongoing project that needs enhancement and fundamental modification related to environmental, social and financial aspects since U.A.E in general and Dubai, in particular, are setting new standards and regulations as part of their effort to join global movement toward sustainable urban development and resist challenges facing future generations.

The Literature review also revealed a list of design principles and urban theories related to microclimate condition and its relation with different building aspects such as Height, Form, Setback, Design Configuration and orientation. Previous researches and studies addressed Urban Design housing communities were discussing traditional architectural through historical districts. The heritage of each region identifies different phases each society has examined where it highlights the needs and requirement of each generation and the way it evolves and relates to the progress in financial status at the region which ends up impacting the environmental condition at the same region.

Through recent research and similar case studies that were presented earlier it was proven that their is no such a thing as " one size fits all" each region and each project within the region or the city has a different case that shall be examined and well studied in order to conceive best

sustainable practices that suits the case and meet social, environmental and financial goals without compromising on future generation rights.

Chapter 3: Methodology

3.1 Introduction

This Chapter is linked to the previous chapter where a number of studies and research topics that are similar to the scope of work in this research were presented. This chapter will address the different methods and strategies used through these studies in addition to the assessment methods and research tools that were implemented to validate and examine the results and final outcome of these strategies. This part is important in this research since it assists in selecting research methodology and set research variables in an accurate way that ensure the neutral impact of any other factor that is not covered in the scope of work and also ensures the accuracy of the results at each phase of the study that will be taken further for the next step.

In reviewing similar studies and research the aim is to build over their results or to examine the same research subjects from a different perspective. or to examine the same methods and strategies that were successful in one location at another area to see if the same results accrue or there were differences that will help realize factors that affect these results. Regardless the aim this step is playing a vital role in saving resources and time in order not to waste efforts that on starting from scratch while the opportunity of proceeding forward and exploring new borders is available and the chance to contribute to the heritage of human knowledge through.

3.2 Similar research topics specifications

In order to ensure efficiency and high up to date information, this research follows a number of criteria in selecting and reviewing similar research topics. Starting by time frame where any research paper or published dissertation that will be referred to in this research shall not be older than 2003 since many rules and policies were implemented and modified since then and the Dubai specifically has been under a tremendous construction boom since 2000, therefore, all resources shall comply with latest built environment regulations and modern characteristics. However, this does not apply to some published books that are seen to present a fundamental

Urban design theory and considered the solid foundation of urban planning strategies and methods.

Other criteria that were taken into consideration is the climatic region. All research papers and articles were the topics and the site subject of the research share same weather conditions as United Arab emirate in general and Dubai, in particular, that means all reference case studies shall be in hot arid or hot humid climate zone. Finally, all reference case studies or research papers shall address housing communities or at least mix land use area. since this research is focusing on housing communities and it is essential to specify function and pattern of behavior within the site to be able to understand the social needs of site users as it will impact environmental resource consumption which will be reflected on financial status.

3.3 Literature Review method

It is an initial process used through any research or experimental study. It is known to be the building a research over other researches (Myllarniemi, 2015). Initiating a literature review process prior to any research helps to highlight the existing statues within the field of the research or present the opportunities for further enhancement in a specific topic. It can be used to clarify and understand a ramified, new topic. Also, it helps in understanding the process behind empowering a theory or a research question with scientific methodology and solid evidence.

Therefore this method is important either as a standalone method or as a support tool for other methodologies. Either way the process of conducting a literature review is the same as it starts with planning and setting a research question or topic of interest then start exploring and searching for similar questions or relevant topics out of which a list of most relevant and similar studies will be analyzed and compared in term of objectives, Scope of work, evaluation methods and finally results and conclusion after that writing the outcome of this entire process ends up either by conclusions and findings that meet or intersect previous findings or answers that

respond to the initial research question (Maier, 2013). The figure below illustrates the influence of conducting a Literature review over all sections of a research see (fig. 3.1). Starting by setting objectives and selecting methodology going with results analysis and finally understanding conclusion and results generated through the research.

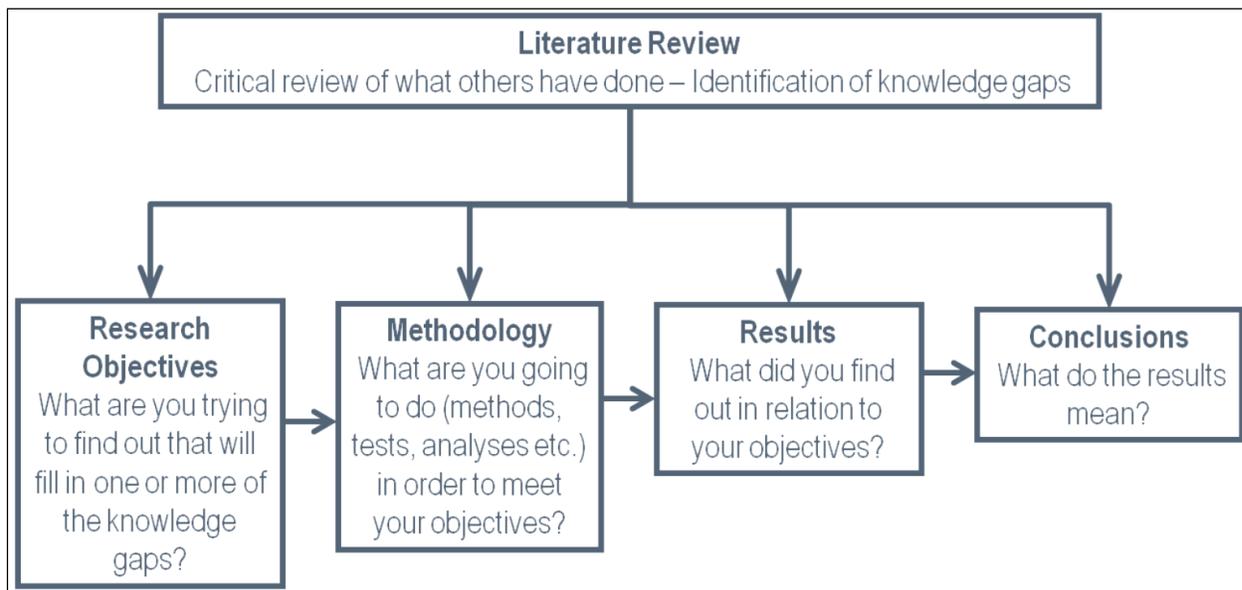


Figure 3.1: Conceptual Representation of L.R influence over Objectives, Methods, Results and Conclusions (Source :Maier, 2013)

3.4 Field measurements and Observation method

Trial and error was one of the earliest learning methods in human history, Observation and questioning the surrounding existing environment was the origin of many innovations over humankind history. As for example, the power of gravity that was triggered by a simple question results from observing an apple falls under a tree. similarly the development of a flying machine that was a dream initiated by observing flying birds and questioning the possibilities of similar movement. Therefore this research method is growing over generations and encouraging different research and innovation products that enhance different life aspects.

Observation and field measurements are considered research methods that fall under the quantitative research method and they include also conducting a questionnaire or a survey. But observation approach in research methodology can be also used in qualitative research. since

observation can be linked to behavior and response or specific factor numerical data as for example observation can be used to determine public interest in new public transit station located beside mixed land use area, In this case the observation method can be used either by keeping an eye over the site and asking pedestrians about their feeling and what do they think about it. to conclude with a percentage of people opinion about the station that can be transferred into a statistic percentage. Or the observation method can be used as a qualitative approach if monitoring the station was done by recording statistics related to the pedestrian traffic pattern. busy hours during the day, the surrounding Demographical composition and traffic jam details or other transportation methods. In this case, a different variable is extracted from the field visit and observation method. Translating these data into numerical tables and charts, as a result, these data help decision makers to improve or re-evaluate the objectives of the project.

This method is used in different research fields however similar to any other method it consists of advantages that can be invested and disadvantages that shall be treated. As for example obtaining data directly from field visit and observation enhance the reliability of these data and saves time and effort in contacting other people or even Authorities to get this information as well as provide the researcher with information that might not be recorded earlier or collected in an accurate way as needed in the study. Another advantage of this method is that it gives consolidated information about behavior either from those who cannot participate in a survey or those who might not give accurate information in order to hide or reveal desired data only. On the other hand, some disadvantages are found in this method as for example time frame that is framing a limitation in this case. as for example if the researcher aims to study the impact of new shading elements that are assembled in the site in term of its impact during summer days then the researcher should wait for the summer session in case it was not the same period of time. Or if the case study is located in a different area in this case researcher shall relocate for the purpose of the research which indeed ads financial load to the research process.

To conclude, This method plays a vital role in the accuracy of research data and basic input but in order to eliminate its disadvantages it is advisable to carefully analyze and understand the scope of work and objectives of the research topic as well as the expected outcome of the observation process and best tools, staff, time and system to carry it on.

3.5 Software Simulation Program and virtual model

As mentioned in the previous section, one of the disadvantages of site observation methodology is that fact that time and weather condition, as well as physical boundaries, can frame a limitation to the research, But building a virtual model using simulation software would definitely overcome these barriers, since this will help to replicate real environment components in addition to any modifications that are needed for the research, that falls under "What If ?" question. Such as exploring the day and night statues at the same model without waiting for the full day to get the results as it is the case in field measurements and site observation. As expressed by (Dr. Ykhlif, n.d) this is supporting tool in decision making, that accelerate the sequence in which data are collected, analyzed and re-evaluated. All without physical impact or existence on site or any financial load related row material and construction work.

This method also likes other methods has its own cons and pros that need to be examined carefully before depending on this method, either as a solo base research method, or combined with a supportive method. As it is usually supported by Literature review as explained earlier to assist in setting initial input data as well as explain the outcome results. However (Dr. Ykhlif, n.d) indicated three main cons of might impact research progress if it was overlooked starting by the fact that it might be expensive as some software can be over the initial budget of the research and might not give the full details as it tends to be specific. another point is the need for expert user who will be responsible for the accuracy of data input and results collection. since getting the software is useless without expert staff and this means that human factor influence over input

stage, progress, and final stage is relatively high and in science experiment, this might need additional revisions and validation.

3.6 Research Case Study

In this study, the research is conducted in Dubai where a housing community was selected out of different locations related all to Mohammad Bin Rashid housing establishment projects that are designed and constructed by the establishment team and consultant offices within the team.

As explained earlier in Chapter one and two, residential communities that belongs to Housing establishments either in Dubai or in any other city within United Arab Emirates are found to be an ongoing projects with accelerating demand since it is designed and distributed among National Citizens who proved to have an increasing population growth as discussed earlier in section 1.5.2 chapter one. These projects are most of the time replicated with same villa model options and plot limit as well as same landscaping design and urban design detailing.

Therefore working to optimize this project is indeed going to be reflected on a bigger scale since the idea and theory are replicated all over the city.

Turning this project into a model that all other projects can look up into and follow will create deep impact over housing community development in the city either in public (governmental) sector or privet (foreign investor) sector. The project is located in "Oud Muteen" area on the borderline between Sharjah and Dubai area. surrounded by residential low rise buildings and beside an ongoing construction work for the next phase of the project as seen below Fig.3.2 where the borders of the project are illustrated as well as the borders of the site subject of this research. The site includes 32 private owned residential villas vary between ground floor only to Ground and First Floor design as shown on Fig.3.3 that has been taken from GIS online maps.



Figure 3.2: Site location within Project boundary in Oud Muteena Area.

(Source, Google earth 2018)



Figure 3.3: GIS Plan for the research site within the project with an indication to floor number of each villa (Source Online GIS)

The project falls under the building code of Dubai Municipality and was designed as per building standard regulation. The work in site started late 2007 and was not completed until late 2009 as shown below in figure 3.4 where timeline is presented using GOOGLE earth History tool. The project is funded by Mohammad Bin Rashid Housing Establishment. In a meeting between Author and Eng. Mariam Sultan from Design Department in MRHS (Mohammad Bin Rashid Housing establishment), Plot Area was discussed and Eng. Sultan explained that each plot goes from 8,000 to 10,000 sq.ft and users are free to choose between number of floors with one of three Facade options as presented in fig3.5 below.



Figure 3.4: the timeframe of construction work in the project site from 29 Feb. 2008 to 29 Oct.2009

(Source Google earth 2018)

However, the eligible citizen is selected after applying the required documents and filling the forms where a number of family members is needed therefore the plot is assigned based on the family size and financial status since in some cases the citizen approach the Establishment for financial assistance in addition to the villa plot and construction support.



Figure 3.5: Three Exterior elevation design options (Source mrhs.org 2018)

In Order to fulfill the requirements of this research, Author conducted a site visit three times within two months where field observation notes were recorded in both text, and image format. In addition to that, an interview with a couple of families at the same site was done and their notes and reply to questions were documented through text format while the interview is documented by taking a group picture with Author.

A first site visit was done on 21 July 2018 to check the status of the project and building condition as well as other general information. It was found that project is fully executed and occupied, landscaping and other infrastructure services like lightings and bus station and pathways are in a good condition and been taking care of by municipality cleaning staff while the irrigation system is activated in different areas of the project. Pathways on both sides of the road

are wide enough for pedestrian crossing and well as wheelchair users and the site is considered walking-friendly environment since speed limits are set and clear pedestrian crossing points are designed carefully with high surveillance opportunity to enhance community sense of security.

However one of the comments from residents was that walking to the nearest Masjid is considered not safe as per his point of view since it takes 15min to walk between residential unite and cross several secondary roads and one main road which increases the potential for a traffic accident. Another comment from the same resident is related to the public transit service that is not considered reliable due to delay and limit in a number of trips over the day. The resident explained that he raised a request to Road and Transportation Authority in Dubai (RTA) through official channels asking to increase the number of stations and bus trips within the area but there was no response so far. It was noticed that this part of the project is served with 2 bus stations that are located on the main road crossing the site.

On the other hand, during the interview with the residents, the social perception was discussed and the Author asked both families how far do they know their neighbors and do they get in touch with other residents from the same cluster. both families confirm that they are comfortable with their community and they get in touch with other families during religious occasions like Eid days or National occasions like celebrating the national day or other social visits during the year. It is important to emphasize that this all residents in this cluster are local citizens and they share the same cultural and religious values which clearly made it easy for interaction and social bonding.

After the first visit and interview with residents, it was essential to check given information and analyze collected data. First in term of the walking distance the nearest Masjid it was found that the longest route will take approximately 10min with consideration of safe and walking friendly pathway as shown on (fig.3.6) below where Google earth was used to assist in the calculation.

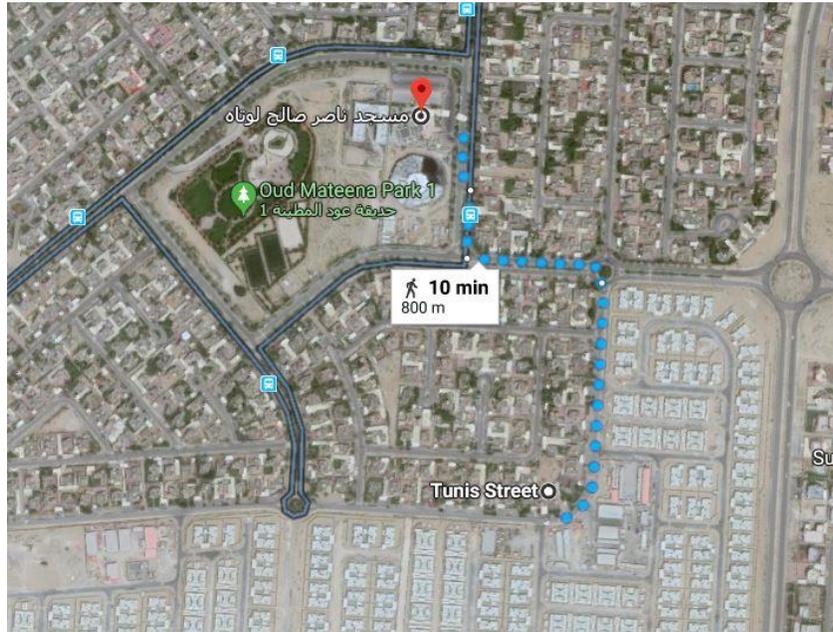


Figure 3.6: longest walking distance to the local Masjid. (Source Google Earth 2018)

The other comment from Resident was related to the number of the bus station and trip frequency. for this information also Google earth map was used to calculate longer distance within the site to the bus station through secured pathways and designed pedestrian crossing points. As shown below in (Fig. 3.7) on both options for walking direction, the trip will need 9 min on average to reach the bus station that serves this cluster. shown in (Fig. 3.8) where it is marked with a sign bar and timing schedule attached to it.



Figure 3.7: walking distance to the local public bus station. (Source Google Earth 2018)



Figure 3.8: Public bus station with a sign for trips timing. (Source Author, 2018)

Another aspect was noticed during the visit related to the open public space designated for outdoor activities that serves the project which is located beside the Masjid area which indicates that this whole zone is considered service area for all surrounding clusters. The walking distance toward this "park" was also studied as shown in Fig.3.9 below and it was found that the longest walking distance is 750m through safe pedestrian walkway.

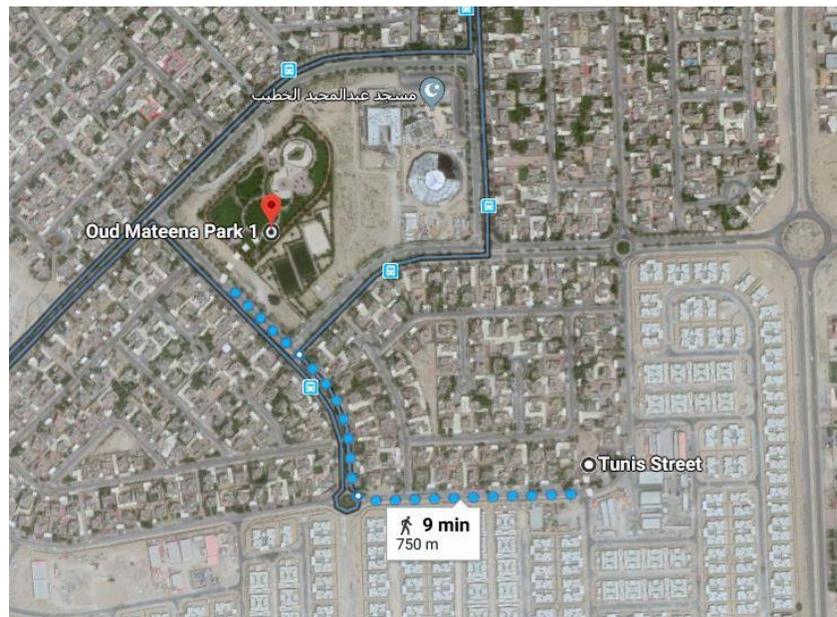


Figure 3.9: walking distance to the local public park within the project. (Source Google Earth 2018)

It was noticed through first site visit and analysis of given comments by residents that the distance toward public spaces like the park, and Masjid as well as public transit stations are falling within the approved standards and meeting local and international regulations however it

was important to understand that these pathways were not considered safe environment by resident mainly for two reasons first this pathways are not shaded or thermally comfortable during summer months or peak noon time which does not encourage the majority of users to use these pathways regularly. The other reason is believed to be a sense of security since this is a very quiet residential area with no security cameras or frequent police patrol trips during the day since Author did not notice any police patrol during the three visits to the site on with total average of four hours in each visit. This might not encourage families to let their kids use these pathways without accompaniment. However, it was noticed that kids are playing in front of their homes with the gate door open afternoon with the supervision of babysitter or house-made.

From an Architectural perspective, it was noticed that the majority of Residential units are designed with two floors height and forms a separated detached house with the setback of 3m from plot limit on three sides with neighbor plots and 6m from front side where main access to the villa is located as well as garage doors. as shown in (fig.3.10 a,b) below. In addition to that, the layout design varies from one plot to another since it is optional for end-users to select out of a given model. The selection includes a number of floors, a number of bedrooms required and external elevation style required. This result in a wide variety of layouts and front view facades. The total height of the residential unite also falls under the regulation of the Dubai Municipality almost all two floors design villas will be on the same height.



Figure 3.10 a: Andalusia and Traditional facade design villas (Source Author photography, 2018)



Figure 3.10 b: Islamic facade design villa with garage door access (Source Author photography, 2018)

Driving ways are also following Dubai Municipality and Road and Transportation Authority standards in term of width dimension, signing and speed limits as well as construction material. All roads are served with lighting poles, green buffer zone, and numbering signage system.

The next two visits were done to record microclimate measurements using specialized instruments and will be discussed in details in the following chapter.

3.7 Methodology Selection

After setting the research topic and objectives as well as defining the scope of work in the first chapter of this by going through a Literature review that covers similar topics and shares the same objectives. It was found that several research methodologies were used in these different research papers such as AlZubaidi, (2007) in this Ph.D. research the researcher is investigating the potential of traditional Architecture to meet the sustainable requirement in the middle east area with a special focus on United Arab Emirate case. In this study AlZubaidi used Literature review as the main and only method for analyzing and critical evaluation of the topic with all resources information, however the extensively and profound analysis and study that was carried in parallel with the objectives of the research and aligned with the variety of information resources that can be used to validate cross-check each detail helps AlZubaidi to meet the research goal and conclude with thoughtful findings. however, the researcher stated that the work was done by thorough investigation aligned with systematic discussion and analysis that and the outcome of the research is being looked at as a guideline and stated that further surveys and sustainable assessment methods are found necessary. (AlZubaidi, 2007)

Similarly, Abdulmonem and loehlein, (2007) also used Literature review as the only research method in their paper submitted for the 2nd International Conference of Dubai Conservation. the research also studied sustainable aspects in locale heritage architecture in Dubai.

Also Hayati and Sayadi (2012) published their article the impact of buildings height over the percentage of pollution in urban communities where they used Literature review as the main and only method of research to evaluate and compare between different researches and studies that were done in this field and collect the results and present it with critical analysis and identify relationship between different factors of the study.

However it is a common practice to have Literature review as a research methodology while presenting research paper in a conference as per Maier,(2013) and (Dr.Ykhlif, n.d) since this method aims to fill the gap of a current topic or present a better illustration for a fragmented information related to new topics, therefore, it is found successful in conferences and lectures.

Another methodology is found to be beneficial for some researchers is the field observation and site survey as for example Kushol, et al (2013) where similar previous work was used as a supporting method when constructing the objectives and research parameters for the selected topic. A field survey was conducted across eight sites of within Dhaka city that are expected to meet the objectives of the research and should be shortlisted so that researchers can select the desired sites for the assessment analysis. Information was collected through repetitive site visits and questionnaire. Then after several stages of data collection during the hottest season in the city that is between March and May , Two locations were selected to be simulated in Envimet with all existing characteristics that were observed and recorded during the field visits phase. Then the simulation results were compared to existing results and correlation analysis was developed in setting final findings and conclusion recommendation. This method of site observation was supported by Literature review and formed the base for software simulation but despite its accuracy and other advantages this method had some limitations such as time frame that was running over three months in this study paper beside the physical effort and workforce that is needed to cover bug areas and large-scale sites that will be an extra load over financial

demand of the research. therefore this method is recommended in the validation or calibration process only where limited time and area can fulfill the need and ensure accuracy.

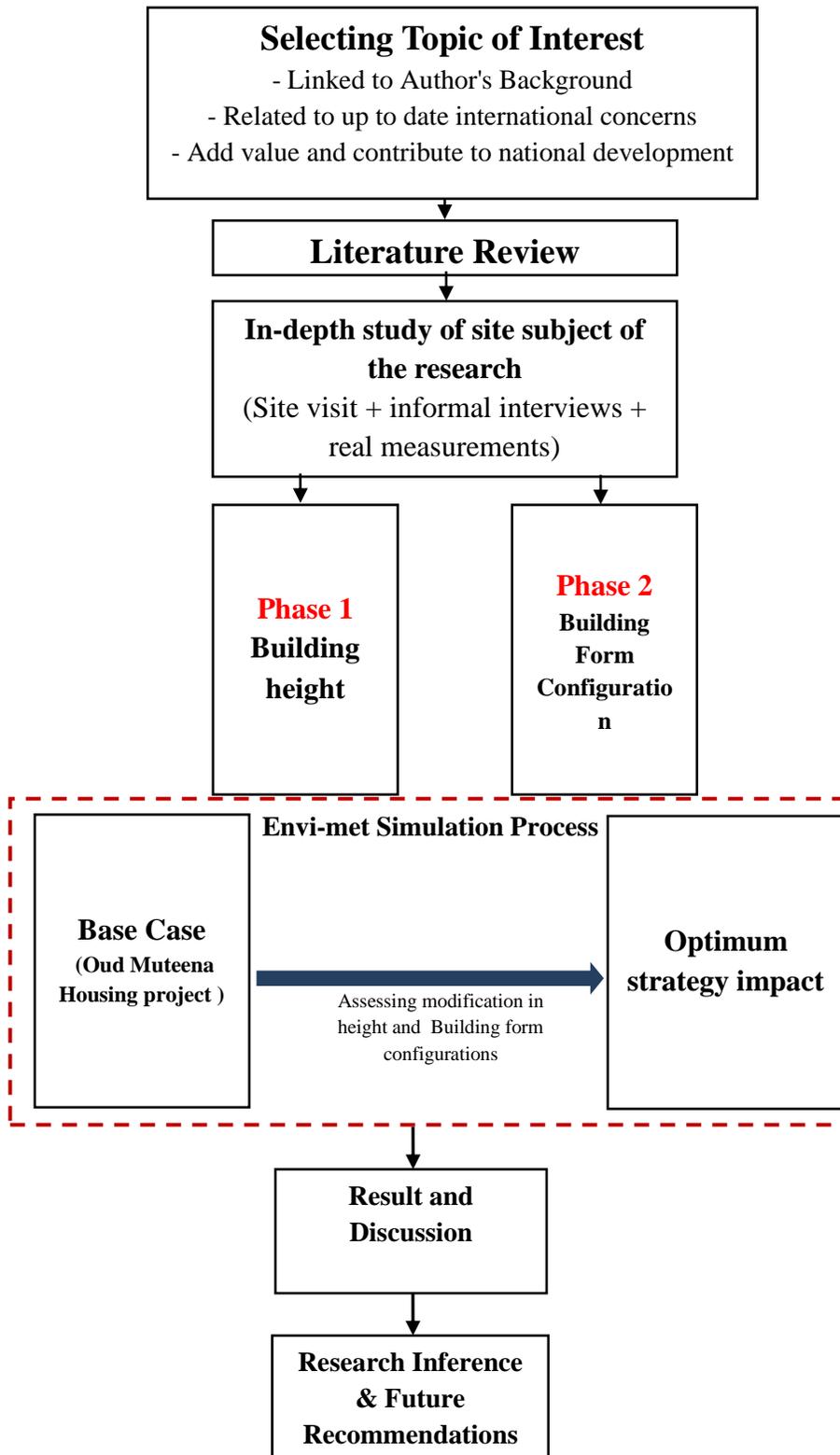
The Third and final research method that was found in the Literature Review phase is the use of Computer simulation software in building a virtual model for the building or site subject of the study. This tends to replicate real environment factors such a weather condition, Terrain, and built environment-physical details surround the research subject. This method becomes a core tool in recent studies where the qualitative approach is needed and numerical values are collected, recorded, and analyzed within different phases of the research. Kakon et. al (2010) incorporated this method in analyzing the relationship between building height and different microclimate parameters such as Air Temperature, wind speed and relative humidity where readings of each parameter within different study areas in Dhaka, India were recorded and compared. Kakon et. al (2010) build a numerical model using Envi-met V.3 as the simulation software tool in addition to the field measurements and survey. Also, Dalman and Salleh, (2011) used Computer simulation software that helps to compare between traditional and modern urban fabric. This research used Rayman Model which is used to record and understand thermal comfort variables by designing built environment details as well as natural, climatic environment details similar to Matzarakis, 2007) methodology as well as Kakon and Mishima, (2012) where Rayman model was used side by side with Envimet software in comparing between buildings footprint and its impact on thermal comfort level in highly density urban areas.

In other recent studies the focus on using Envi-met increased as Kushol, et al (2013) , Peng and Jim (2013), GAL, (2013) and Yahia and Johansson, (2015) all used Envi-met as a core tool in building the virtual model and replicating the surrounding existing environment in term of physical built up elements like roads, adjacent building, landscape material and vegetation or other natural environmental elements like Date and time of simulation process and weather data.

After reviewing previous research papers and studying the research methodology that was incorporated through research phases as summarized in the previous section, the following notes were highlighted as a result that will be followed in this research. First, the literature review is an essential tool that is used to define Evaluation parameters used in the project assessment and the related national and international benchmarks. Also, Literature review will help to compare final outcome results with previous work done by other researchers in discussion and finding section.

Second field measurements and site visit will be used as a validation and calibration tool that will ensure the accuracy of the research process and results throughout early phases. However, no physical measurements of built environment such as building architectural details and infrastructural dimension will be done since this action requires special authority approvals and additional team members to assist in collecting information and recording it. The architectural details of the standard residential model are available online through Mohammad Bin Rashid housing establishment website and the Booklet provided for this project, therefore these measurements will be used for all research phases. Third, the qualitative approach is implemented in this research as it complies with previous similar studies approaches of other researchers and meets this research objective. Fourth and final point is based on previous research studies it was noticed that Envi-met software is widely used in similar topics to investigate different scenarios as per research scope of work, Therefore this software will be used identically to previous work presented in the previous section.

3.8 Methodological chart



Chapter 4: Case study research setup

4.1 Introduction

As discussed earlier in Chapter one and two United Arab Emirates are following international efforts related to sustainable development. And for this goal, several initiatives, regulations, and guidelines are set. This research is aligning with these efforts and aims to study the impact of passive design strategies on housing communities design. The case study that was selected as discussed in chapter three section 3.6 is a housing community located in Dubai at "Oud Muteena" Area on the border with Sharjah and it is one of Mohammad bin Rashid housing establishment projects. After conducting a literature review in chapter two followed by methodology analysis in chapter three, this chapter will present different research phases and elaborate on the details related to the implementation of the research methodology.

This chapter will present also the evaluation parameters and different simulation variables that impact the final results. As well as discuss the ground on which each parameter and variable was selected. But first, it is essential to conduct a validation process over Software and ensure input data calibration.

4.2 Software Validation and readings calibration

In order to proceed with the research, it is essential to conduct a validation process where software outcome results are checked against another resource and site measurements to ensure first that Software user is capable of running the simulation process, as well as the right method, is followed by the user. On the other hand, the environmental outcome values should match the national recorded data for the same day of simulation on the same period of time in which it will prove software reliability and present consolidated findings that meet actual site measurements.

The validation process was done on The second visit to the site that was on the 29th of July 2018. a measurement tool for weather variables was used in this visit as seen in (fig 4.1a.b) below where Extech 45170 was used since it is pocket size and considered user-friendly in addition to the fact that it presents 4 environmental readings without any additional instruments or connections. It was found to be efficient especially since the screen presents two readings at a time such as Air temperature with Relative Humidity or Air temperature with Wind speed.



Figure 4.1 a The measurement device is located at landscape furniture (Source Author photography 2018)



Figure 4.1 b The measurement device is used in different locations within the site (Source Author photography 2018)

Since the site is located on the borderline between Dubai and Sharjah it was essential to calculate the distance from both Sharjah international airport and Dubai International Airport to the site and compare both weather stations records in both airports to understand the difference and determine the benchmark records that this research will refer to. The research location was found to be 9.4 Km from Dubai International report on Google earth map and 8.9km away from Sharjah international Airport. Therefore Dubai records to be followed.

weather recorded data from Dubai International airport weather station is presented below in the table. (4.1) where it indicated the records of July and August that is known to be peak summer season and therefore second site visit were also conducted in 3rd of August also to validate measurement instrument readings against national recorded data.

Table 4.1: Weather average detail records from 2003 to 2017 in Dubai (source ncm.ae, 2018)

Month	Temperature					Humidity			Rainfall	Wind			Solar Radiation
	Max	Mean Max	Mean	Mean Min	Min	Mean Max	Mean	Mean Min		Mean	Max	Mean Max	
January	31.8	24.2	19.3	14.5	7.7	82	65	45	15.8	12	59.3	22.3	3806.6
February	37.5	25.5	20.4	15.5	7.4	82	64	43	20	13.1	57.4	24.3	4579.3
March	41.3	28.6	23	17.8	10.1	81	61	38	23.1	13.5	59.3	25.5	5392.6
April	43.5	33.2	27	21.2	12.8	75	53	31	4.8	13.1	72.2	25.6	6222.1
May	47	37.8	31.1	25	15.7	71	49	27	0.4	13.6	63	25.8	6806.4
June	47.9	39.7	33.2	27.5	20.7	77	55	30	0	13.7	51.9	25.1	6770.9
July	48.5	41.2	35.1	30.2	24.1	75	54	31	0.8	13.7	66.7	25.5	6304.5
August	48.8	41.4	35.2	30.5	24	73	53	30	0	13.4	55.6	25.8	6114.2
September	45.1	39.2	32.8	27.8	22	80	58	31	0	12.3	40.7	24.6	5786.5
October	42.4	35.6	29.7	24.3	14.6	81	60	34	1	11.3	61.1	23.3	5074.2
November	38	30.7	25.2	20	10.1	79	60	39	4.4	11.2	61.1	22.2	4204.1
December	33.2	26.3	21.3	16.4	8.2	82	65	45	15.8	11.2	55.6	21.5	3783.2

The above table shows that max. average Air temperature in July is 41.2 C°, however, the max. recorded is 48.5 C° while minimum average Humidity is found to be at 31 % with an average wind speed of 13.7 km/h that is equal to 3.8 m/s. These records did not fall far from August records as seen in table 4.1 above where the average Air temperature is 41.4 C° and minimum average relative Humidity is 30% and finally, wind speed is 13.4 km/h that is equal to 3.7 m/s. These records were used as a benchmark for validating Extech 45170 as a measurement tool by comparing these results to field visit records as well as Envi-met as a simulation software by comparing the result to Base case model results and users capability to use both in this research.

The field measurements were done over two visits since 29 July had a high percentage of sky cover (cloudy day) against usual summer days therefore in order to ensure accuracy another visit

was scheduled on 3rd of August where sky cover was not an issue then. See fig.(4.2a,b) where sky cover differences are clear between second site visit and third visit, at the same time and same location.



Figure 4.2a: Field visit on 29 July with sky coverage over 80%
(Source Author, 2018)



Figure 4.2b: Field visit on 03 August with clear sky
(Source Author, 2018)

The measurements were taken over two locations within the site also to ensure consistency of results and to use these points in studying different values results in simulation maps in chapter five of this research. See Fig. 4.3 below which represents the site area simulated for validation and the exact two points that were selected while doing site measurements on during both visits.

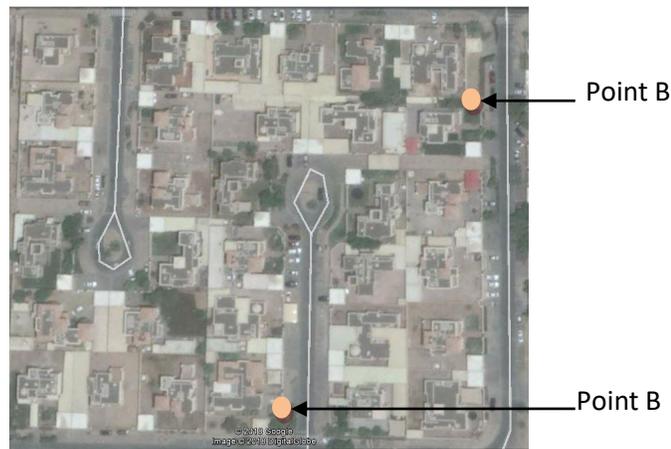


Table 4.2 below represent the site measurements - listed in Appendix A- compared to the national records of weather on the official web site of Emirates National Center of Meteorology (NCM .ae)

Table 4.2 Weather detail recorded from Site visit on 29th July and 3rd August (source Author)

Day 29 July (Point A)	Time 10:30	Time 16:15	Weather Data	NCM records
Air Temp.	39.3 C°	43.7C°	Air Temp.	41.2
Relative Humidity	21.8 %	17.6%	Relative Humidity	31%
Wind Speed	1.2 m/s	0.5 M/S	Wind Speed	3.8 m/s
Day 29 July (Point B)	Time 10:30	Time 16:15		
Air Temp.	40.4 C°	42.9 C°		
Relative Humidity	19.7%	26.4 %		
Wind Speed	1.1 m/s	0.0 m/s		
Day 3rd August (Point A)	Time 10:30	Time 16:00		
Air Temp.	40.1 C°	35.1	Air Temp.	41.4
Relative Humidity	32.7 %	47.4 %	Relative Humidity	30%
Wind Speed	0.0 m/s	1.1 m/s	Wind Speed	3.7 m/s
Day 3rd August (Point B)	Time 10:30	Time 16:00		
Air Temp.	42.9 C°	34.4 C°		
Relative Humidity	26.4 %	50.1 %		
Wind Speed	0.0 m/c	2.5 m/s		

The above data indicates that Air temperature recorded in site visit were matching the average records by the national center but the wind speed is exceeding the records since the source of these values is the weather station at the airport that is located 19m above sea level while site measurements are taken from human scale height between buildings therefore the difference is justified, However the relative humidity records of 29th July represent a big difference from the national records data while on 3rd of August the site measurements are falling at the same range with the weather station records and this is believed to be related to the fact that 29 July had a high sky coverage percentage that was unlikely to happen on an average day in July, therefore, this discrepancy was found and that was expected as explained earlier and indeed it was the motivation behind a third visit on 3rd of August was needed for both calibration of site measurement tools and validation for process and software input data. This process validated

Extech 45170 as an accurate measurement tool as well as ensure researcher knowledge in using the device since values were meeting national records for the same day.

The next phase of validation requires building and testing a virtual model replicating the same area on the same day and time where site visit took place to ensure that final outcome results will match real built environment microclimate records recorded in Table 4.2 above. For that purpose, the simulation day that was used for this phase is 3rd of August and the simulation hour that was chosen is at 11:00. The following maps are generated using Envi-met V4. and graphically illustrated by LEONARDO where it represents the same microclimate variables presented in Table 4.2 above. Simulation maps are presented below in fig.4.4, 4.5, 4.6 below. The illustration and map legends indicate that Air Temperature, wind speed and Relative humidity values are falling within the range of the range on the same day on the same time frame over both site measurements points.

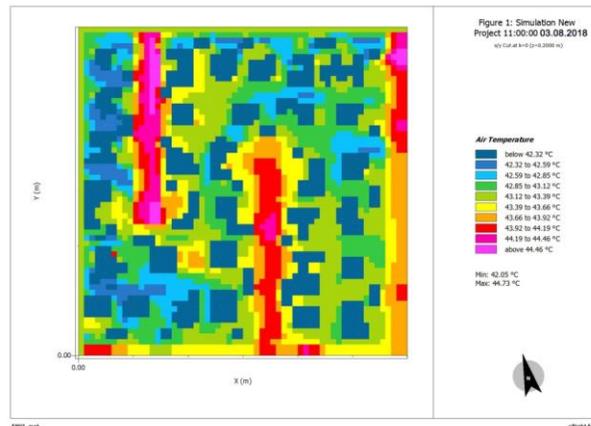


Figure 4.4 : Air temperature illustration map, Using Envi-met simulation software.

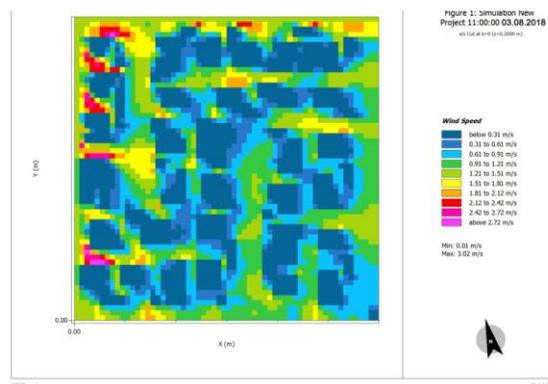


Figure 4.5 : Wind Speed illustration map, Using Envi-met simulation software.

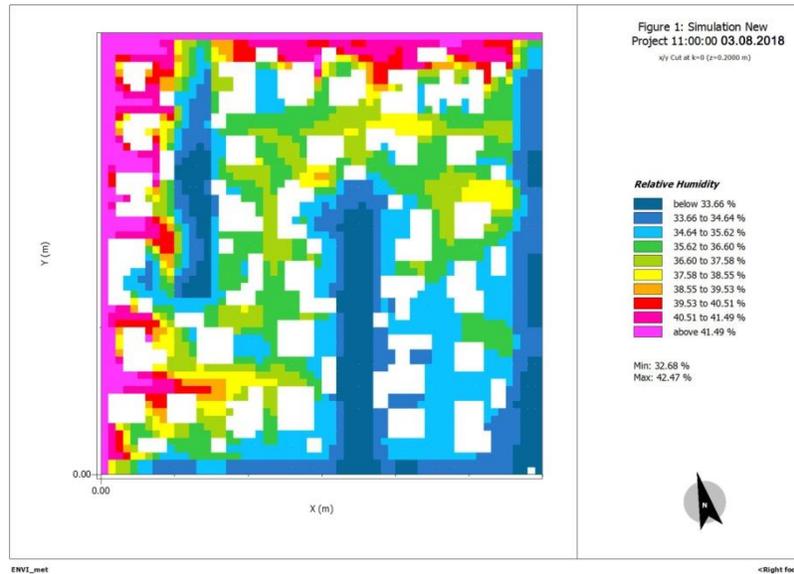


Figure 4.6 Relative Humidity illustration map, Using Envi-met simulation software.

The outcome illustration maps that results from the validation simulation phase meets the national recorded microclimate values as well as site observation measurements. Therefore the software is considered reliable for next research phases where it will be utilized to investigate the impact of building height and form layout over the same microclimate variables that were tested in the validation process.

4.3 Virtual Model Development

In this section, the process of collecting the data related to the virtual model designing and the following process of input details and characteristics as well as limitations of the software will be addressed in order to have a clear understanding of the replication of the existing site. This will help in understanding the final outcome results of the simulation and furthermore understand the proposed scenarios and modifications over the base case model. Also it is important to notice that the input data in this phase is complying with the scope of work discussed earlier in chapter four in which any influence by any factor or indicator that is not part of this study were

neutralized overall simulation phases and this was done by maintaining it at the same condition from base case model up to final stage simulation stage . This will suppress the impact or any influence over the progress and other evaluating parameters within the scope of work. As an example, the building material of the residential units is not related to the interest or objectives of this research, therefore, the materials eliminated from any changes overall simulation phases.

4.3.1 Research Variables and Parameters

The Parametric analysis process is found necessary for this research in order to save time, cost and effort since using this system provide researchers with the ability to examine different parameters through different scenarios and extract reliable findings out of the process within a short period of time as Cashman J. anxiously who is ANSYS, CEO who finds it critical in this fast-track lifestyle to consume relatively long period of time in producing information. having the opportunity as Architects or Urban designers to evaluate different design proposals with a wide range of strategies is really important and beneficial for decision makers and shareholders as this process will eliminate wrong and insufficient options while prioritizing other proposals according to its value compared to cost or any other required formula. (ANSYS, 2011).

Since aiming for sustainable Housing development communities highlights the need for a sustainable financial study that ensures the best value for optimum environmental and socially sustainable design. And this indeed cannot be achieved without profound study for all design possibilities and solutions which might consume time, row material and additional working force that will end up raising the cost of sustainability which is not acceptable.

Accordingly, this research has applied the parametric process into the analysis where relevant parameters were categorized into Active parameters and static parameters. The first category includes Active parameters these are the project aspects that will change and develop through the simulation phases, It is related to the main research topic and had an impact on the final

conclusion. These parameters are Building height and Building form since both parameters are shaping the core of this research. Besides these two main parameters, this research introduces a secondary parameter that results by the modification of Building form and height. It is the greenery coverage percentage which is not considered a focal point in this study, however, the results of this parameter will not be ignored since it impacts the thermal condition of the project overall. as illustrated below fig. (4.7).

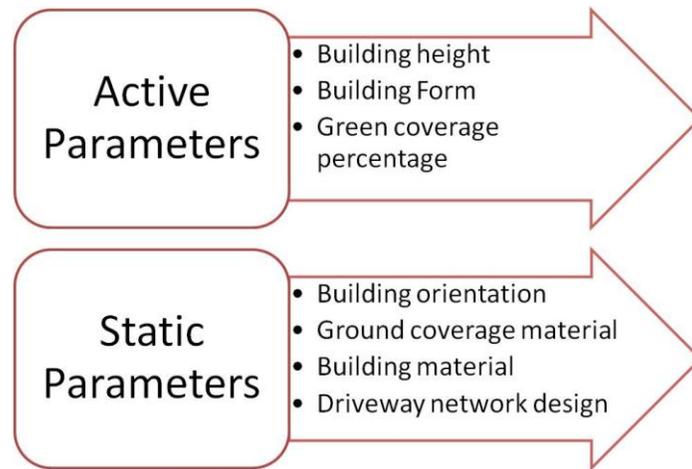


Figure4.7: Research Parameters categories. (Source Author illustration)

The second category of parameters is considered out of the research scope of work and such as Building orientation and site layout, Ground coverage material, Building material, Driveway network design, and characteristics. parameters are referred to as Static parameters since their influence on the simulation process will be eliminated and considered out of interest.

These parameters performance will be examined through a set of variables that are referred to as "evaluating variables". These variables are used to trace the Active parameters performance and set a benchmark and guideline for enhancement. These variables are related to the objective of this research as it impacts microclimate comfort conditions as per previous studies discussed earlier in chapter two and chapter three see fig.(4.8) below.

Evaluating variables are needed to analyze the understand the impact of the active parameters in each scenario and these variables are Air temperature measured in Celsius, Wind speed measured in meter per second and Relative Humidity metered in percentage. Since the wide spectrum of researchers stated that these factors, in particular, have the biggest influence on environmental comfort conditions as for example Ahmad,(2016), Yahia and Johanson (2015), GAL (2014) Kakon and Mashima(2012) and Kakon et al (2010). Beside other researchers and studies that additional variables that influence comfort conditions in urban communities.

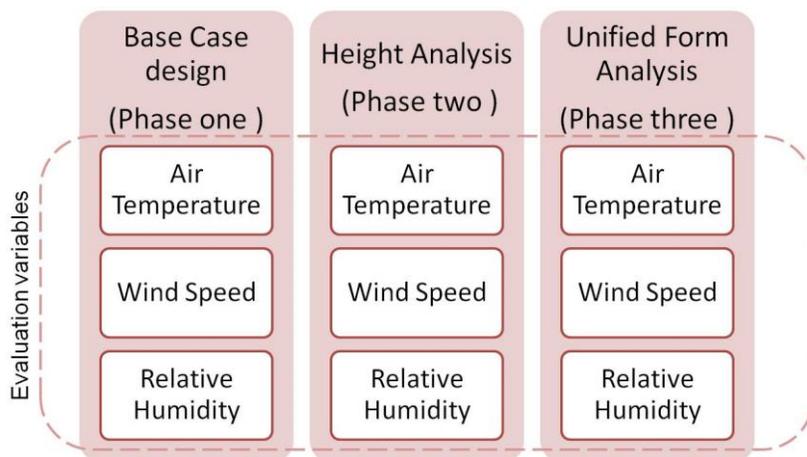


Figure 4.8: Research Evaluation Variables. (Source Author illustration)

4.4 Phase one - Building Base case virtual model

As discussed earlier in chapter three, This research is following the qualitative research approach where a parametric simulation is conducted using a virtual model designed by software where different scenarios are introduced and examined over the same model.

In this section, the selected site within the research project will be built using all data that were collected either through literature review phase or by observation and field visits. The aim is to replicate the exact environment surrounding the project in term of physical aspects or environmental conditions.

The designated project is located at a low rise district that consists of residential projects in addition to some commercial areas and public spaces to serve the population that is considered

low density since it is private owned residential units, unlike other investment housing projects. The project construction details fall under Dubai Municipality building code and regulations but do not comply with the green building code or Sa'fat rating system since the project was completed in 2009, around three to four years before the announcement of the green code. The project is designed and constructed by consultant office - the name is confidential - under the supervision of urban planners and design team Mohammad bin Rashid Housing establishment design team and urban planners.

The project perimeter is around 1.5 km as seen in fig. (4.9) below. It consists of 126 villas where 28 villas are ground floor design only while the rests are ground and first-floor design, The design team in MRHE do not propose any villa design with basement options unless the owner is willing to pay an additional fee and get full basement of half-floor basement level.

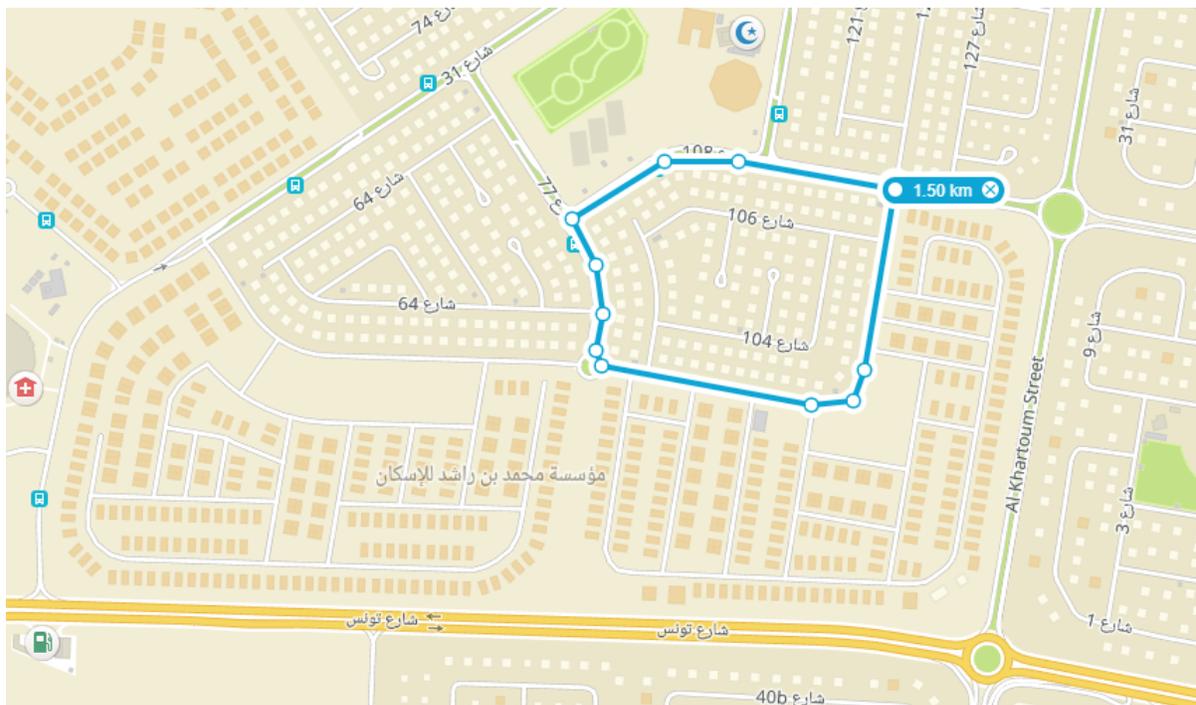


Figure 4.9: Project Perimeter by GIS map, (Source: 2gis.ae 2018)

Due to the limitation in Envi-met working platform where it forces a rescale of large areas in order to fit within 60 x 60 drawing unite that might compromise the accuracy of the

measurements and details. therefore a smaller, central zone will be designed as a sample for the project. The central area where the total perimeter is around 740 m , contains 39 villas of which 10 are designed in ground floor only. As per Eng. Maryam Sultan from the design team in MRHE the villas are complying with Dubai Municipality building code which means that maximum total height for the residential villa is 12meters. Interior details, as well as facade design, is out of this research scope of work. Fig. 4.10 below shows the designated area for simulation using the Envi-met software. The area includes two "col-de sak" design clusters with asphalt paved driveways and some green coverage on the side walkways. as seen in fig (4.11).



Figure 4.10: Site for software simulation process, (Source Google EARTH, 2018)



Figure 4.11: Greenery within the site , (Source Author , 2018)

The designated area was built as a virtual model with design unite set to be 3.74 on X and Y grid as shown in fig. (4.12) below while it is 2m on z grid. the north direction and geographical locations were set in the basic model domain window. and the model was conducted as shown below fig (4.13a.b).

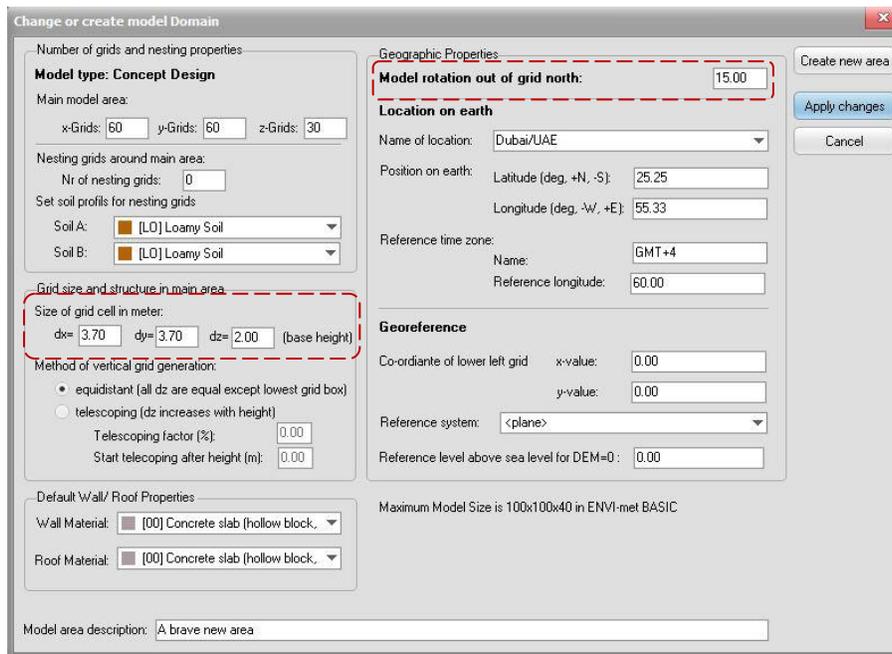


Figure 4.12: Model Domain Window in Envi-met Space design, (Source Envi-met V4)

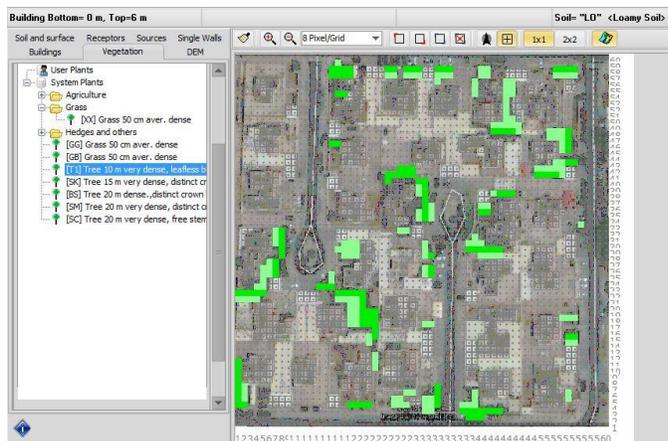


Figure 4.13 a : Space working place, (Source Envi-met V4)

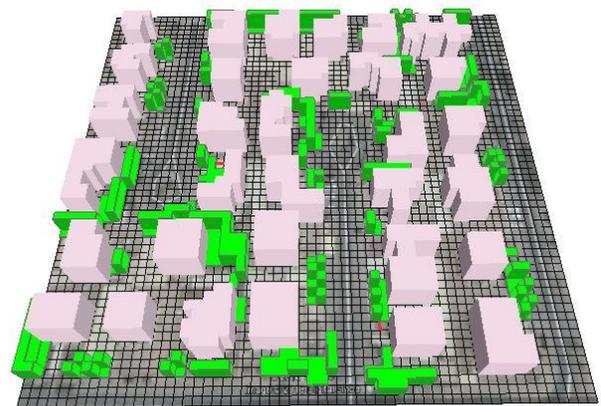


Figure 4.13 b : 3D view of Virtual model , (Source Envi-met V4)

4.5 Phase Two - Building height impact analysis

This phase investigates the impact of changing building height by setting all buildings to the same height in the first scenario or keeping two different heights within the site in the second scenario. This proposal was initiated in compliance with several local and international requirements related to Population growth aspects and its demand for urgent solutions as well as population density and the link between going vertical instead of expanding in a new land with new demand of infrastructure and services.

The impact of building height was discussed earlier in chapter two section 2.4.1 where several research papers that investigated the influence of building height on microclimate variables were presented as for example Hayati and Sayadi, (2012) who concluded that increasing project density in residential projects by using optimal building height can positively impact social pattern and financial study of the project, but only if it was studied deeply to avoid environmental damage to surroundings. This view meets Pandya and Brotas,(2014) findings related to solar radiation. it was concluded through simulation analysis and site observation that tall buildings create a shadow effect over surrounding streets and pathways which in fact reduce solar radiation within outdoor urban spaces (Pandya and Brotas,2014). Also, Yahiya and Johansson, (2015) stated that building height impacts wind flow between building but in case of proper orientation. this impact can be seen as a cooling strategy for outdoor spaces.

In this research, the suggested height in the first scenario is 15m for all buildings without any change to building footprint. See fig. (4.14)The design shall accommodate Ground floor plus two floors which is similar to some other districts in Dubai such as Jumeirah Village Circle and Mirdife district. while the second scenario also keeps all building with 15m height but turns ground floor plan to Parking area and turn the current parking constructed unites into green areas which indeed maximize the green cover. See fig. (4.15). The second scenario utilizes the famous

concept of Villa Savoy by famous architect Le Corbusier. The aim behind this concept is creating same indoor environment for users of the same family while reducing building footprint and construction efforts over the natural environment of the project by going higher and keeping parking space within building foot print without the need for separated structure used as cover parking space. Both scenarios were tested using Envimet V4, Results and discussion are presented in Chapter Five

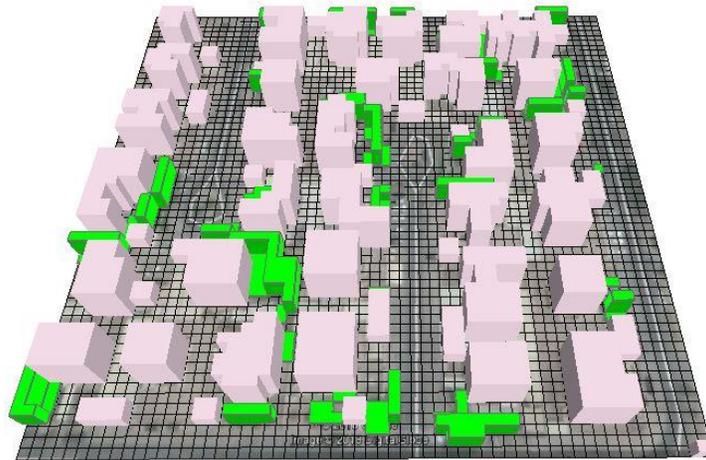


Figure 4.14: Phase one scenario one, 3D View with parking Structure, Author Illustration (Source : Envimet V4)

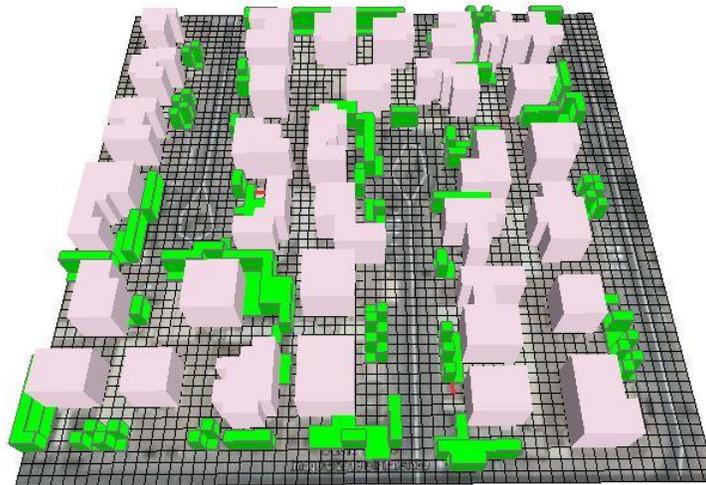


Figure 4.15: Phase one scenario two, 3D without parking structure, Author illustration (Source: Envimet V4)

4.5 Phase Three - Building Form impact analysis

This phase of the analysis process studies the impact of building form modification over the microclimate variables that were selected and discussed earlier in section 4.3.1 in this chapter.

Since many studies were found to highlight the importance of Building Geometry and mass configuration in microclimate analysis. such as Dalman and salleh, (2011) who investigated the impact of Building heights in Bandar Abbas.where it was concluded that building form and spacing can enhance thermal condition during some hours of the day due to its impact over solar radiation and direct exposure to the sun. Also, Kakon and Mashima, (2012) indicated that ground coverage within a dense Urban areas have a direct impact to the Air temperature and wind flow at the surrounding open spaces. Similarly, Kushol, et al (2013) agrees that Morphological properties of a built environment influence the micro-climate within that area, as per the study that was conducted in Dhaka, Bangladesh. Also, recent studies as Gal, (2014) and Ahmed, (2016) meets Kushol, et al (2013) and previous conclusions by finding that different Building configuration will result in different microclimate conditions which impact outdoor spaces within mixed-use or residential communities.

This phase is interested in studying the impact of having a unified form over the whole site while keeping building spaces as per Dubai Municipality building code that requires minimum distance to be 6m between units. this idea is proposed in different housing communities projects that were developed by private investors and it contributes to the concept of "mass production" which reduce cost in several aspects. The suggested form also incorporates the courtyard concept that is found in heritage residential architecture design. As discussed in chapter two section 2.4.3 where Al-Zubaidi,(2007) elaborated on the cooling mechanism of the courtyard in response to weather condition over the day. This concept was also discussed by Abdulmonem and lohlien, (2007) and recently Ahmed, (2016) who studied the different proportion of the courtyard to

understand the different influence over microclimate variables. This idea was incorporated in this phase to comply with traditional architecture concept and analyze its impact on the surrounding microclimatic variables. The aim is to encourage the influence of local heritage in modern architectural designs since it was found to be of a great help in mitigating weather conditions in the past for the same geographical area.

In this Phase, two scenarios were examined by building upon previous phase both scenarios. The proposed design suggest that unified design with central courtyard spacing will influence Air temperature, wind speed and relative humidity on the surrounding spaces which will encourage pedestrian and public utilization of public outdoor spaces. As seen in fig. (4.16) below the results and will be evaluated and compared against each other to understand the impact of each scenario. The Results and findings of both phases will be discussed and analyzed in details chapter five.

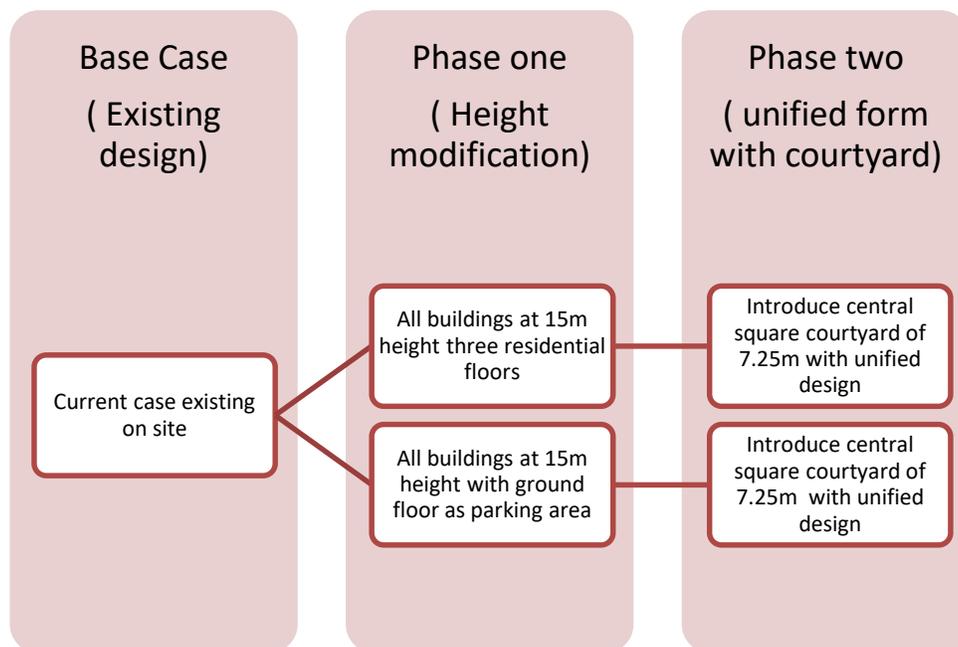


Figure 4.16: Simulation Process Phases , Author illustration (Source : Author 2018)

Chapter 5: Result and Discussion

5.1 Introduction

This chapter presents the results generated by Envi-met V4 simulation program and graphically illustrated by associated program LEONARDO. The simulation runs on the same day and same period of time through all phases in order to eliminate static parameters as discussed in chapter 4, section 4.3.1 earlier. The simulation process runs on 3rd of August 2018 from 09:00 to 16:00 that generates 18 maps in total where every six maps are assigned for one variable out of the three main microclimate variables that are subject to analysis in this research and considered as evolution variables since their values determine the performance of the active parameters that are subject of the each phase analysis.

The simulation process was selected to cover the hottest session in Dubai while the simulation hours were selected to include a peak temperature period during the day. On the other hand, this simulation aims to enhance the thermal comfort condition to encourage the utilization of public spaces within the selected housing community, By encouraging different outdoor activities and opportunity of walkability within the community in respond to residents comments and concerns regarding walking distance toward the bus stations and The Masjid. Since it was found that the distance calculated in meters falls under international and local standard requirements as discussed in chapter three section 3.6. However the social sense of comfort is not satisfied and it is believed that enhancing thermal comfort will contribute to the general physiological response.

This chapter presents the results according to the simulation structure starting by Phase one which is the base case existing on site where the model was replicated and all physical and climatic characteristics were incorporated in developing the virtual model. The results will be discussed and recorded as a benchmark for further phases within the simulation. Then the same model will be used to conduct the simulation of phase two where results from both scenarios will be presented, discussed and compared to the benchmark in phase one and previous studies

presented in literature review, chapter two earlier. After that both scenarios will developed to reform building layout in which all residential unites shall have same design where central courtyard opening will be introduced to the building configuration. Also results will be presented, discussed and compared to Benchmark values at phase one and phase two recorded outcomes to understand the impact of the active parameters tested over two phases.

Finally all results will be summarized and compared against previous studies presented in Chapter two earlier where similar analysis were conducted in similar conditions. In order to understand the influence of the proposed strategies over the microclimate condition in the selected housing community project.

5.2 Phase one - Base case analysis

The Base case model was built as discussed in chapter four in compliance with Dubai municipality standards and as per spacing and height regulations and with the assistance of Google earth maps. The simulations runs on 03 August 2018 from 09:00 to 16:00 which covers 6 hours where any fluctuations and pattern can be traced and recorded.

The simulation results were extracted from Envi-met maps at the same points that were used in validation process, see fig. 5.1 below. where first hour maps are presented as a sample of the simulation outcome while the full set of 18 maps over six hours is attached in Appendix B.

As discussed earlier in chapter 4 section 4.2 the Base case model reflects the current statues on site that were validated and will be used as a bench mark to trace enhancement or deterioration of thermal comfort conditions.

The aim as per UAE climate condition is to reduce Air temperature and increase wind speed in order to regulate Relative humidity at comfort average levels.

The simulation results are presented below in table 5.1 where each evaluating variable was recorded and average value was calculated by at the end.

Table 5.1 : Base case simulation analysis results (Source : Author)

03 August 2018 Base case	Air Temperature C°	Wind Speed	Relative Humidity
10:00	42.33	1.21	41.3
11:00	43.66	1.0	35.62
12:00	44.39	0.93	31.41
13:00	45.84	0.9	26.51
14:00	47.17	0.86	26.0
15:00	47.83	0.83	25.6
Average	45.2	0.95	31.07

The previous results that were presented in table (5.1) above were generated by reading maps from LEONARDO related to 6 hours analysis of microclimate variables as shown in fig.(5.1a,b,c) below where 3 maps are presented as sample of the 18 maps generated through simulation process and attached in Appendix A.

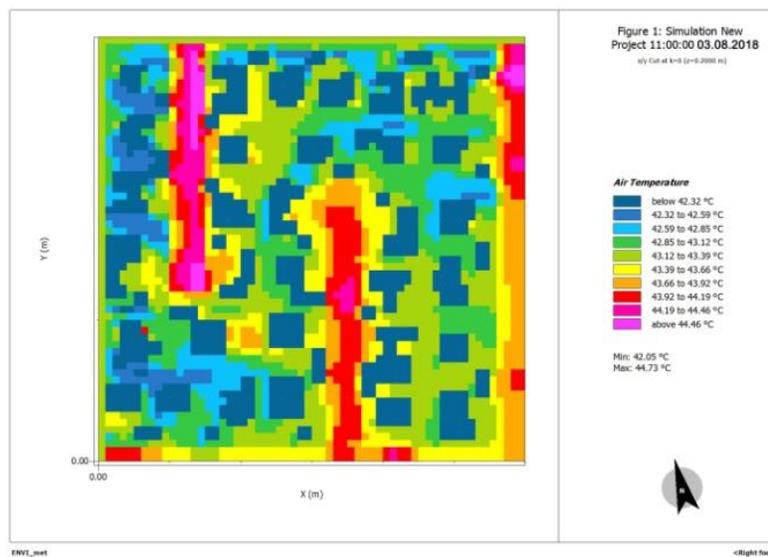


Figure 5.1 : Air Temperature map at 11:00 on 03 Aug. 2018 base case analysis (Source: Envimet maps)

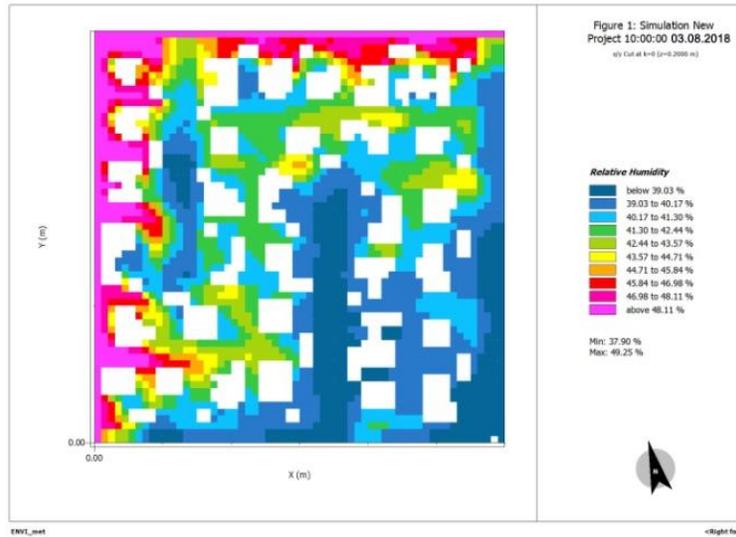


Figure 5.1b :Relative Humidity map at 11:00 on 03 Aug. 2018 base case analysis (Source: Envimet maps)

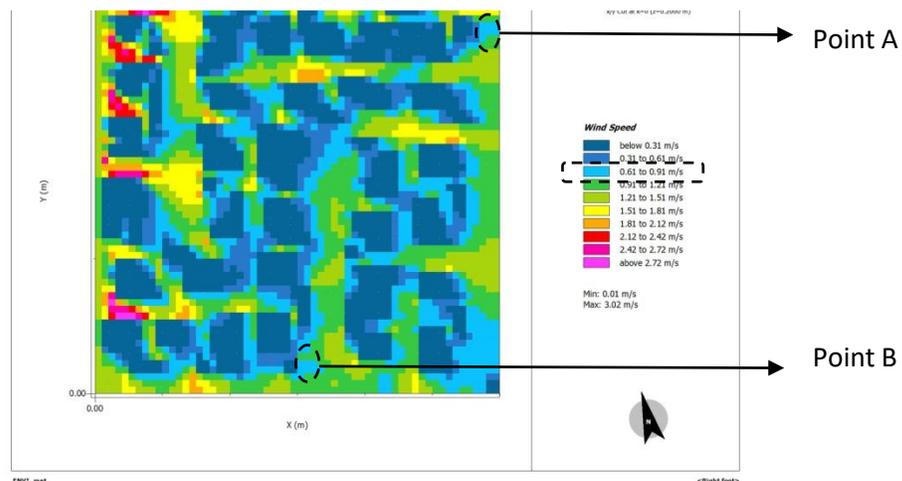


Figure 5.1c :Wind speed map at 11:00 on 03 Aug. 2018 base case analysis (Source: Envimet maps)

The maps indicates variation in values of microclimate variables since color variety between building blocks reflects different range of values as per different condition that may affect the readings such as shade between buildings , ground cover and material selected. Therefore in another action that aims to eliminate these Static parameters in this research, the readings will be taken from the same points over all phases. as shown in fig. 5.1 c above.

5.3 Phase Two - Height Impact simulation Analysis

The second phase of the analysis studies the impact of raising building heights from current case that is 10m in two floor height design and 6m in ground floor only design to a revised proposal where in scenario (1) all residential units will be designed as three floors buildings where the three floors are occupied with single family as per UAE regulations but it replicates the design in other districts in Dubai where the planning regulations allows three floor height residential units and it replicates as well the design in other regional countries such as Kuwait and Saudi Arabia where having a single family house designed on three floors is considered standard case. As shown below Fig.5.2 that shows residential villa in Jumairah District in Dubai

The first scenario suggest keeping the current Parking structure separated from the house as it is in the current case while the second scenario suggests keeping the ground floor of the house as a parking area with minimum occupied rooms and covering current parking structure location with greenery and plantation which will increase the green coverage percentage.



Figure 5.2: Ground plus 2 floors , villa design in Jumairah , Dubai (Source : propsearch.ae,2018)

The results were extracted from Simulation maps that were illustrated in LEONARDO. As it is in the base case in section 5.3 a,b above. Using same Static data that was introduced earlier. Below is the map representing Air temperature values on 03 August 2018 at the first hour of the simulation process. followed by the Wind speed for the same hour presented as a sample out of the eighteen maps generated through the simulation process.

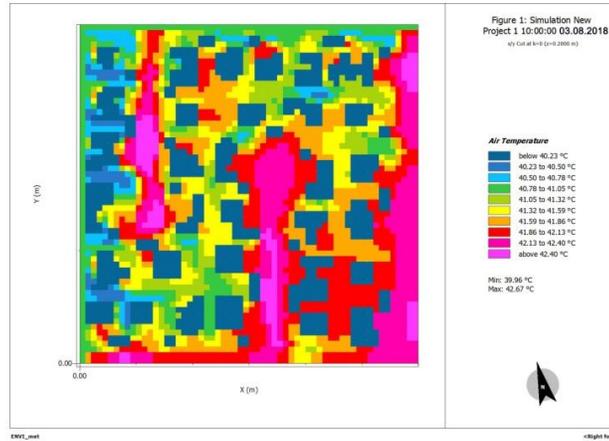


Figure 5.3a: Phase one, First scenario, Air temp. simulation map illustrated using LEONARDO (SOURCE : Author)

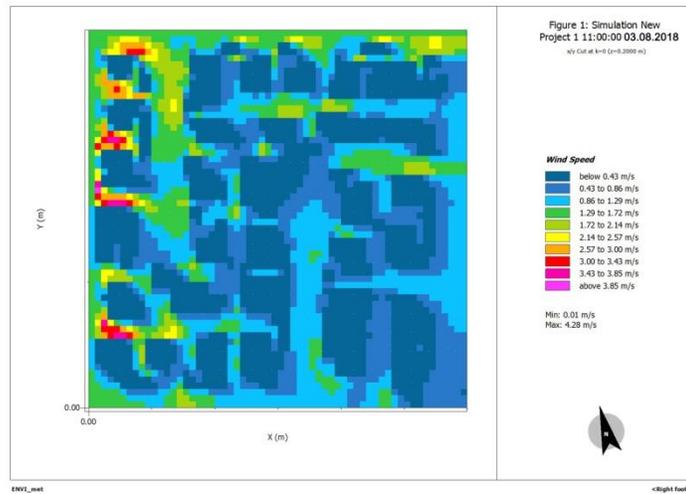


Figure 5.3b: Phase one, First scenario, Air temp. simulation map illustrated using LEONARDO (SOURCE : Author)

Table 5.2 below presents the values of first scenarios compared against the base case records on the same day and same period of time. The results indicates a drop in Air temperature average value by 0.26 C° and also a drop of Relative humidity percentage by 4.35 % this is believed to be due to the increase of wind flow between the masses where the results indicates an increase in the proposed scenario by 0.29 m/s.

Table 5.2: Phase Two First scenario analysis results (Source : Author)

03 August 2018 Base case	Base Case	Phase two first scenario	Base Case	Phase two first scenario	Base Case	Phase two first scenario
	Air Temperature C°	<u>Air Temperature</u> C°	Wind Speed m/s	Wind Speed m/s	Relative Humidity %	Relative Humidity %
10:00	42.33	42.13	1.21	0.86	41.3	41.15
11:00	43.66	43.4	1.0	1.29	35.62	36.65
12:00	44.39	44.58	0.93	1.31	31.41	31.50
13:00	45.84	45.81	0.9	1.32	26.51	26.49
14:00	47.17	46.75	0.86	1.33	26.0	25.3
15:00	47.83	47.0	0.83	1.36	25.6	22.23
Average	45.2	44.94	0.95	1.24	31.07	26.72

These results in fact meets previous studies where a relationship was established between the increase in building heights and the increase of wind flow which reduces the relative humidity percentage. On the other hand the reduction in Air temperature was also noted in previous studies that were presented in chapter two were it was found that increasing building height increases the shading effect over outdoor spaces which in fact reduces the solar radiation during the day which is found to result as a reduction in Air temperature during specific hours daily.

In the second scenario where the height maintain at 15m but the ground floor was used as the parking therefore the separated parking structure was canceled and replaced with green cover.

The simulation indicates that the impact of green coverage as one of the active parameters is found to be minimum in reducing Air temperature but the increase of green coverage helps increasing Relative humidity and encourage wind flow

Table 5.3 Phase Two second scenario analysis results (Source : Author)

03 August 2018 Base case	Base Case	Phase two Second scenario	Base Case	Phase two second scenario	Base Case	Phase two Second scenario
	Air Temperature C°	<u>Air Temperature</u> C°	Wind Speed m/s	Wind Speed m/s	Relative Humidity %	Relative Humidity %
10:00	42.33	41.71	1.21	1.28	41.3	42.54
11:00	43.66	43.31	1.0	1.29	35.62	37.73
12:00	44.39	44.55	0.93	1.31	31.41	32.44
13:00	45.84	46.02	0.9	1.32	26.51	27.96
14:00	47.17	46.89	0.86	1.33	26.0	21.85
15:00	47.83	47.81	0.83	1.34	25.6	17.64
Average	45.2	45.04	0.95	1.31	31.07	30.02

The above results indicates that increasing building height reduces average air temperature by 0.26 C° maximum and increased wind flow by 0.36 m/s maximum when green coverage is also increased which will influence relative humidity to also by reduced by 1.05% and further reduction would be possible if the green coverage was not increased and replaced by different landscape elements such as shading elements.

5.4 Phase Three - Unified Form Impact simulation Analysis

The same virtual model that was used in previous phases, was also used in this phase, but the building form in this phase is suggested to be unified and the design represent a central courtyard opening that was inspired by the heritage architectural design of residential homes in this city as well as regional countries. The design was also examined over both scenarios from phase one, in order to understand the influence of building configuration as one of the active parameters on the microclimate evaluation parameters which are considered in compliance with previous research studies that were also presented in chapter two earlier.

The first scenario presents three floor residential house with a courtyard opening at the center as shown in fig.(5.4) below that was generated from Envi-met virtual model. Parking structure are located away from main house mass similar to the first scenario in phase one as seen below.

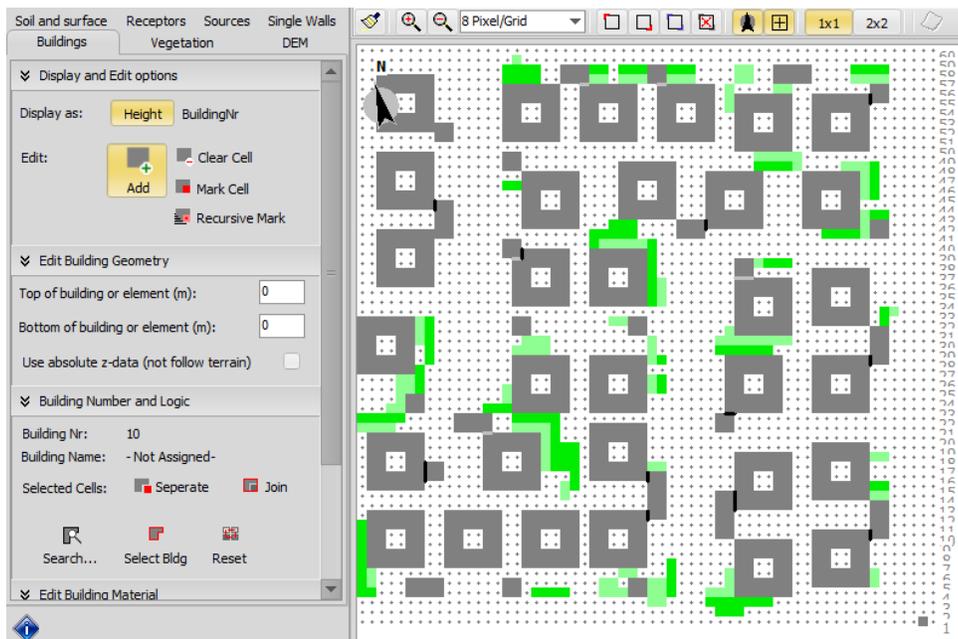


Figure 5.4 : Virtual model of Phase three first scenario proposal. Envi-met/ Space work platform (Source : Author)

The graphical map below in Fig. (5.5) is illustrated using same software that was used in previous phase and it indicates The air temperature and Wind speed followed by relative humidity at the first hour of the simulation analysis.

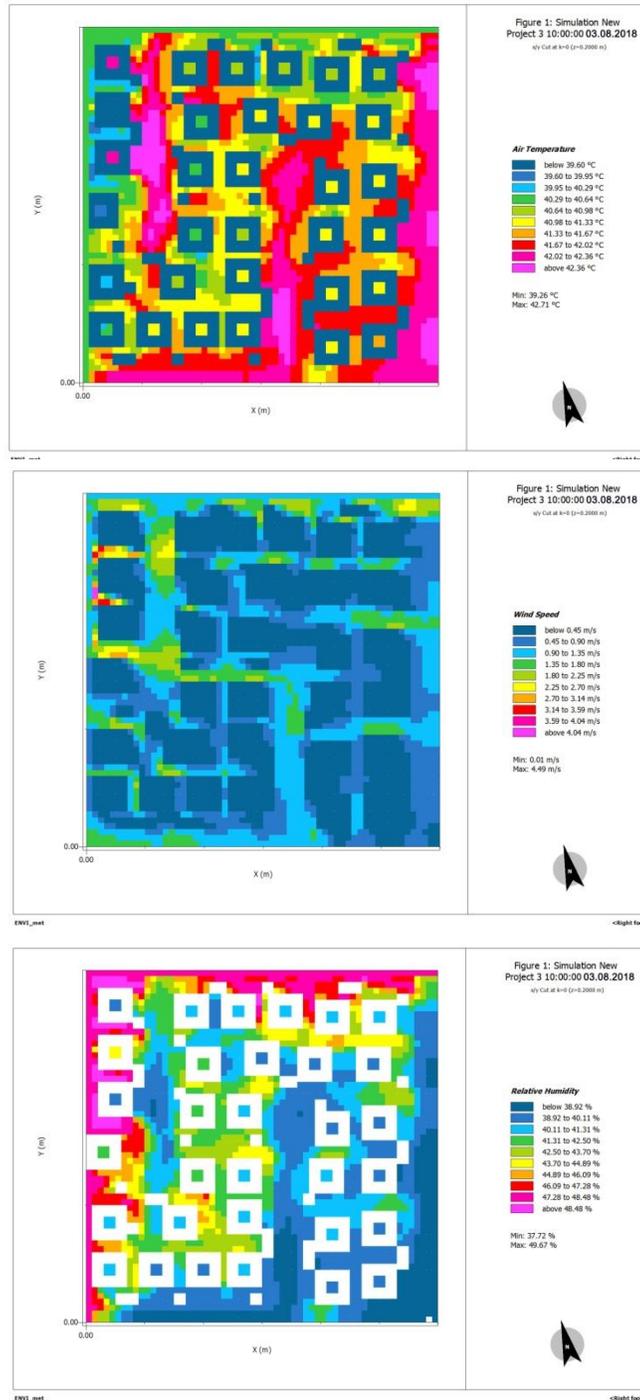


Figure 5.5: Phase three second scenario simulation maps illustrated using LEONARDO (SOURCE : Author)

The numerical value of the simulation analysis are presented below in table 5.4 where it was compared against previous results in phase two first scenario. It was found that unified building design has results in a drop of wind flow by 31 m/s while relative humidity value is increased by 2.18% since Relative humidity and wind speed are linked to each other where a drop in wind speed increases relative humidity. while an increase in Air temperature was raised also by 0.11 C° compared to Phase two first scenario results. as shown below in table 5.4. However these result did not fall far from the basic case results that were presented in table 5.1. Since in this proposal Air temperature drops by 0.15 C° from base case and 0.02 m/s in wind speed records followed by a drop of 2.16 in Relative Humidity percentage.

Table 5.4: Phase Three first scenario analysis results (Source : Author)

03 August 2018 Base case	Phase two first scenario	Phase Three first scenario	Phase two first scenario	Phase Three first scenario	Phase two first scenario	Phase Three first scenario
	<u>Air Temperature</u> C°	<u>Air Temperature</u> C°	Wind Speed m/s	Wind Speed m/s	Relative Humidity %	Relative Humidity %
10:00	42.13	42.36	0.86	0.90	41.15	41.31
11:00	43.4	43.66	1.29	0.92	36.65	35.7
12:00	44.58	44.99	1.31	0.93	31.50	30.68
13:00	45.81	45.69	1.32	0.94	26.49	26.58
14:00	46.75	46.63	1.33	0.94	25.3	21.22
15:00	47.0	46.99	1.36	0.95	22.23	18.01
Average	44.94	45.05	1.24	0.93	26.72	28.91

While studying the graphical maps of this scenario it was noticed that court yard area kept a difference in Air temperature values of around 0.8 C° to 2 C° compared to the surrounding records as seen in figure 5.5 below that illustrated the graphical data of Air temperature recorded on 15:00 that is considered as the peak of all 6 hours as presented in table 5.6 above.

difference of 0.3 m/s but increased by 0.06 m/s compared to base case values. while relative humidity was also decreased by 0.45% in comparison with phase two second scenario and also decreased by 1.53 % compared to base case.

03 August 2018 Base case	Phase two	Phase Three	Phase two	Phase Three	Phase two	Phase Three
	Second scenario	Second scenario	second scenario	Second scenario	Second scenario	Second scenario
	<u>Air Temperature</u>	<u>Air Temperature</u>	Wind Speed	Wind Speed	Relative Humidity %	Relative Humidity %
	C°	C°	m/s	m/s		
10:00	41.71	42	1.28	0.99	42.54	41.7
11:00	43.31	43.40	1.29	1.00	37.73	35.78
12:00	44.55	44.2	1.31	1.01	32.44	32.74
13:00	46.02	46.09	1.32	1.02	27.96	27.72
14:00	46.89	47.41	1.33	1.03	21.85	21.6
15:00	47.81	47.73	1.34	1.03	17.64	17.7
Average	45.04	45.13	1.31	1.01	30.02	29.54

Beside the data presented above in table (5.5), In this scenario also it was noted that court yard kept a minor difference in air temperature and relative humidity values compared to the surrounding environment however it was concluded the this simulation proves that the influence of building form over microclimate variables is less than the influence of building height at same day and time of the day. In fact it can be neglected in some areas within the map.

Chapter 6: Conclusion

6.1 Research Inference

Through analyzing and understanding similar cases for other researchers that tackles similar subject a profound base was established for the simulation process analysis that was selected as research methodology. The research set number of questions in which the answer would contribute to the ongoing research that focus on sustainable practice in United Arab Emirates since the national agenda sets the goal of being a role model for sustainable Urban development revolution that responds to the United nation Goals and ensure prosperity for future generations. For that purpose this research selected a governmental housing community that is designed and constructed by Mohammad bin Rashid housing establishment to be the case study of this qualitative research analysis.

Through literature review it was found that local heritage house designs responds to the social and environmental requirements at that time and it reflects the financial statues of its owners despite the fact all materials that were used in construction were of local origins. however with the modern revolution and exposure to international building design, architectural perspective is found to be different and drifted away from local style but the social and personal ethics of the communities are relatively the same since it was driven from Islamic teachings, therefore it was found that replicating traditional architecture will not be acceptable for current and future generation however the design principles that were used in heritage residential units would remain the same and can be introduced in new form and design layout that meets current design scene and brings latest technologies and domestic management system in use.

On the other hand this research focus on community level design strategies that are implemented on building scale however the impact was assessed on master plan scale in order to investigate the potential of micro design strategies on macro level if it was replicated as in this research where the building height was modified over the full site as well as the building form

layout that was modified and repeated all around the site. This process meets the concept that encourage small steps on small scale level to be repeated and duplicated to achieve the goal at a bigger scale. therefore in addressing the question of whether the building scale passive design strategies can enhance microclimate condition on urban scale, the answer would be ye if t was adopted and replicated in a thoughtful way.

This research investigates the building height and unified form design influence over Air temperature, wind speed and relative humidity sense these variables are found to be the most effective factors on thermal comfort condition in the region and specially in Dubai. the research concluded that building height has a bigger influence on microclimate conditions compared to the proposed building for m which is related first to the shadow effect that is generated between buildings which reduces the solar radiation during the day and second to the wind channeling system that is generated due to the modification in the ratio between building heights and driveways and walkways width between these buildings. The channeling system encourage wind flow which also encourage building facade to release heat which contributes to the overall outdoor thermal comfort also wind speed reduces relative humidity which also contributes to the comfort conditions in outdoor areas. In the second scenario in phase two the green coverage was increased within the master plan area however it was not a big percentage but it had an influence over the relative humidity records therefore it is important to evaluate and study the landscape design proposals while studying the different architectural options since it was found that greenery coverage impacts the microclimate conditions even when it is not a primary goal or design aspect within the research.

Building form also influenced the microclimate condition within the site however, using a unified design all around the site regulates the fluctuations between different positions within the same site at the same time since the unified design generalized the impact of different microclimate variables around the site. But it was important to notice that the central courtyard

within the mass kept different value all around the six hours of simulation. this aligns with previous studies and researches where it was stated that central courtyard design helps creating different microclimate condition within the building mass based on several cooling strategies that are generated through the concept of the court yard. It was found that incorporating this traditional concept within modern design ideas would enhance microclimate mitigation and contribute positively to the social lifestyle in housing communities since this concept complies with local culture and life style aspects.

Finally it is believed that reconsidering number of floors in residential units will contribute to UAE Vision 2021 which encourage the extended family model and encourage keeping strong family relations through generations in order to pass unique culture and local traditions on to the future generations which will help preventing shallow personality as a result of globalization and at the same time this will help in mitigating population growth side effects such as the need for new community development that will increase the demand for infrastructure and services.

6.2 Future recommended research

This research sets the foundation for future topics to be investigated and studied related to different sectors that was addressed in this study, Some of these topics for example are:

- 1) National Agenda and UAE vision 2021 Guide line reflection in Urban design policies and Architectural design principles.
- 2) Investigate the Heritage architecture design principles within current environmental and social requirements.
- 3) Study the potential of housing residential communities to become sustainable models for other private investors and individual home owners. since these projects can benefit from the "mass production " theory which impacts the financial cost of the projects.

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