Environmental and Social Sustainability of Roofed Alley in Yazd City of Iran

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ABSTRACT

The main aim of sustainable architecture is creative usage of the environmental situation and also architectural components. Historical architecture shows the experience of humans which is reflection of this issue to the build environment.

One of the major problems of cities in hot and dry climate is high level of heat in urban space and lack of comfort in outdoor spaces. This issue can have direct effect on quality of outdoor activates as well. However, in vernacular architecture of Yazd city in Iran which is located in hot and dry region, this issue was solved by designing roofed alleys to create shady spaces as much as possible as a sustainable architectural tool which helped to ease outdoor activates too. This study has been focus spatial sustainability of roofed alley in Yazd city because of roofed alley created by combination of sustainability and vernacular architecture. These issues are main points of roofed alley which caused to build it with attention to vernacular design and climate and geography of Yazd city which roofed alley in harsh climate of Yazd could provide human comfort and friendly relationship with natural environment of Yazd city.

In first chapter, there are some definitions and introduces of sustainable development at the beginning and also how sustainable development and design can combine with vernacular architecture design. And also, this chapter was focused on problem of climatic issues in Yazd city of Iran, aim of the study and the methodology of it. The second chapter is defined and discussed some of sustainability objectives, such as sustainable development, sustainable design and sustainable architecture and in

addition the issue of sustainability and vernacular architecture. In addition all aspects of sustainability were explained. The aim of this chapter is review the literatures on sustainability in architecture to create main keywords and discussion factors for chapter three as a case study.

Chapter three has focus on roofed alleys of Yazd by two main factors base on sustainable architecture parameters such as environmental, social which environmental part divided in two main parameters such as natural and physical. This chapter, discussed about the possibility of the roofed alley to create comfort zone for social and environmental activity and also increase the quality of outdoor spaces even in harsh climate of Yazd. As it mention the focus of this chapter, roofed alley divided by four main and more popular types and analyzed with keywords on two main issues, environmental, social.

In last part, there is conclusion of roofed alley evaluation by two major factors, environmental and social sustainability of architectural design. The conclusion of evaluation is shows that roofed alley as architectural solution in harsh climate of Yazd city could increase influence of outdoor spaces quality by creating comfort zones for environmental and social activities. This study shows that roofed alley has specific character in public spaces because of deep functional role as architectural solution to create friendly relationship between human and natural environment.

Keywords: Sustainable architecture, vernacular architecture, Yazd city, hot and dry climate, roofed alley.

ÖZ

Sürdürülebili rmimarinin temel amacı, çevresel faktörleri ve mimari öğeleri yaratıcı bir şekilde kullanmaktır. Tarihi mimari, insane deneyiminin, inşa edilmiş çevre üzerindeki yansımasını gözler önüne sermektedir.

Sıcak ve kurak iklimlere sahip olan ülkelerin temel sorunlarından biri, kentsel alanlardaki sıcaklık seviyesinin yüksekliği ve dış alanlardaki konfor eksikliğidir. Bu sorun, dış alanlarda yapılan aktivitelerin kalitesini de doğrudan etkilemektedir. Ancak sıcak ve kurak bir bölgede bulunan, İran'ınYezd şehrinin geleneksel mimarisinde, mümkün olduğu kadarıyla gölgeli alanlar oluşturmak ve dış alanlardaki aktiviteleri kolaylaştıran bir sürdürülebilir mimari araç yaratmak amacıyla, çatılı ara yollar inşa edilmiş ve bu soruna bir çözüm bulunmuştur. Bu çalışma, sürdürülebilirliğin ve geleneksel mimarinin bir birleşimi olan Yezd şehrindeki çatılı ara yolların konumsal sürdürülebilirliği üzerine yoğunlaşmaktadır. Yezd şehrinde bulunan çatılı ara yolların inşasında, Yezd şehrinin geleneksel mimarisi, iklimi ve coğrafi özellikleri göz önünde bulundurulmuştur ve çatılı arayolların inşasıyla Yezd şehrinin zorlu iklim şartlarına rağmen, insanlara konfor ve doğal çevre ile uyumlu bir ilişki oluşturmak amaçlanmıştır.

Birinci bölümde, bazı tanımlamalar ve sürdürülebilir mimarinin nasıl geliştirildiği ile ilgili bilgilere ek olarak sürdürülebilir gelişim ve tasarımın, geleneksel mimari tasarım ile nasıl birleştirilebileceği ile ilgili bilgile rverilecektir. Bunlara ek olarak, bu bölümde İran' ın Yezd şehrinin iklimsel sorunları, çalışmanın temel amacı ve kullanılan metodoloji ile ilgili bilgiler bulunmaktadır. İkinci bölümde ise,

sürdürülebilirliğin amaçları, sürdürülebilirliğin gelişimi, sürdürülebilir tasarım ve mimariye ek olarak sürdürülebilir mimarinin geleneksel mimari ile birleşimi gibi konular ile ilgili bilgi verilecek ve tartışılacaktır. Bunlara ek olarak sürdürülebilirlik her açıdan incelenecektir. Bu bölümün temel amacı, sürdürülebilir mimarinin literatürünü inceleyerek anahtar sözcüklere ulaşabilmek ve üçüncü bölümdeki vaka çalışmasını incelemek için kullanılabilecek faktörler geliştirmektir.

Üçüncü bölümde çevresel, sosyal ve fiziksel gibi sürdürülebilir mimari parametrelerin Yezd şehrindeki çatılı ara yollar üzerindeki etkisi ile ilgili bilgi verilecektir. Bu bölümde, çatılı arayolların sosyal ve çevresel aktivitelerin, konfor seviyesi üzerindeki etkisi tartışılacaktır; Yezd şehrinin zorlu şartlarına rağmen dış alanların kalitesini artırılması ile ilgili bilgi verilecektir. Yukarıda da bahsedildiği gibi, çatılı ara yolların dört temel ve popular türünden bahsedilecek ve anahtar sözcüklerle birlikte çevresel, sosyal ve fiziksel olmak üzere üç temel açıdan analiz edilecektir.

Son bölümde ise, mimari tasarımın çevresel ve sosyal sürdürülebilirliğinin oluşturduğu iki temel factor ışığında çatılı arayollar ile ilgili bir değerlendirme verilecektir. Sonuç bölümünde, çatılı ara yolların, Yezd şehrindeki zorlu iklim koşullarına rağmen dış alanlardaki çevresel ve sosyal konfor seviyesini artırmak için kullanılan bir mimari çözüm olarak değerlendirilecektir. Bu çalışmaya göre, çatılı ara yollar mimari bir çözüm olarak, doğa ve insane arasında uyumlu bir ilişki yarattığından dolayı, kamu alanlarında önemli bir rol oynamaktadır.

AnahtarSözcükler: Sürdürülebilirmimari, gelenekselmimari, Yezdşehri, sıcakvekurakiklim, çatılıarayol.

To my Family

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INTRODUCTION

1.1 Introduction

Sustainable architecture has recently emerged and is now among one of the top wide spread areas of focus in ongoing research in relation to the built environment. Besides, in relation to the environmental assessment and energy performance of buildings, it is important to create an overview of present theoretical views, inputs, applications, trends and challenges as well towards achieving a green environment (Ghaffarian Hoseini, 2013)

Buildings play a variety of roles in the society just as the people that use them do. Therefore, it is of utmost important to acknowledge the fact that built structures greatly influence the comfort, productivity and efficiency of the users, as well as leaves a social and environmental legacy for coming generation to follow. To sufficiently maximize all of these outcomes thorough research has to be further carried out (Ancell, 2008). By using a comparative analysis of different building types, employing the use of a sustainable design approach, this will go a long way to reduce inefficiency, and improve the comfort level, as well as cut down environmental, social and economic costs, hence elevate the value of the property. The approach of Sustainable design is such that it sees the built structure as an integrated system of interacting components. This concise approach creates the necessary euphoria for builders, building users, federal authorities and all too

critically investigate and evaluate the usefulness of the different construction materials, and construction methods employed (Hosany, 2002).

According to Robins, Sustainable development aims to find a way to categorize sustainability basically in three parts (Robins, 2006). Besides, sustainable development equally focuses on finding a way to create balance amongst the major factors of sustainability namely; economic, social and environmental (Szekely, F. Knirsch, M, 2005). Environmental, social and economic factors of sustainability are all integrated into planning, implementation and decision making process, this is done with the sole aim of ensuring that today's development is not done to the detriment of the future generation (Goebel, 2007). Therefore, the outcome of applying the sustainable design procedures can be defined as a frontier that strives to unify the environmental, social and economic performance. The construction industries play a key role in influencing the climate, resources depletion and environmental pollution globally. Therefore seeking ways to protect the environment should not be taken lightly (Chen, 1999). Environmental sustainability through the use of natural resources helps prevent hazardous and harmful effects on the environment, it also encourages the use of renewable energy as well as create ways of saving the soil and air from pollution (Abidin, 2009). Furthermore, environmental sustainability concerns itself with safe ways of extracting natural resources. Though the building industry have limited control over the extraction of natural resources, they can contribute by helping to demand more recycled materials rather than non renewable ones, as well as efficient use of natural resources (Addis, 2001).

More so, sustainability plays a key role in the society, as it has the ability to afford the people with quality education, goodwill, improving community consultation and

promoting interest in various fields (Lombardi, 2001). Firstly, certain issues that pose a challenge to the area such as crime, ill health, and social issues should be put into serious consideration, before undertaking any action geared towards sustainability (Boyko, C., Cooper, R, 2006).Besides, social well being is geared towards benefiting both workers and future users. As it focuses more on human feelings like: satisfaction, safety, comfort and human well being such as health, skills, knowledge and motivation (Parkin, 2000). It further relates to other aspects such as quality of life, accessibility, aesthetics, health, safety and disturbance to neighbors.

According to Zhai (2010), vanacular architecture always stood out as an example of sustainable architecture over time, and it also potrayed the proper use of natural materials as well as local techniques. Vernacular architects through their designs produced a built environment that met the basic needs of the people (Zhai, 2010). Cardinale (2013) suggested that growing interest for the use of local building materials as well as local techniques over the years is indicative of the fact that there is a widening appreciation and there are a lot of ideas to draw from these architects (Cardinale, 2013). Some factors that may stand as an impediment to viability of traditional approaches to built environment include; demographics, movement from rural to urban areas, natural and man-made resources depletion, and changes in expectations as well as like style (Singh, 2009).

Accordingly, this research focuses on Iranian vernacular architecture in hot and dry climate suggesting possible ways on how this type of vernacular architecture design approach could improve the present climatically situation. Yazd city stands out to be one of the most important cities in the hot and dry region of Iran. Besides, it has most

of the architectural and vernacular qualities needed to create a comfortable zone in harsh climate of Yazd city. One of these architectural solutions is roofed alleys which can be used to provide human comfortable conditions and also to create acceptable relationship between human and natural environment. The use of roofed alleys in Yazd city has social, economical and environmental dimensions as well as the ability to increase the urban quality of Yazd city.

1.2 Problem Statement

Yazd city is one of the most well known cities in Iran. Besides, it is also known for its vernacular architecture. Unfortunately, due to the increasing population which has led to inadequate space in the surrounding environment, the city has gradually lost its vernacular taste and is headed towards a more compact oriented form. The sustainable features of vernacular architecture of the city of Yazd have been ignored. Nevertheless, Vernacular architecture can still play a significant role as an integral part of sustainable architecture design, as well as provide acceptable human condition in the harsh hot and dry climate of Yazd city. In other words, sustainable architecture can bring into play the major factors, such as social economic and environmental sustainability to improve the environment.

Roofed alleys are one of vernacular architecture elements base on sustainable design factors which can greatly improve the environment in Yazd city. This thesis focuses on the sustainability of roofed alley that has gone out of use in present times, even though roofed alley had played a significant role in solving both social and environmental plights of the people. Moreover, climates, form, function, energy usage, materials, social community, gatherings, neighborhoods, are main factors which have deep role in the design of roofed alley of Yazd city in Iran.

Unfortunately, with advent of modernism, the relationship between humans with natural -environment has been lost. Vernacular architecture is one of the main issues that have been sidelined after the advent of modernism. There is a lot to be learnt from a thorough study of vernacular architecture which will bring about the necessary development needed. The use of roofed alley in hot and dry climates is one of these subjects which should be explored and used.

This study seeks to answer the following questions:

- What are the environmental and social indicators of roofed alley in Yazd City of Iran?
- What are the relationships between vernacular architecture design and sustainability?
- What are the sustainable architecture design parameters?

1.3 Aims and Objectives

Yazd city is located in the central part of Iran with hot and dry climate because of the desert area around it. Vernacular architecture of Yazd city could find some architectural solution base on sustainable architecture design. The main issue of sustainable architecture design of Yazd city is connected to environmental and social sustainable factors. One of these sustainable solutions is roofed alley, which can provide comfortable area for outdoor activities in harsh climate situation. Furthermore, this study aims to survey and evaluate the use of roofed alleys as well as determine possible ways to implement it in Yazd city and hence provide comfortable outdoor spaces that enhances environment sustainability.

Evaluation of some vernacular architecture design of Yazd city can be helpful to understand how sustainable design can create friendly relation between human and harsh natural environment. These historical experiences such as roofed alley can be useful in modern development of cities and buildings of Yazd city.

1.4 Research Methodology

As mentioned above, the aim of this study is evaluation of roofed alleys of Yazd city in Iran that has sustainable concepts and roles. The research methodology requires gathering relevant data from specified documents and compiling databases in order to analyze the material and arrive at a more complete understanding of roofed alley applications in Yazd city and also observation of real environment of Yazd city. Besides, the methodology of this study has two main parts; content analysis and physical analyses through observation (C.R.Kothari, 2004). The first method is content analysis base on literature review. Fortunately, there are so many academic resources such as articles, books, reports and journals about vernacular and sustainable architecture and also about roofed alley as vernacular architectural elements. The main point of physical analyses through observation is base on two reasons; observer should live and work in the case study area and second reason is that roofed alley and Yazd city are historical issue. Observation of roofed alleys in Yazd city happened in each of the three summer months during which the temperature is highest in the year. These two methods were useful to collect and analyze data about roofed alley in Yazd city.

1.5 Limitation of the Research

The limitation of this study will be to explain the sustainable architecture concept of Yazd city in two main types of sustainable design, environment sustainability and social sustainability, and that roofed alley of Yazd is working as vernacular

architecture elements in both main issues of sustainability. Yazd city is in the desert area of Iran and it is characterized with hot and dry climate, for this cause, creating some vernacular and traditional architectural elements such as roofed alley to serve as architectural solution providing acceptable human conditions for both indoor and outdoor activities.

The main area of study in Yazd city is Fahadan town, this area is the very core of Yazd city for this reason, and there are so many real examples of roofed alley in Fahadan. There are basically four major types of roofed alleys, and this thesis attempts to explain each of them and their differences as well as well as to evaluate each of the environmental and social role of roofed alley in different position.

This study chooses four more popular types of roofed alley in Fahadan area of Yazd city of Iran which have more efficiency as vernacular architectural elements in Yazd city. The differences of these roofed alleys as case studies are base on different types of function, scale, location, etc.

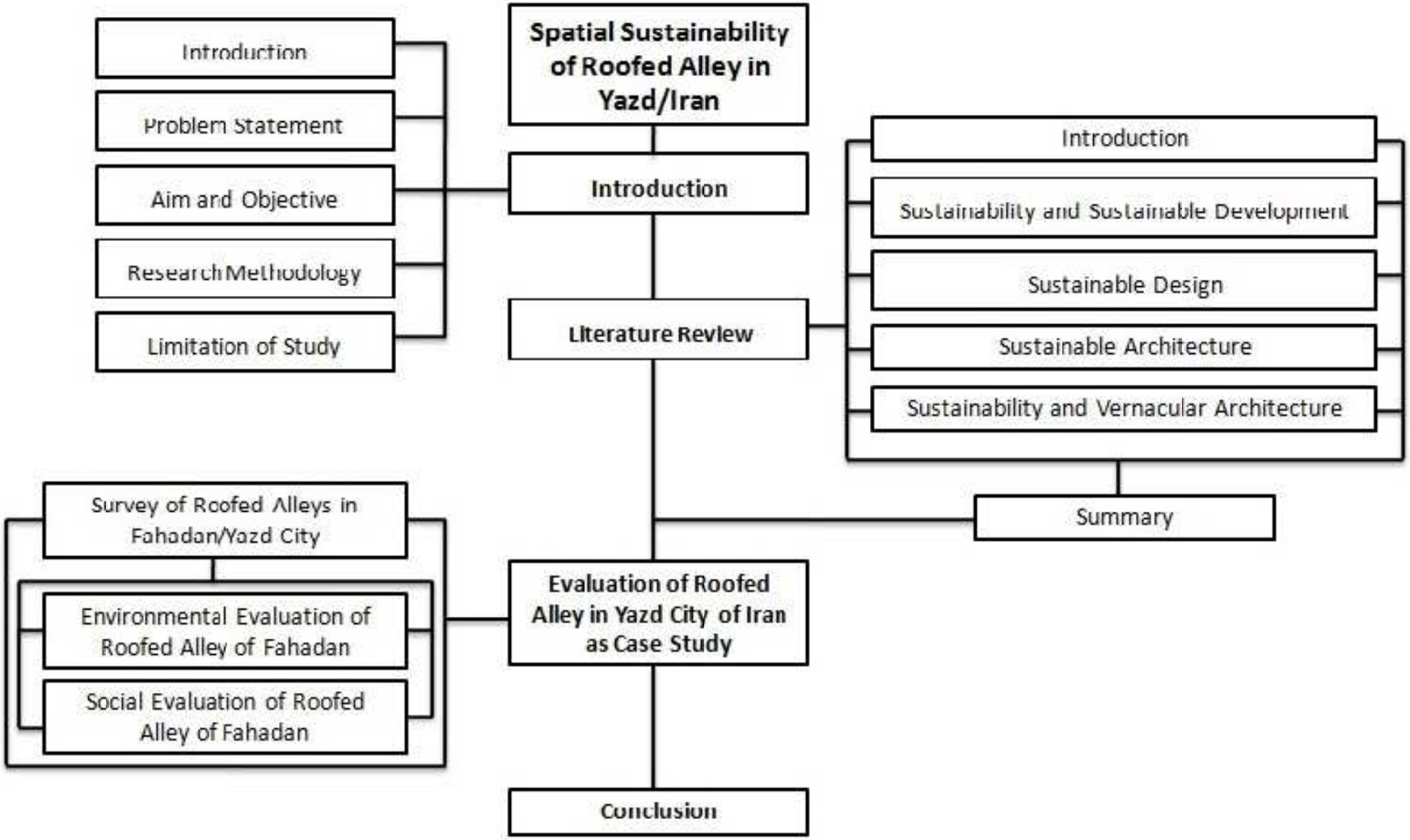


Figure 1: General view of this study

Chapter 2

AN OVERVIEW ON SUSTAINABLE ARCHITECTURE

2.1 Introduction: Sustainability and Urban Quality

Research into the various types of urban design theories has produce similarities and differences accounting for the quality of the urban space and the major criteria given by those who set the standards for defining good urban design. In order to address the economic, social and environmental ills, city and regional planning body embodying urban sustainability needs to be put in place. Though, there is no universal model to follow in achieving a sustainable city, but with various sustainable cities emerging each with its peculiar approach for each city with its own unique cultural, environmental, historic, and political situations. However, planning bodies focused towards 'urban sustainability' can be adapted from approaches formulated in cities and regions where problems of infrastructure, social equity, and urbanization of the environment have been creatively addressed (Balbo, 2006).

According to "Jane Jacobs" In her classic book "Death and Life of Great American Cities" in analyzing the structural characteristics of the urban environment particularly the streets as a sociologist she expressed her worries over the lack of social interaction openness and security.

From Jane's own point of view the criteria that determine how good an urban is are as follows:

- *"Continuity of proper activities more than attention to visual discipline"*
- *"Using combined utilization from application and monuments with different ages in an area"*
- *"Attention to the elements of street"*
- *"Accessibility of the fabric that means conversion of the urban smaller blocks"*
- *"Social activity and flexibility of the spaces"* (Plemenka, 1982)

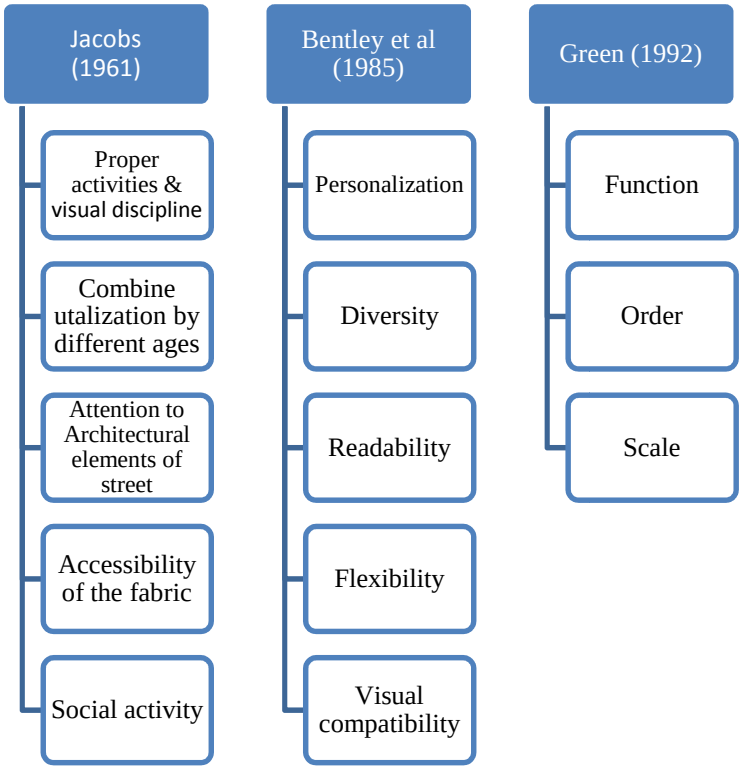
According to Bentley et'al 1985 in a book "as responsive environments," he proposed one of the one of the most famous sets of urban design qualities. This is referenced in occupation association as it stands to possess such qualities as being easy to read, comprehensive and visual attraction. Apart from the basic qualities which relates to functionality and efficiency, plus technical issues such as environmental condition setting, he proposed about seven more new qualities which is now being referred to as new criteria necessary for designing the urban space. The first quality is diversity, attaining functional diversity and human diversity and social groups in urban places. The second is readability, ability to easily understand the environment and navigate through to access the mentioned point without difficulty. Flexibility is the third. This relates to the power and ability of the space in accommodating activities (Whitehand, 2011). The fourth are visual compatibility, fitness of the environment visual characteristics with function and content of the mentioned environment. The fifth are personalization; it means that the residents and the citizens could personalize the city and have feeling of belonging (Azuma, 1982).

According to the article "city shape" they mention three basic components of urban design quality. They include:

- Function: involving communication, security, climatic convenience, and diversity.
- Order: this is related to integration, clarity, continuity, identity, balance, identity shaping of cannons, unity, personality and attractiveness.
- Scale: visual and functional alteration, liveliness and harmony (Green, 1992).

Furthermore, as discussed above there are various theories about urban space quality in relation to sustainability. These theories have been collated and summarized in table 1 below to show their different approach to urban quality.

Table 1: Theoretical parameters of urban quality (Amended from (Marshal, 2005))



2.2 Sustainability and sustainable development

The awareness on sustainability development became more pronounce in the 1980s, this created more environmental awareness around the world. Though there is no

generally accepted definition of sustainable development as up twenty four different definitions can be seen in the book “blueprint for a Green Economy” (Kim, 1998). Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. ‘Sustainable’ development ties together the concern for the carrying capacity of natural systems with the social challenges facing humanity (figure 2), (OBE, 2012).

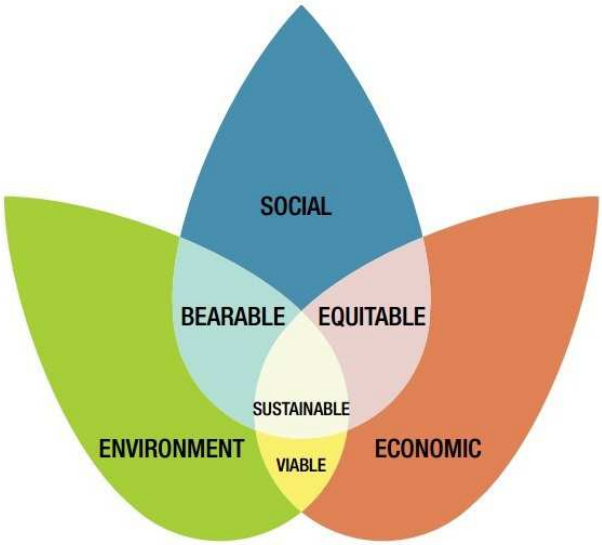


Figure 2: The Concept of sustainable development base on social, environmental and economic factors (OBE, 2012)

The major concept of sustainability is geared towards achieving the best out of the environmental conditions with maximum internal attributes of environment so that it can minimize undesirable aspects of the construction. Figure1 shows one of the concepts behind sustainable development principles. The classification of sustainable development in figure 3 above was created by Lynne Sullivan in RIBA Guide to Sustainability in Practice in 2012.

In this category of sustainable development three new keywords came into play in the second level they are Bearable, Equitable and Viable. The major difference

between the classification of sustainable development by Lynne Sullivan in 2012 (figure 1) and Alnaser in 2008 (figure 3) is the addition of the three new keywords as connection with each of three economic, environment and social sustainability factors. The keyword viable is an intersection between economic factor and environmental factor. While Equitable created as link between social and economic issues in sustainable development. The last new word Bearable stands as a link between social and environmental factors in sustainable development in the table. Furthermore, the second classification of sustainable development was by Alnaser in 2008 (Figure 3), (Table 2). In this classification, some keywords were added to the basic parameters of sustainable development in other to make the description clearer.

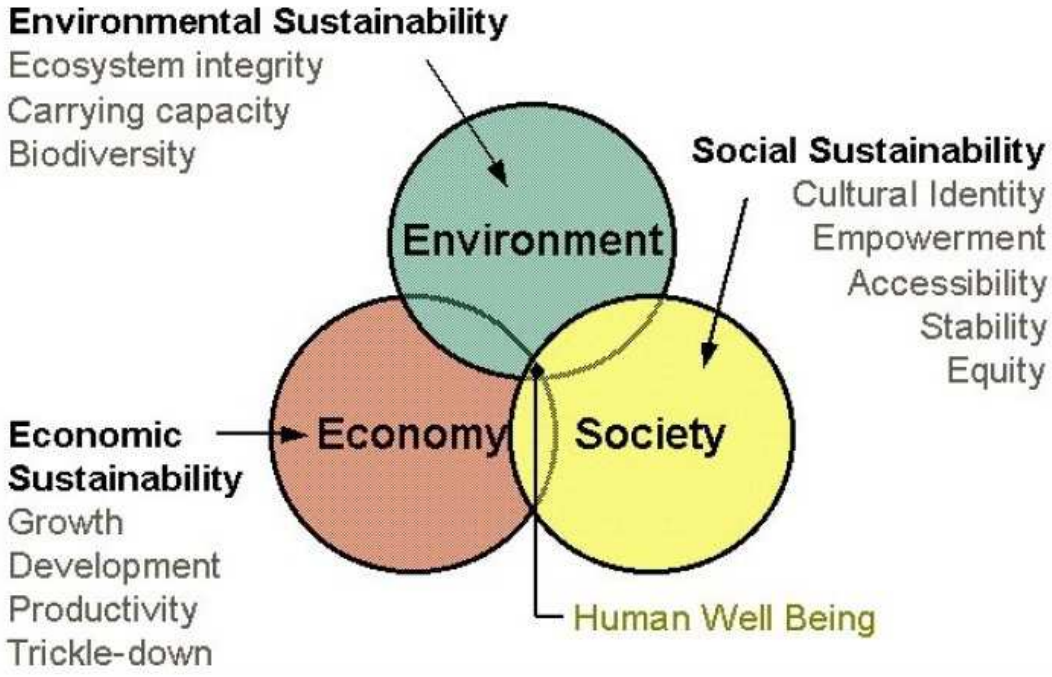


Figure 3: Classification of sustainable development (Alnaser, 2008)

Table 2: Descriptions of sustainable development factors (Alnaser, 2008)

Economic dimensions of sustainability	Environment dimensions of sustainability	Social dimensions of sustainability
▪ Creation on new markets and opportunities for sales growth ▪ Cost reduction through efficiency improvements and reduced energy and raw material inputs ▪ Creation of additional added value	▪ Reduced waste effluent generation, emissions to environment ▪ Reduced impact on human health ▪ Use of renewable raw materials ▪ Elimination of toxic substances	▪ Worker health and safety ▪ Impact on local communities, quality of life ▪ Benefits to disadvantaged groups e.g. disable

The basic idea of sustainable development is targeted towards ensuring a better quality of life for everyone, both for the present and generations unborn. To achieve this, four major objectives have to be met simultaneously in the world as a whole (John, 2005):

- Social progress which recognizes the needs of everyone;
- Effective protection of the environment
- Prudent use of natural resources
- Maintenance of high and stable levels of economic growth and employment

Table 3: Classification of sustainable development (Alnaser, 2008)

Element	Criteria
Economic Sustainability	Growth Development Productivity Trickle Down
Social Sustainability	Equity Empowerment Accessibility Cultural Identity Stability
Environmental Sustainability	Eco-System Integrity Carrying Capacity Biodiversity

2.2.1 Economic Sustainability

To achieve Economic sustainability a production system has to be in place that satisfies present consumption levels without compromising future needs. The 'sustainability' that 'economic sustainability' seeks is the 'sustainability' of the economic system itself. The notion of 'economic sustainability' was originated by Hicks. In his classic work *Value and Capital* _1939; second edition 1946. Hicks defined 'income' as 'the amount one can consume during a period and still be as well off at the end of the period' (Coaffee, 2008).

Economist had this assumption that the supply of natural resources was unlimited; they also assumed that the growth of the economy would bring technological capacity to replenish natural resources destroyed in the production process. This assumption has in a way placed undue emphasis on the ability of the market to distribute resources appropriately. Although today, it is now certain that natural resources are finite.

Any economic system where that applies the principles of economic sustainability is definitely going to be constrained by the demands of environmental sustainability. It ensures sustainability of natural resources by restraining resources (Barr, 2003).

Table 4: Classification of economic sustainability (Burgess, 1998) and (Adems, 2011)

Element	Criteria	Means
Economic Sustainability	Growth Development Productivity Trickle Down	1. Launch program to reduce automobile use 2. Establish modern bus mass transit scheme 3. Enhance bus system efficiency to draw rides 4. Make bus transit fast, cheap and comfortable 5. Place high density living near major arterials 6. Zone for mixed residential commercial use 7. Make downtown streets pedestrian malls 8. Expand green zones to safeguard open space 9. Enlarge the amount of per capita green space

2.2.2 Social Sustainability

Social sustainability can be defined as the "*maintenance and improvement of well being of current and future generations*" (Chu, 2003). According to Sachs, he stated in his book "Social sustainability and whole development" in 1999, that social sustainability is system of cultural connection where the good parts of contrasting cultures are promoted and valued. Also, the need for participation is not only in the electoral procedures of politics but also to be active at the local level in decision making. This is seen in three aspects: development-oriented, environment-oriented, and people-oriented (Sachs, 1999).

Bramley Et al in 2009 gave a working description of social sustainability, he identifying two core ideas as bases of social sustainability. The first is social equity. And the second is concerned with the continued feasibility, health and performance of "society" itself as a communal entity; this is generally demonstrated under the heading "community". This is not to suggest that these two dimensions are completely independent of one another, merely, that this is a useful conceptual

distinction. Examination of social sustainability at the urban development level requires both of these dimensions to be covered (Bramley E. , 2009).

Bramley (2009) used a formal consultation process in exploring the level of social sustainability this include meeting, discussions and presentations. Their discoveries show that the target in urban settings are what make society strong and livable, now and into the future are including equity, diversity, interconnectedness, quality of life, and democracy and governance. These findings bring to light that social sustainability occurs when the formal and informal processes, systems, structures, and relationships actively support the capacity of current and future generations to create healthy and livable communities. Social sustainable communities are impartial, varied, associated, and autonomous and provide excellent quality of living (Bramley, 2009).

Social sustainability, just like in environmental sustainability maintains the concept that generation unborn should possess same or even greater reach to social resources as the present generation. Social resources have been broadened to include culture as well as basic human rights. This has been evident through its evolving meaning and definitions from scholars of social sustainability principles, including core issues of social sustainability in planning developments and future communities, so that more operational measures of its achievements may be discovered. Table 5 below shows a lineup of social sustainability considerations in urban development (Davidson, 2009).

Table 5: Classification of social sustainability (Alnaser, 2008)

Element	Criteria	Means
Social Sustainability	Equity Empowerment Accessibility Cultural Identity Stability	1. View natural resources as limited in nature 2. Cultivate the lushness of the settlement are 3. street equitable distribution over production 4. Work for enjoyment rather than avoiding toil 5. Cherish folk life rather than entertainment 6. Reduce family size and resource use 7. Eliminate divisions of clan, caste, class 8. Practice gender-neutral

2.2.3 Environmental sustainability

According to Brutland (1987) Environmental sustainability demands that the earth should be used by people in a preservation manner such as to sustain it for the next generation. The implication of this definition is that human activities are termed environmentally sustainable when these activities are carried out in without destroying or degrading the natural environment (Bruntland, 1987).

Achieving environmental sustainability comes with great responsibility. Humans must in every way possible learn how to manage renewable energy for the long term and reduce waste and pollution. Besides, humans must begin to use solar energy in a more economical way as well as initiate ways to repair damages already done to the earth over time by industrialization across the world (Choguill, 2008) Furthermore, to achieve Environmental sustainability the right conditions that are not in themselves a part of the basic factor or sustainability but also democracy, human resource development, empowerment of women, and much more investment in human capital than is common today (Burgess, 1998) .

The fundamental criteria for environmental sustainability are listed below (Barr, 2003):

A) Environmental sustainability has about four basic conditions of economic sustainability:

- *"Maintenance of per capita manufactured capital (e.g., artifacts, infrastructure), per capita"*.
- *"Maintenance of renewable natural capital (e.g., healthy air and soils, natural forests, oceanic fish stocks), per capita"*.
- *"Maintenance of per capita non-renewable substitutable natural capital, with capital values based on the value of the services of the present stock of natural capital. For example, this means that if the cost of supplying energy substitutes rises, sufficient capital must be accumulated to maintain these services"*.
- *"Maintenance of non-substitutable, non-renewable natural resources (e.g., waste absorption by environmental sink services). No depletion or deterioration of non-substitutable non-renewable natural capital. This means no net increases in waste emissions beyond absorptive capacity"*.

B) Economic consumption needs to be priced by to show the total cost of all capital depletion, which should include waste creation, the cost should be same to the price of reducing an equal amount of that particular waste.

C) Declaring the criteria in per capital terms attracts notice to the importance of eradicating population growth. Theoretically the stock per capital of the various types of capital might as well stay constant as the stock increases at the same level with population growth. But actually the population growth and the stocks pf physical resources must move in the direction of zero.

Table 6: Classification of environmental sustainability (Alnaser, 2008)

Element	Criteria	Means
Environmental Sustainability	Eco-Integrity Carrying Capacity Biodiversity	1. Educate the team in environmental planning 2. Survey the landscape's natural attributes 3. Identify natural opportunities and constraints 4. Identify sensitivities of plants and animals 5. Identify social opportunities constraints 6. Identify cultural opportunities constraints 7. Apply eco-principles from other regions 8. Adapt environmental laws from other regions

2.3 Sustainable Design

Sustainable design starts with a proper understanding of place. It is possible for humans to live in a place without damaging it if they are sensitive to it. A good understanding of the environment helps the practice of architecture in a lot of ways, this include solar orientation of the site, accessibility and preservation of the natural environment. Regardless of where the building site is whether in the city or else where it is a known fact that intimate relationship with nature brings life to the built environment (Balbo, 2006).

Lately, there has been an immerse increase in the level of studies and research into sustainable architecture. Sustainability aims at focusing on the natural surrounding conditions to achieve a designed output with maximum internal attributes of environment so that it can minimize the undesirable aspects of these constructions. Buildings must reply to environment from design stage and settling when they are to decrease confronting with nature. The aim of sustainability in environmental design as follows (Barnett, 1982):

- "*Maximizing the human comfort"*
- "*Efficient planning"*
- "*Design for change"*
- "*Minimizing waste of spaces"*
- "*Minimizing construction expenses"*
- "*Minimizing buildings maintenance expenses"*
- "*Protecting (keeping) and improving natural values"*

One great influence on a community's economy, environment and quality of life is the process of designing, developing and inhabiting of the built environment. Sustainable design of the built environment poses a challenge to the planners, developers, and architects who are tasked with the responsibility create the link between their buildings, the environment and the community. The basic idea behind all of this is to integrate the local ecology into design and construction, minimizing natural resources impacts, reduce non-renewable energy usage, use of environmentally friendly products, protection and conservation of water resources, enhance indoor air quality, and improve maintenance culture. A modification of the codes and ordinances of the local government is necessary to exert control on the environment. Existing regulations that don't favor sustainable designs may be a barrier.

Jong Jin Kim in his book, "*Introduction to Sustainable Design*" created an ideological structure of sustainable design in three level, (Principles, Strategies, and Methods) corresponding to the three objectives of architectural environmental education: making environmental awareness, explaining the structure's ecosystem

and showing ways of designing sustainable buildings. The entire conceptual diagram for sustainable design is shown in figure 4(Kim, 1998).

Jong Jin Kim in 1998, according to his study suggested three main factors as the principles of sustainability. The economy of resources' has to do with the reduction, reuses, and recycling of natural resources. Life Cycle Design proffers a method for analyzing the impact of the building process on the environment. Humane Design concentrates on the connection that exists between people and the natural environment. These principles can provide a wide awareness of the environmental impact, both local and global, of architectural consumption.

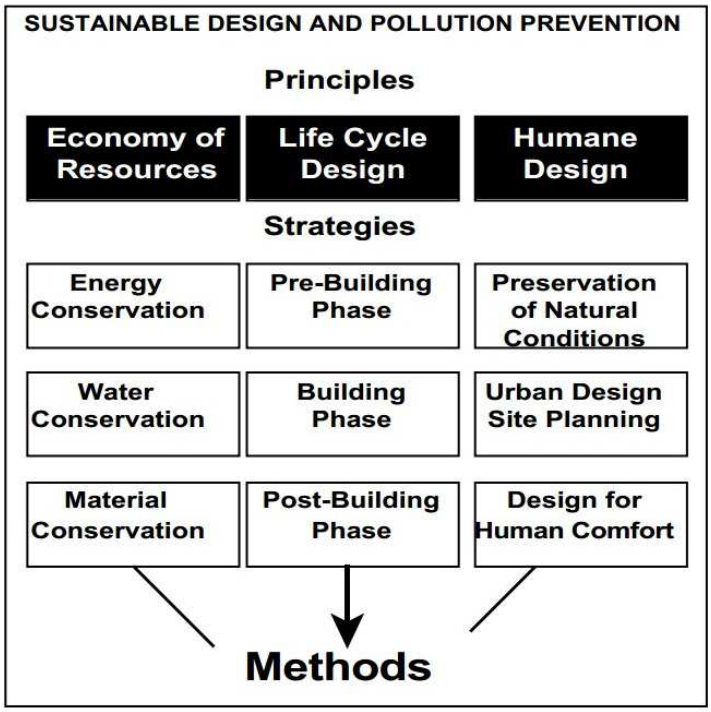


Figure 4: Classification sustainable design factors (Kim, 1998)

2.3.1 Economy of Resources

Preserving energy, water, and materials could lead to targeted procedures that will enhance sustainability of architecture. The table 7 below shows the classification.

Table 7: Factors of Economy of resources in sustainable architecture design (amended from (Kim, 1998))

Economy of Resources	
Energy Conversation	Energy – conscious urban planning, Energy – conscious site planning, Alternative sources of energy, Passive heating and cooling, Avoidance of heat gain or heat loss, use of low embodied – energy materials, Use of energy efficient appliances with timing devices
Water Conversation	Reduction: Low –flow showerheads, Vacuum-assist toilets or smaller toilet tanks Reuse: Rainwater collection, Gray water collection
Material Conversation	Material- conserving design and construction, Proper sizing of building systems, Rehabilitation of existing structures, Use of reclaimed or recycled materials and components, Use of non-conventional building materials

The major aim of conserving energy is to minimize the use of fossil fuels. Buildings use up energy not only for heating, cooling and lighting, but also in the construction process. The materials used in the construction process have to be harvested, processed and transported to the site. Construction itself often requires large amounts of energy for processes (Coch H. , 1996).

2.3.2 Life Cycle Design

The principle of life cycle design embodies three approaches; they are pre-building, building and post building. These strategies, in turn, can produce specific design guidelines that will significantly improve the sustainability of a building. How each method relates to major strategies Life Cycle Design is shown in figure 4. Besides, the methods are geared towards minimizing input. With fewer materials used the environmental effect will be lessened. Thus the output building ecosystem is reduced (UNDSD, 2001).

Pre-Building Phase

At this stage the structure materials to be used in the building are carefully selected and further examined to determine its environmental impact. The material selection

process is taken very seriously at this stage; its processing is also taken into cognizance as it can have a long term consequence globally.

Building Phase

This stage is majorly concerned with the construction phase, the strategy is concerned with the environmental impact the construction process could cause.

Post-Building Phase

At this phase the architect is concerned with task of determining environmental consequence of buildings that are no longer in use. In determining this, there are three considerations possible in the buildings future namely: reuse, recycling and disposal. While reuse and recycling finds a way to reintegrate the resources into new building, disposal requires contributes to the already overburdened waste stream (Spangenberg, 2004).

Table 8: Methods of life cycle application (amended from (Kim, 1998))

Life Cycle Design	
Pre- Building	Use material that are: Made of renew- able resources, Harvested or extracted with – out ecological damage, Recycled, Recyclable, Long-lasting and low maintenance Minimize energy needed to distribute materials
Building	Schedule construction to minimize site impact, Provide waste separation facilities, Use nontoxic materials to protect construction workers as well as end users, Specify regular maintenance with nontoxic cleaners
Post -Building	Adapt existing structure to new users and programs, Reuse building components and materials, Recycle building components and materials, Reuse the land and existing infrastructure

2.3.3 Humane Design

As discussed earlier, this principle contains three key strategies: preservation of natural conditions, urban design and site planning, and design for human comfort.

These strategies will results into distinct design approach that will improve the sustainability of buildings. Table 9 shows how each method relates to the three strategies of Humane Design. These methods focus primarily on improving the quality of life for humans and animals (Kim, 1998).

Table 9: Factors of human design in sustainable architecture design (amended from (Kim, 1998))

Human Design	
Preservation of Nat'l Conditions	Understanding impact of design on nature, Respect topographical contours, Do not disturb the water table, Preserve existing flora and fauna
Urban Design Site Planning	Avoid pollution contribution, Promote mixed use development, create pedestrian pockets, Provide for human-powered transportation, Integrate design with public transportation
Design for Human Comfort	Provide thermal, visual and acoustic comfort, Provide visual connection to exterior, Provide operable windows, Provide clean fresh air, Accommodate persons with differing physical abilities, use non toxic materials

Promote Mixed Use Development

Sustainable development encourages the mixing of residential, commercial, office and retail space. People then have the option of living near where they work and shop. This provides a greater sense of community than conventional suburbs. The potential for 24-hour activity also makes an area safer (Ghani, 2012).

Provide Thermal, Visual, and Acoustic Comfort

It is true that people are not at their best when the building envelop is too cold or too hot. Tasks are best performed when there is proper lighting and conducive temperature in place. Another thing to be considered is acoustics as well as visual comfort. All of these are necessary for the comfort of the building users (Godfaurd, 2005).

Provide Visual Connection to Exterior

As the sun rises in the morning and sets in the evening, so also does the human body synchronizes to the day and night cycle, to create that psychological balance openings in buildings are essential (Islam, 2003).

Provide Fresh Clean Air

Provision of fresh clean air is essential for the well being of building users. Therefore the air ducts should be clean and clear from pollution. When this is lacked it puts the occupants of the building in harm's way and at risk of bacterial and chemical contamination (Heerwagen, 2004).

Accommodate Persons with Differing Physical Abilities

Sustainable designs have longevity, besides, when a building is durable and adaptable it tends to be more sustainable than those that are not. A building in this sense is said to be adaptable when it usable by people of different ages and physical conditions (Alex, 2001).

2.4 Sustainable Architecture

Architecture is so unique in the sense that it merges artistic skills with science and technological creativity. A key aspect of architecture is its ability to provide basic human needs likes shelter, transportation and commerce. It further plays both aesthetic and functional roles as well as a major role in sustainability and civilization. The key challenge the architect has is the ability to whole introduce the key principles of sustainability without compromising the place of aesthetics and functionality. To achieve this there need to be a modeling of the architectural education system to accommodate the principles of sustainability as well as a focus on conservation of energy both for new and existing buildings (Taleghani, 2011).

Another way approach to sustainability in architecture is creation of design for the future. Sustainability doesn't on focus on the physical conservation, it further seeks ways to sustain and preserve the earth and its resources. In the year 1994, the international Council Building defined the aim of sustainable architecture as innovation ways to create a healthy environment that is founded on the bases of resource efficiency. A sustainable structure is one having the lowest possible inadaptability with artificial and natural environment and it includes the building itself, the immediate environment, regional and global environment (Islam, 2003).

To further define sustainable architecture, it is seen as an architecture that interacts with the environment and also apply ecological context in order to produce favorable environmental condition; and due to its friendliness to the environment it cause minimal effects to the ecosystem. Besides, it possesses such qualities as; flexibility, adaptability and continuity to changes (Baladi, 2000).

A principle of sustainable architectural design defines (Turan, 1999):

- **Understanding Place:** Architecturally, there are several ways to make a building sustainable and to meet the emerging environmental challenges on the earth. It is possible to make a building green without compromising its aesthetics, efficiency, functionality and cost. To successfully achieve a design that is green, these five areas must be considered: healthy interior, Energy efficiency, Ecological building materials, Building form and good design
- **Connecting with Nature:** Regardless of where the building site is whether in the city or else where it is a known fact that intimate relationship with nature brings life to the built environment

- **Understanding Natural Processes:** In the ecosystem nothing is wasted. Living organisms get there food from each other, such that the byproduct of one could be the food for the other. Natural systems are made of close loops. Thus, the need of any specie should not be taken for granted; the process should be geared towards regeneration rather than depletion. By observing this cycle, life is brought back and sustained
- **Understanding Environmental Impact:** Sustainable design aims to analyze the environmental impact of the project by first accessing the building site, available energy, contamination of the materials and construction techniques necessary. To check bad environmental impact, sustainable local building materials can be used since they are less toxic both in manufacturing and installation as well as recycled material.
- **Understanding People:** sustainable design must accommodate the verity of cultures, religion, races and the entire life of the people the buildings are being designed for. To achieve this, the architect needs to be sensitive to the needs of the people in that locality.

Architecturally, there are several ways to make a building sustainable and to meet the emerging environmental challenges on the earth. It is possible to make a building green without compromising its aesthetics, efficiency, functionality and cost. To successfully achieve a design that is green, these five areas must be considered: healthy interior, Energy efficiency, Ecological building materials, Building form and good design (Datschefski, 2001):

- **Healthy Interior Environment:** it is of outermost important to ascertain that the construction materials and methods employed do not release harmful unhealthy gases to the built environment. It is also very important for

maximum amount of natural air enough to ventilate the building interior be allowed.

- **Energy Efficiency:** another important factor to insure is that the building use should be reduced as much as possible. The structure's design should be such that requirement for artificial heating and cooling would be minimal (Ghani, 2012).
- **Ecological Building Materials:** as much as possible the materials used for construction should be sourced from renewable.
- **Building Form:** There should be a harmonic relationship between the buildings forms the people living in the environment and surroundings, as well as the climate.
- **Good Design:** the basic standards for defining design are Structure, Material and Aesthetics. Therefore, it is important that they are well integrated together to achieve a habitable space (Dili, 2010).

2.4.1 Environmentally Friendly Buildings

The following five principles if well followed can lead to a sustainably achieving what is known as sustainable design. An environmentally friendly building is designed and constructed to suit its occupants, nature, environment and ecosystem. It is designed and constructed fit into the environment it is located in, keeping in mind the climate, material, availability and building practices (Ulusoy, 2012).

Energy and Environment

Due to inadequate awareness amongst people about renewable energy resources, there is a rise in the consumption of nonrenewable energy sources; this has cumulatively led to the increased use of fossil fuels. Natural resources are limited, thus a continuously existing ecosystem is necessary for live (Seyfang, 2010). With

the current increase in knowledge of the consistently growing demand for energy as a result of nonrenewable energy sources, it is assumed that this challenge should have gain more attention from around the world (Roufechaei, 2014).

Building Materials

A large quantity of wood is used in the construction of buildings. To increase the efficiency of timber these three key approaches must be adhered to:

- Reducing the amount of material used in construction.
- Using recycled materials that otherwise would have been waste.
- Reducing waste generation in the construction process.

Ensure as much as possible to use sustainable indigenous materials and finishes having the lowest toxic content both for manufacturing and construction (Coch, 1998).

Passive Heating and Cooling

The most significant energy input to buildings has been discovered to be the solar radiation incident on building surfaces. This radiation releases heat, light and ultraviolet radiation which is necessary for photosynthesis. Building designers have over the years devised ways where the building envelop gives shade in summer and retains heat during winter. Though, in present times this requirement has mostly been sidelined. Passive solar architecture does provide a design model that attempts to maximize the penetration of solar radiation using the building envelop, so as to reserve it to be used at a more desirable time of the day. Plants used for shading in summer help prevent heat gain in summer and thus reduce air conditioning cost. The flow of the wind brings cooling; the prevailing winds have been a major factor in urban design (Billings, 1993).

Natural Cooling System

There are two major elements that control temperature in a traditional building; they are air exchange and natural ventilation. Thus in hot regions loose infiltrations allow for ventilation, while on the other hand, buildings in cold climate, in other to keep the heat within the building tight infiltration is needed within the building except for an opening in the roof to allow smoke to escape and light to come in if necessary (Oliver, 2003).

From the observations above, it suggests that some vernacular traditions help the steady temperature of the earth as a method to minimize temperature changes of the dwelling. The frequent of use eaves were seen in hot climates on buildings with thin walls suggesting they are used for cooling the building (Turan, 1999). For places like Morocco and Tunisia with high temperature ranges massive walls are commonly used yet eaves where never seen. In cold climates, overhangs appear to only serve the purpose of protecting the structure from rain or snow. In the Mediterranean region courtyards are mostly used while overhangs are introduced to the structure for cooling porches and terrace (Dabaieh, 2011).

Day lighting

When buildings are designed with openings to allow for natural lighting this enable the users to conserve electrical energy, saving leak electrical loads and minimizing energy consumption required for cooling. Besides, natural lighting tends to increase the luminous quality of indoor environments, enhancing the psychological wellbeing and productivity of occupants of the building (Islam, 2003).

Choose Materials with Low Embodied Energy

Structural materials differ based on how much energy is required to produce them. The energy a structural member consumes and retains attempts measure the amount

of energy that is transferred into the life cycle of the building material. An example of this is aluminum a very high embodied energy because of the large amount of electricity that must be used to manufacture it from mined bauxite ore; recycled aluminum requires far less energy to prefabricate. Choosing materials like this for construction goes a long way to reduce the environmental impact of the building. And the use of domestic materials over imported ones minimizes transportation cost (Datschefski, 2001).

Sustainable Construction

Sustainable construction is defined as "*the creation and responsible management of a healthy built environment based on resource efficient and ecological principles*". Sustainable designed buildings focuses ways to reduce their effect on our surroundings by the efficient use of energy and resources. "Sustainable building" may be defined as building practices, which strive for integral quality (including economic, social and environmental performance) in a very broad way. Further, various energy is related issues during the different stages in the construction of buildings can be understood with respect to the chart shown in figure 5 (Alex, 2001).

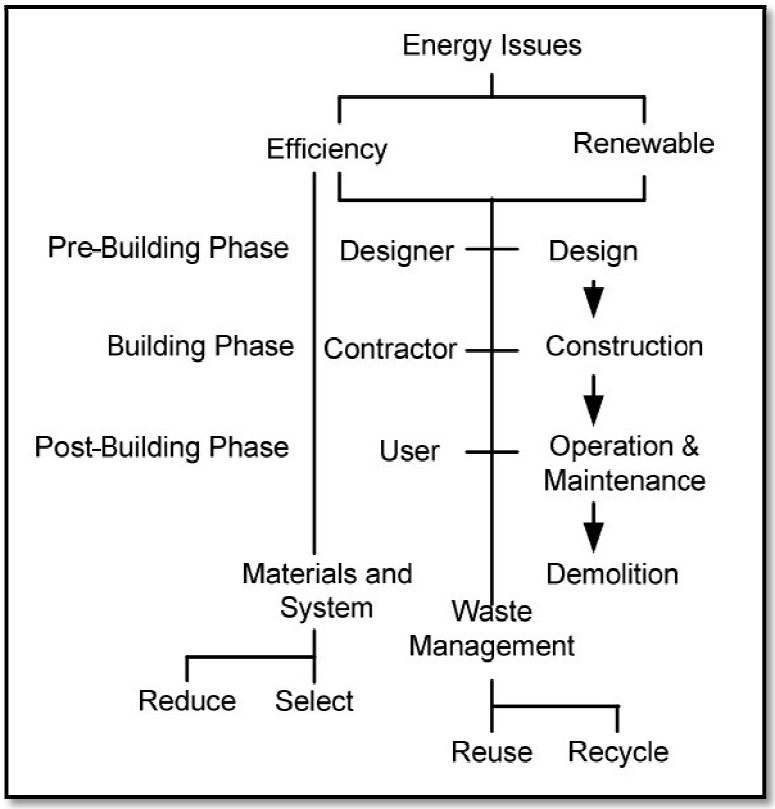


Figure 5: Factors of energy issues in building construction (Ghani, 2012)

Table 10: Environmental friendly buildings factors

Title	Key Factors	References
Energy and Environment	Reduce energy gain and loss, Lighting, External ventilation, Maximizing the human comfort and thermal, Application of passive solar, Orientation, Infiltration	(Seyfang, 2010), (Roufechaei, 2014), (Anna Maria, 2009)
Material	Reducing the amount of material, Minimize the use of new material, Design for minimal material waste through modularization, Use of material with the potential for long live, Reduce human exposure to noxious material	(Coch H. , 1998), (Fernandes, 2014), (Ghani, 2012), (John, 2005)
Construction	Minimizing construction expenses, Optimization building envelope, Completeness, Connectedness, Design for component update, Minimizing waste of spaces, Support pedestrian	(Kalan, 2014), (Dabaieh, 2011), (Dipasquale, 2005), (Grierson, 2011)

2.4.1.1 Environmental Physical Sustainability

The inseparable trend of activity, worship and death in the traditional community has shaped the city in particular way. Integration and interweaving of urban elements from bazaars, mosques to houses in total in a traditional city make difficult

separation of the spaces. The wonderful trend of proportionate and coordinated shapes in the connective fabric offers the exalted manifestation of unity. This characteristic is obvious in hot and arid cities structure due to continuous effort in solving sever climatic problems. Coordination and connection of the residential complexes, passages and alleys is resulted from observing the principles. The house main direction and size of yard space relative to volume have been considered (M. Mehdi Maeiyat, N. Movahed, 2009). In the past, construction was done by an architect and all buildings and elements were constructed as a complex not individually.

Structure

One of major differences of modern urban design with traditional one is texture of urban that structural elements of traditional cities have important role in this difference. Traditional cities with compact texture have some types of structural elements which have vernacular features. Roofed alley as vernacular structure in urban scale has some differences effect and role such as pattern and aesthetic features.

The urban environment elements and factors are important from possessing appearance aspects and influence on the observer in addition to having particular functions. Light, signs, green spaces and urban designing are historical valuable elements. So, they are divided into natural and artificial sections or day and night lights (Sharifi Yazdi, Jabbari. H, 2012). In day, the sunrise is considered so that optimal levels of light is shined and sever light and darkness is prevented. This process is important in desert areas that direct sunrise is unpleasant. So, different solutions have been offered for control of sunshine inside buildings, passages and bazaars and other places. It can be refer to covering of the bazaars roof and building

small holes and enclosing of passages with long walls for providing shadow, narrow passages and using polished stones for control of interiors of the mosques and vegetation in public spaces (Mirmoghtadaee, 2009). In passages of hot and arid region in Iran ceiled passages, curtains and lightning by day light add to aesthetic aspect of the places that increase external environment visual quality by combination of volumes and light.

Figure 6: Pointy sun light by roof openings of roofed Alley

Figure 7: Combination of sun light and shadow by roofed alley

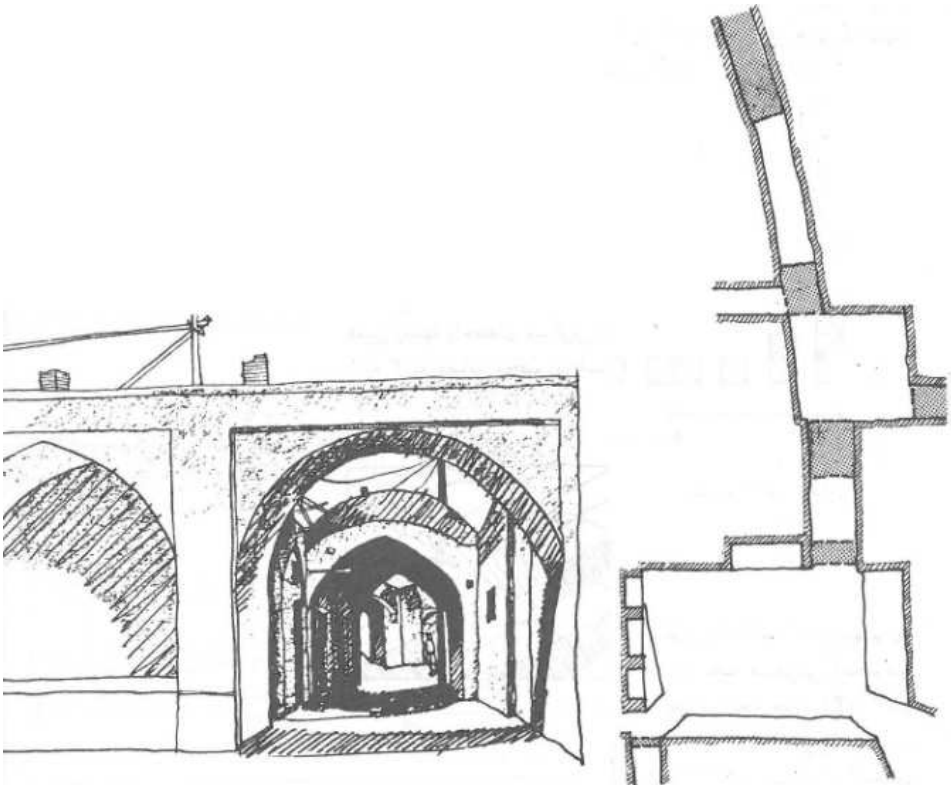


Figure 8: Popular pattern of roofed alley in desert cities of Iran

Landmark

Current study about urban design shows which mental symbol of visual landmark of environment is necessary to remind the image of environment (ROGER, 2009). Landmarks can be useful to create some sense such as visually, auditory, olfactory and semantic which can be acceptable as importance symbol of visual image for city and also as navigator and reflector difference types of functions too (CADUFF, 2008).

Barton defined the structural salience of landmarks along routes in two steps; formalization of salience of objects, and conceptualization of their way-finding actions. It is true for formalization process but not enough as the salience or saliency denotes relatively distinct, prominent or obvious features compared to other features. The complexity of spatial layout in an urban landscape causes the most general requirement of landmark that it must be in contrast with the environment in order to have perceptual distinction (Barton, 2000).

The faces of the monument like appearance of individuals indicate tier inner and walls and facades transfer meaning and communicate with the observer. Forms and symbolic elements, colors and signs, volumes and spaces, styles and monuments and also materials are language of a city. These symbols determine the primary account of any newcomers. Influence and domination of modernism in one hand and chaos and mental disorder resulted from western culture have converted the facades of city and led to corrosion and lack of identity (Shahraki, 2011) .

Figure 9: Narrow and roofed alley in historical area of Yazd city of Iran

Privacy and Enclosure

While unlimited scopes show continuity the limited scopes indicate lack of continuity. Privacy defines space and time and offers identity, safety, diversity, selection and freedom. Visual and spatial privacy is fundamental characteristic of the private houses (figure 10) (Tavasoli, 1990):

- providing privacy in different levels
- providing privacy by separation of spaces
- Providing semi private place in public places
- Providing owning sense for residents and owner

Figure 10: Create neighborhood privacy by roofed alley in Fahadan area, Yazd/Iran

Centrality is a general form of patterns that substantiated in all contexts particularly in urban designing. So, cultural and economic reasons of the centrality concept can be used in all aspects of urban designing (Abouei, 2006) (figure 11):

- centrality of the quarters centers by the help of tall roofed alley
- Spatial relationship between centers and other parts of the city

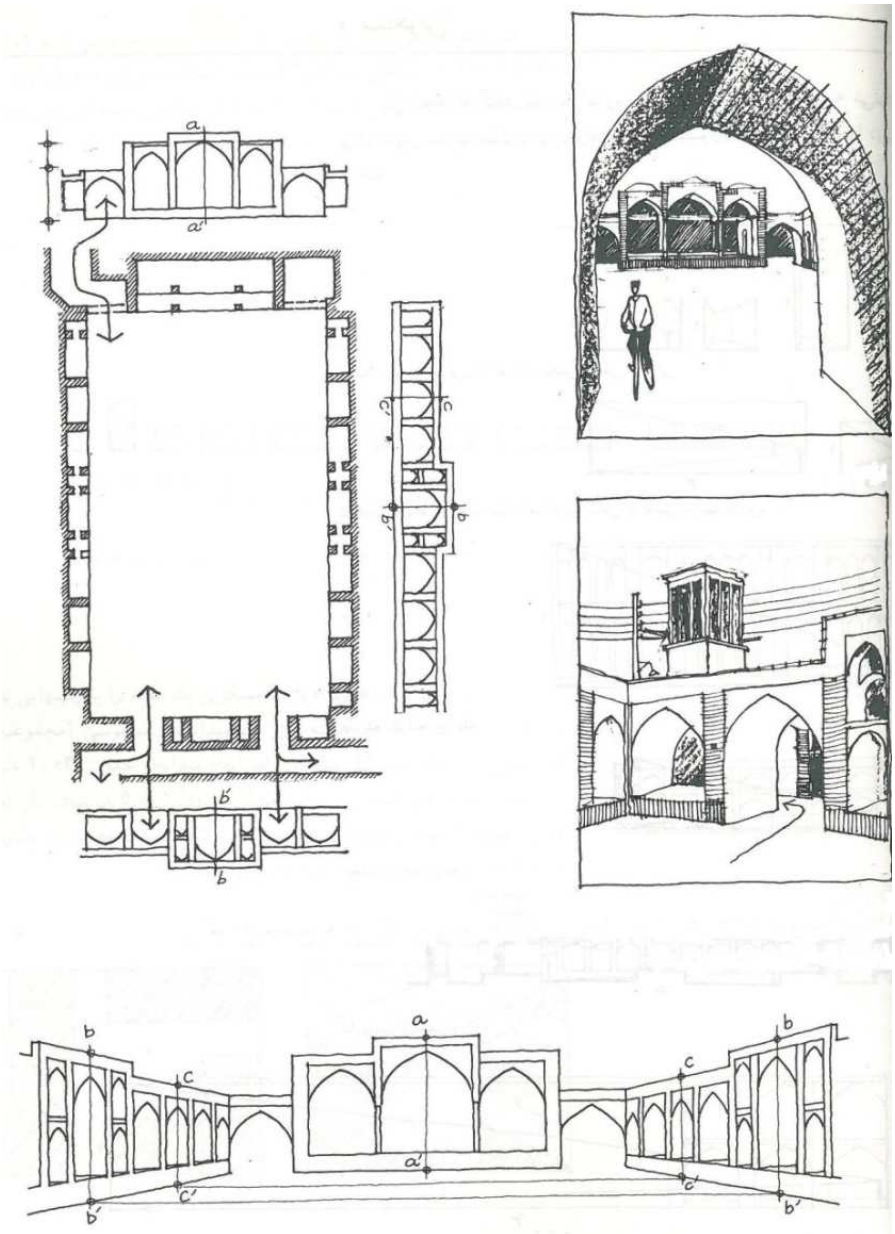


Figure 11: Centrality in urban design of desert cities of Iran

Neighborhood

Pacione (Pacione, 2005) defines neighborhood like "*an urban district in a strict sense defined as one in which there is an identifiable subculture to which the majority of residents conform*". Also, Schuck et al. (Schuck, 2006) emphasize which a neighborhood is a spatially defined exact geographic region and also a functionally defined place of social communication. They are understood to be the spatial unit in that direct social connections happen; the individual properties and condition

someplace residents look for to recognize regular maintain, socialize, and values successful social control. The original idea of neighborhood goes back to Ebenezer Howard and Raymond Unwin near the beginning of twentieth century; from the Garden city movement for the concept of domestic structuring of the region around school catchments by housing enclaves give contact to the segregate walker system leading to some public places with no danger as of traffic (Barton, 2000). Base on Farr definition (Farr, 2008) "*it is necessary to reassert the definition of the term neighborhood; neighborhood cannot be referred to the disconnected and single use developments which represent sprawl, such as stand-alone apartment complexes, subdivision tracts, office parks, or shopping centers*".

On balance, perfect neighborhoods which meet all residents' necessities are more probable to be in a design which is generally various in conditions of user, use or form. Actually, a balanced combine of uses and services in a rich form of growth that integrate by natural surroundings, can be to hold different types of inhabitants together; so, various user in education, income level, gender etc. have the ability to complete their requirements during diverse services accessible there. Hence, the chance to get more than a diversity of experiences inside the neighborhood is accessible which will also get about valuable perceptual meaning for neighborhood. Although on the opposite, lack of variety in particular area of single use (figure 12), makes them not capable to appear during the diversity of experiences, so, the idea of meaning which has its roots in practical diversity and is highly needy on the variety of forms, requirements inside such areas remains quite lost (Bentley, 1985).

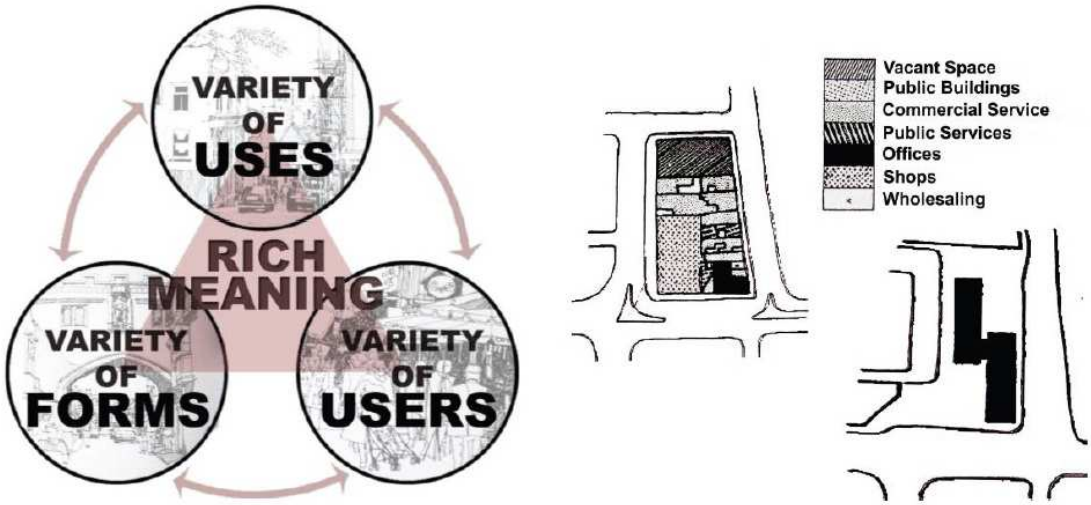


Figure 12: Diversity and main components of neighborhood (Oktay, 2012)

As it surveyed in previous definition, there are parameters (table 11), in shaping urban spaces that all of them has different effect in quality of urban spaces and also it should be mention that these factors have deep role to create special form of city in Iranian hot and dry climate.

Table 11: Evaluation of shaping urban spaces

Key Factors	Subset of Key Factors	References
Structure	Monuments symmetry, balanced connection, organic fabric, system of integrated quarters, historical continuity	(Sharifi Yazdi, Jabbari. H, 2012), (Mirmoghtadaee, 2009)
Landmark	Forms and Symbolic Elements, Color and Sings, Volume and Spaces, Style and Monuments, Materials	(ROGER, 2009), (CADUFF, 2008), (Shahraki, 2011)
Privacy and Enclosure	In different levels, by separation of Spaces, Centrality of the Quarters, Spatial relation	(Abouei, 2006), (Tavasoli, 1990)
Neighborhood	Residents Conform, Social network, Face to Face social interaction, Divers users	(Farr, 2008), (Schuck, 2006), (Oktay, 2012)

2.4.2 Social Sustainability and Architecture

Social sustainability has always been said to be a key aspect of sustainable development, alongside with environmental and economic factors (Colantonio, 2009). The benefits of social sustainability in design are concerned with the level of progress in the quality of life and well being. This is achieved at different levels – from building to community and then to the society at large. The building envelop should mainly be focused on comfort, well-being and satisfaction. Though all of these are closely knitted together they employ different methods (Stephen, 2004). Basic amenities afford support services for the people and the infrastructures allow connectivity in a neighborhood or a city.

The basic facilities supplied to enhance service for the people while the infrastructures helps improves for easy connection and accessibility within a city. In order to ascertain a socially sustainable community, it is quintessential to make provision for the establishment of basic amenities and this should be done at the beginning stage of the planning and design process. Furthermore, by making access to basic amenities and providing the necessary structural amenities this create visit ability; this is said to be the ability to create an environment that allows for interaction, easy movement, and integration within the environment (Jani, 2003). The provision of infrastructures like proper accesses, transportation systems and pedestrian walkways allows for easy connectivity within the community. According to Dempsey, in his article "The social dimension of sustainable development: defining urban social sustainability" described three basic ways to enable walk ability, they are (Dempsey, 2011):

- *"Pedestrian network is interconnected and accessible to all amenities and services"*

- *"Apply Universal Design or barrier-free design"*
- *"Destination and amenities are within walking distance"*

Thos is a process of examining the issues associated with defining social sustainability so as to create a frame work for general use in a wide organization. However, much of this section problematical the task of arriving at a single useful definition and instead suggests that a range of approaches should be adopted. Generally, there has been a strong focus on defining sustainability as a condition, and measuring it with a series of indicators. This intention is not to criticize such frameworks, but rather to investigate their potential while also suggesting other possibilities (McKenzie, 2004).

This section explains social development of people living in a community by the use of the component of social sustainability framework by Hackett, (figure 13), as the means for a livable environment which promotes social interaction and participation. The four components of social sustainability framework namely; amenities and social infrastructures, social and cultural life, voice and influence, space to grow, are elaborated upon in connection to global design as to present the idea of social development through an enabling environment (Hackett, 2011).

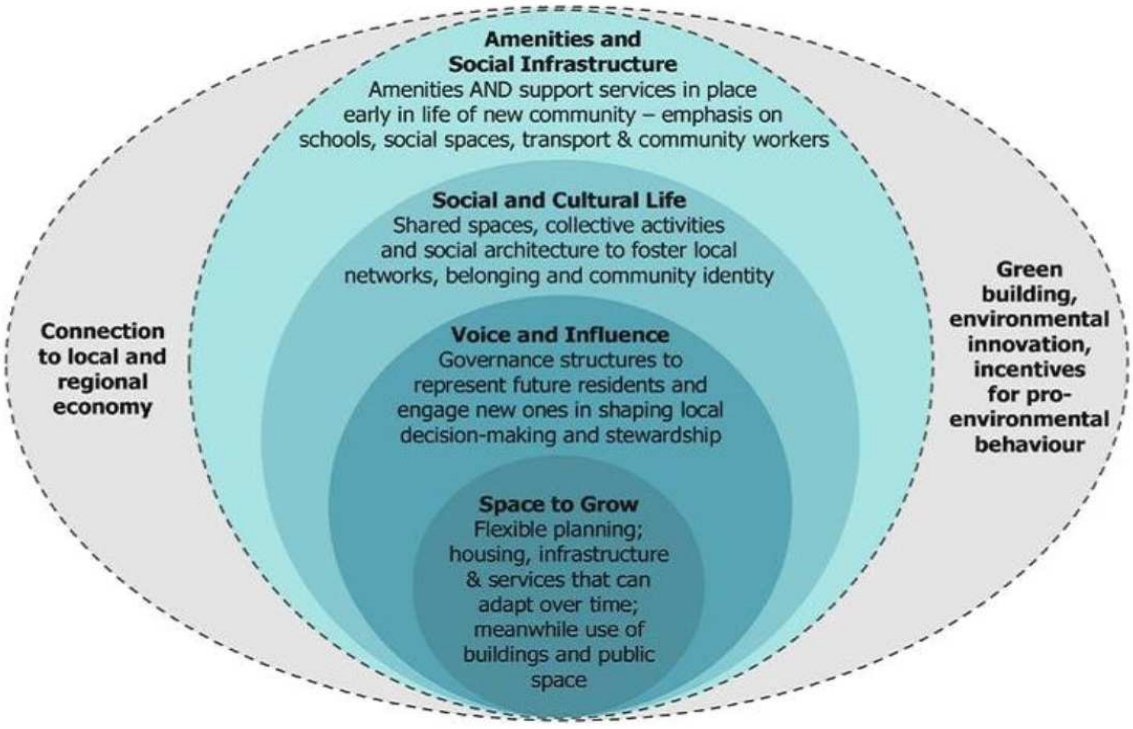


Figure 13: Design frame work of social sustainability (Hackett, 2011)

With regards to the built environment, social sustainability is Identified as a means of creating a green space that promotes the wellbeing of peoples by an understanding the desires of the people living in the area (Choguill, 2008). Social sustainability further combines the physical realm with design of the social world to enhance both cultural and social life, social amenities, and systems for support people's participation and evolution (Dave, 2011). As home is where people grow and develop their values as well as build up a family. Studies have been carried out as to create a list of criteria to enable scholars evaluate the level of social sustainability of a community.

According to research, the basic themes of social sustainability such as poverty mitigation and employment rate are being cumulated and slowly substituted by the more subjective themes such as sense of place, social participation and happiness.

This study compares the traditional and emerging key themes of social sustainability as in table 12, (Kadir, 2013).

Table 12: Social sustainability key factors (Kadir, 2013)

Traditional	Emerging
Basic needs, including housing and environmental health	Demographic change (aging, migration and mobility)
Education and skills	Social mixing and cohesion
Employment	Identity, sense of place and culture
Equity	Empowerment, participation and access
Human rights and gender	Health and Safety
Poverty	Social capital
Social justice	Well being, Happiness and Quality of Life

The features below are indicative of the conditions, and a path way towards establishing them as a key part of the process (Oliver, 2003):

- *"Equity of access to key services (including health, education, transport, housing and recreation)"*
- *"Equity between generations, meaning that future generations will not be disadvantaged by the activities of the current generation"*
- *"A system of cultural relations in which the positive aspects of disparate cultures are valued and protected, and in which cultural integration is supported and promoted when it is desired by individuals and groups"*

Reporting Guidelines outline of a voluntary framework for annual sustainability given by the Global Reporting Initiative's Sustainability state that it can be applied to

different kinds of organizations. The report also provides stable grounds for reporting on various organization strategy, management techniques and performance indicators. This framework has been built up through international stakeholder consultation with professional from all ramifications as well as a wide range of stakeholder groups, (MAK, 2011).

Table 13: Global reporting initiative's sustainability framework for social performance indicators (MAK, 2011)

Labor Practices and Decent Work	Employment Labor/Management Relations Occupational Health and Safety Training and Education Diversity and Equal Opportunity
Human Rights	Investment and Procurement Practice Non-discrimination Freedom of Association and Collective Bargaining Child Labor Forced and Compulsory Labor Security Practices Indigenous Rights
Society	Community Corruption Public Policy Anti-competitive Behavior Compliance
Product Responsibility	Customer Health and Safety Product and Services Labeling Marketing Communications Customer Privacy Compliance

Table 14: Social sustainability factors

Title	Keywords	References
Human Rights	Freedom of association and collective bargaining, Health and Safety, social benefits and consumer privacy, Social service, Human scale development, Satisfaction with the neighborhood, Pride and Sense of the place	(Barr, 2003), (Barron, 2002), (Bramley, 2009)
Society	Social homogeneity, Public commitments to sustainability issues, Contribution to economic development, Citizen participation, Feeling of belonging, Education and Cultural heritage, Attractive public realm	(Weingaertner, 2011), (Dave, 2011), (Barr, 2003)
Local Community	Social and Capital network, Social cohesion and inclusion, Housing and Community, Connectivity and movement, Social interaction adaptability	(Hackett, 2011), (Bramley, 2009), (Dave, 2011)

2.5 Sustainability and Vernacular Architecture

The Latin word “VERNACULUS” means native. Architecture is vernacular when it exhibits all of its criteria related to the ‘native context’ in the sense that it can only be acceptable and recognizable within any particular society by applying some particular technology, materials, social rules and systems (Rapoport, 1990).

When people within a locality construct their dwelling using local materials and traditional methods of construction this is Vernacular architecture (Singh M. , 2009). The design and construction of vernacular buildings is a product of ideas gained overtime through trial and error approach. This kind of architecture tends to proffer solutions to the climatic challenges and gives the highest possible level of adaptability and flexibility. These attributes make the architecture unique, hence creates an identity for that community that is tied to their culture (Plemenka, 1982). By a step by step process they are able to adjust their architecture to the micro climate to achieve human thermal comfort conditions through bioclimatic integration (Gaitani, 2007). The outcome of several research have proven that bioclimatic are an integral part of vernacular buildings (Ancell, 2008).

Desert vernacular architecture has a unique natural identity and character that has evolved from the amalgamation of influences such as natural desert topography, climate, and geography, along with cumulative cultural, social, religious and historical factors (Correa, 2009). All of these factors contribute significantly to how they live and also add to the uniqueness of their building forms and patterns. The harmony buildings have with nature when natural resources and local materials are use in construction is awesome (Dabaieh, 2011). The custodians and historians of architecture classified architecture basically by how monumental and prestigious the buildings were. These buildings were actually built for the top class members of the society, or for other purposes such as ports, religious buildings, palaces, mausoleums and government buildings. Besides, these structures where actually well planned and systematically designed be the architects and designers of those times (Islam, 2003).

There are lots of definitions given by various architects and theorists, which apply to the modern or classical buildings. The homes of the common people of every society were mostly ignored or not considered as an example of architecture (Oliver, 1997). By analyzing the words ‘architect’ and ‘architecture’ will help to a good comprehension of the characteristics and the standpoints of these houses within the domain of architecture.

The researchers of vernacular architecture tried to elaborate the idea of vernacular in different ways. Some tried to give a specific definition so that vernacular architecture can be distinguished from the other types of architecture. There are also some definitions, which are basically elaborating the features of vernacular architecture. Some of these conventional definitions of vernacular architecture are mentioned in the following texts:

"Vernacular architecture comprises the dwellings and all other buildings of the people. Related to their environmental contexts and available resources, they are customarily owner or community-built, utilizing traditional technologies. All forms of vernacular architecture are built to meet specific needs, accommodating values, economics and ways of living of the cultures that produces them" (Oliver P. , 2003).

"Vernacular architecture is a practical activity pursing environmental adequacy rather than knowledge; it is a way of acting within the conditions of existence, fulfilling certain environmental needs for a particular group of peoples" (Turan M. , 1990).

Most of these definitions can be mentioned as the descriptions of the essential features or purposes of vernacular architecture. With the help of these descriptions and in combination of the essential features a definition of vernacular architecture can be written as *"Vernacular architecture refers to the built forms that are built of local materials using available technology in a functional way that devised to meet the needs of common people in their time and place"* (Richardson, 2001).

Rapoport says in his book (1990)," *House form and culture*" that it is difficult to satisfactorily define vernacular architecture and that at the moment it is the best way to sufficiently describe it is in terms of process, that is how it is built (Rapoport, 1990).

In defining characteristics of vernacular architecture, the assessment is usually done by determining its character as either more or less vernacular. . Therefore, a working definition will be that one, which can compare one environment with others to see

whether it is more or less ‘vernacular’ and not only dealing with the ideal types (figure 14).

Figure 14: Idea of Rapoport about evaluation of vernacular architecture (Rapoport, 1990)

Furthermore, the tradition of vernacular architecture might seem to differ from region to region and place to place, infarct it may change with time within the same region as the surrounding environment changes. Like in the west and in Europe, vernacular architecture is associated with the industrial movement at the time and sometimes mentioned by pre-industrial or post-industrial vernacular architecture. While in Asia, it is described in general terms rather than relate with pre or post industrial movements (Denel, 1990).

Vernacular architecture is not static, it is subject to change with regards to time and place *“It is a practical characteristic of vernacular architecture that each tradition is intimately related to social and economic imperatives; it has developed to meet specific needs within each cultural milieu”* (Oliver P. , 2003). Techniques or typologies may similar from region to region but they are sustained by their different unique ways of survival. There is no particular set of vernacular architecture but sometime different special terms are used with vernacular architecture to explain their respective characteristics and settings. Sometimes vernacular architecture is described with ‘rural’ and ‘urban’ terms in explaining rural and urban settings respectively when place is considered as a major guiding factor for the distinction.

Burnskill in his book, "*Illustrated Handbook of Vernacular Architecture*" in 1988 classified vernacular architecture based on their use types such as (Burnskill, 1998):

- **Domestic Vernacular Architecture:** it encompassing the structural design for living as basically seen as eating, sitting, sleeping, storage, etc and also ancillary buildings like the brew house, bake house, kitchen, sculleries, wash houses etc. generally it includes all the buildings where the domestic activities are predominated over the commercials.
- **Agriculture Vernacular Architecture:** It comprises all the erected structures of the farmstead without the farmhouse and its domestic ancillaries. The barn, the cow-house, stable, granary, cart shed, etc would be the examples of agricultural architecture.
- **Industrial Vernacular Architecture:** this are generally seen buildings, which housed the industrial activities related to country sides- wind and water mills, corn and limekilns, smithies and potteries etc. This industrial vernacular architecture also includes the buildings where some of the manufacturing activities have to do more with domestic than commercial such as, a workshop attached to a dwelling or incorporated within it.

Burnskill (1988) in this category attempts to separate the agricultural and industrial activities that are inter-related to dwellings and mentions them as different types of vernacular architecture.

2.5.1 Bioclimatic and Vernacular Architecture

The term Bioclimatic architecture is said to be an architectural ideology where the building envelope is systematically integrated into the environment. It further involves an implementation in the following into the designing and construction of

dwellings: climate, conditions of the location, tradition, materials, context, resources, and capacity (Khan, 1999). This architecture is very sensitive to environmental context. Besides, bioclimatic architecture can be further defined as a general programming, designing and planning architecture approach to comprehend urban and architectural pieces as integral organisms of multiple correlations to its environment, based on scientific research of natural and developed characteristics of every concrete place and its influence on man and his activity (Norton, 1999).

The term vernacular architecture has various meanings. Though generally, it means a style of construction in which traditional methods local materials are put into use Torgal Pacheco (2012) calls it: "*architecture without an architect or architecture without pedigree"* (Pacheco, 2012). With regards to the original name, depending on the situation he uses terms like: vernacular, anonymous, spontaneous, indigenous and rural. Thus it is anonymous architecture-architecture where the architect is unnamed and it sprang up from culture and tradition of specific community (Dumreicher, 2008). According to Norton (1999) he strongly emphasizes the notion that bioclimatic architecture comparing to natural environment to integrate it into its flow and rhythm as well as observing the principles of architecture (Norton, 1999). The vernacular architecture of the selected Areas have been confirmed here as a reasonable decision for polygon's research. The various researches and numerous assessments agree with the fact that vernacular architecture follows certain principles of bioclimatic architecture. Therefore, as a result of this in this study we can come to a conclusion that vernacular architecture can also be defined as bioclimatic architecture (Gaitani, 2007).

The necessity of the context as a beginning part of bioclimatic architecture can be seen in the examples of vernacular architecture. The objects of vernacular architecture are strictly conditioned to their origination context (both natural and man-made: the sociological, cultural, etc.). Acknowledging that there the context in which they are found in is an important part. The term context means a combination of situations where concrete object exist including social and natural environment. Beginning from theoretic attitude of Kami Heath (2009), concrete area is as a result of interactions of natural and social factors that affects it (Heath, 2009). Different meanings that stand for this idea are many. The aspect of dialectical materialism enquires into the connection that exists between man and nature, insisting on the concept that you cannot separate man from nature. This definition sufficiently describes the concept of livelihood as a synthesis of natural and social factors. In relation to that, the different components that make up context can be broken into two. Firstly, the natural conditions of the environment which consist of climate, soil, topography, vegetation and water surface, while the second is concerned with the developed conditions of the environment this includes street, grid, parcel and urban structures.

Outstanding context interpreted in this manner can be clearly seen with oliver (2003) "*theory of tradition of the place"*, where he considered the metaphysical aspects as a place of genius loci *"The spirit of the place is an expression of traditional folk spirit, actually it is the result of everything that has been stored throughout time and sublimed through its authentic expression"* (Oliver P. , 2003).

Context can be defined as the expression of natural behavior of the environment and in the way it is. By effectively combine to a fingerprint. There are similar situations

but are different (Pacheco, 2012). That gives a distinct individuality to each context, which if it is given its place with eventually produce architecture of outstanding regional identity. Architects of the traditional architecture over time have produced peculiar architectural pieces that attest vividly to that logic.

2.5.2 Climate

It is popularly known in architecture that the climate is basically one more of the various forces (whether social-cultural, economic, defensive or religious, or involving the availability of materials, technical and constructive resources, etc.) that creates the architectural form. Climate plays the central role in the solution used basically if the condition technology is low. The more harsh the climate, the more inflexible the solutions employed (Jovanovic, 2012). Based on the facts derived from this principle, people should device a distinct solution, and employ the most efficient economical and useful ones. Nevertheless, in reality it might not be achieved in this way, in a particular zone, and with a given climatic condition; people usually find various way of resolving the same climatic challenges employing different approaches (Islam, 2003).

In hot and dry climatic regions, the approach is such that the great temperature differences is taken advantage of during the day-night cycle, this is done by preventing the heat of the day from directly penetrating to the interior so as to reserve it till night when it would be needed to heat up the interior space. To achieve this materials with great thermal inertia are used such as clay in the form of adobe bricks or mud walls thick stone and all the possible combinations. Building around regions like these are constructed close to each other such that a little separation in the form of alley or courtyards (Dabaieh, 2011). Thus the exposed surfaces to direct solar radiations are minimizes significantly reduced and the built weight per unit of

volume occupied is increased which increases the thermal inertia. The shade created between buildings minimizes the heating of their facades by solar radiation and also helps them to be cooled by the night's cool air (Sharifi, 2013). Furthermore in such buildings with great thermal inertia the windows and doors should be handled in such a way that during the day they should be tightly locked to prevent light and hot air from entering in and widely opened at night to take in cooling effect of natural ventilation (Newport, 2005).

2.5.3 Construction

Systems of construction used for building can basically be categorized into two: massive and lightweight. It is generally observed that most traditional buildings that are massive in nature mostly use lightweight roofs, most frequently thatch roofs (Zhai, 2010). As the climatic condition becomes hotter and more humid, lightweight building structure and construction materials gets more prevalent, (figure 15-16).

Climate zone	Number of vernacular regions
Continental subarctic (CS)	10
Tundra ice cap (TIC)	6
Desert (D)	13
High altitude (HA)	11
Humid mid latitude (HML)	8
Mediterranean (M)	11
Semi desert (SD)	15
Tropical Savanna (TS)	13
West coast marine (WCM)	9
Wet equatorial (WE)	11
Humid subtropical (HS)	7
Total	**114**

Figure 15: Number of vernacular regions per climate zone (Zhai, 2010)

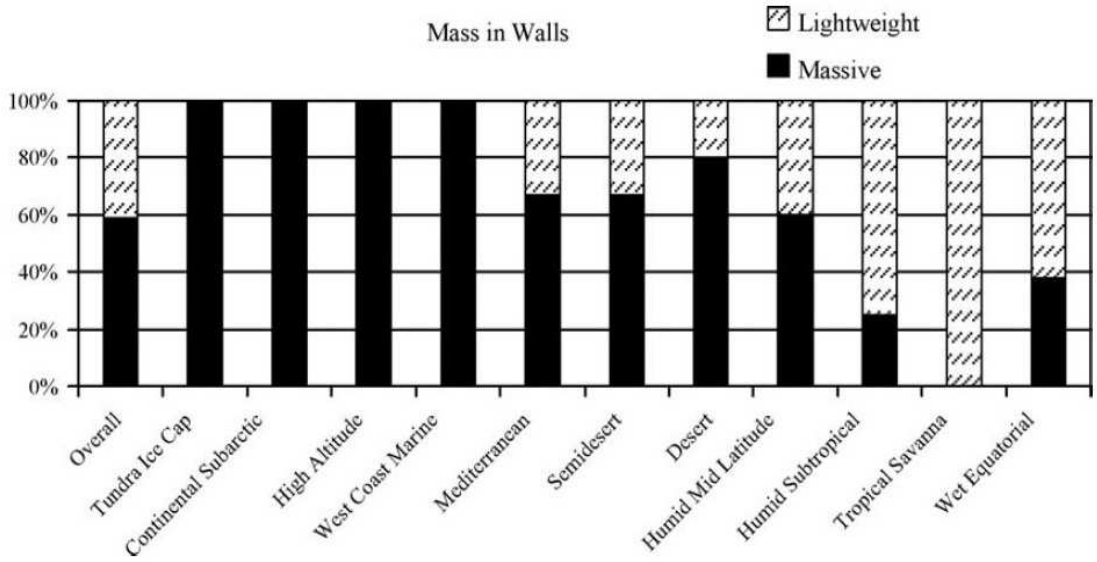


Figure 16: Wall mass types in percentage of dwellings in individual climatic Regions (Zhai, 2010)

Due to the ability they possess to both store and reradiate heat, as well as minimize infiltration by properly developing a tight and massive structure, these were the most common structures mostly seen in cold climate. This same type of massive buildings were not only found in the cold climate but also in desert climates with extreme dermal temperature variations when the proper thick the massive structure would absorb and reserve the extreme heat temperature of the day for use at night when the weather is cold. Massive dwellings structure in desert climates will often have loose infiltration to maximize the dry winds (Alex, 2001).

Materials used for roofing in vernacular architecture include tile, thatch, skin, bark, stone, felt, wood and turf (Figure 17). To further buttress its value in vernacular building tradition, the use of thatch showed up more as roofing material , but wood timber covered with turf were mostly used in tundra and sub-arctic regions. Thatch has a good insulation quality, yet it’s still a wonder why it’s not commonly used in very cold regions (Alexander, 2004).

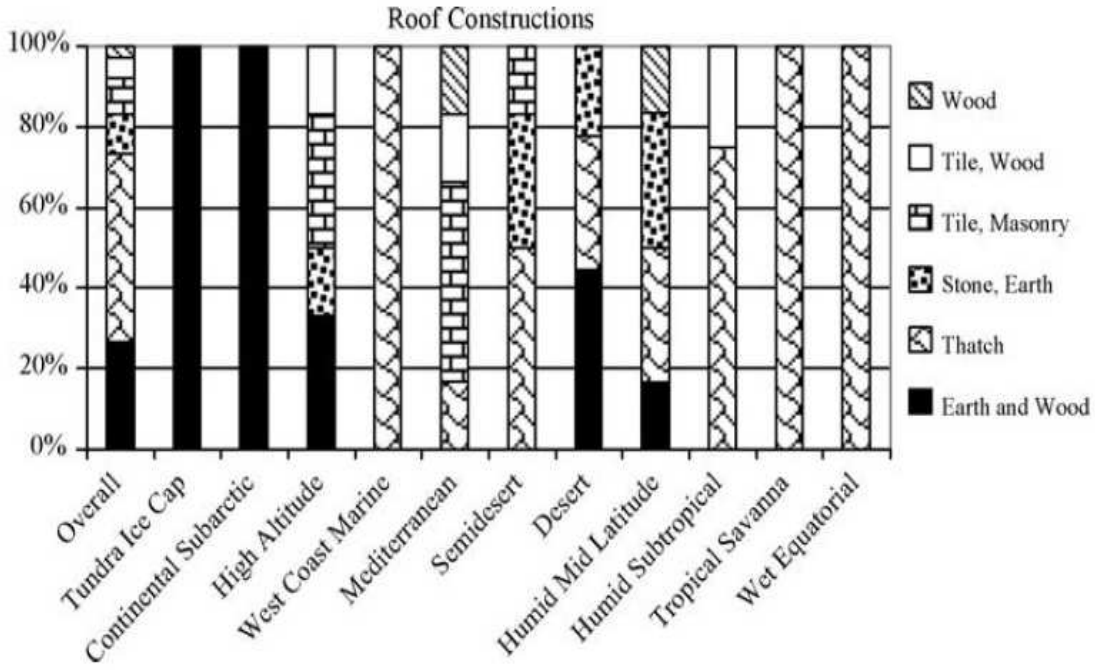


Figure 17: Observed roof material types in percentage of dwellings in individual climatic regions (Zhai, 2010)

Table 15: Vernacular architecture factors

Title	Keywords	References
Bioclimatic	Social and Natural Environment, Integration into flow and rhythm, Manmade and nature, Natural condition (climate, soil, topography, vegetation, water surface), Developed condition (urban structure, street grid, parcel)	(Khan, 1999), (Norton, 1999), (Pacheco, 2012)
Climate	Direction, Identification, Context, Location, Original use of building, Use and Ownership	(Turan, 1999), (Oliver, 2003), (Fernandes, 2014)
Construction	Material, Roof configuration, Architectural details, Material, Form of building, Walls and Structure	(Chase, 1986), (Dabaieh, 2011)

2.5.4 Roofed Alley as Sustainable Vernacular Structure

The sustainability of desert vernacular is about managing the balance between preservation and use. Dwellers of desert vernacular were aware of use of local materials which means they had ability to inspire the forms by the nature. The possibility of re-using the indigenous material is another aspect of sustainable desert

vernacular. From an economical point of view, such local materials are almost cost-free. Additionally the cost of construction was almost zero because people built their own dwellings (Dabaieh, 2011).Apart from these features, because of using the local natural resources for building materials, inherently harmony and homogeneity between buildings and nature were created (figure 18).As the famous Egyptian architect Hassan Fathy used to say, a building dwells in the land to which it belongs (Ultav,Zeynep. Sahl, Sare, 2004).

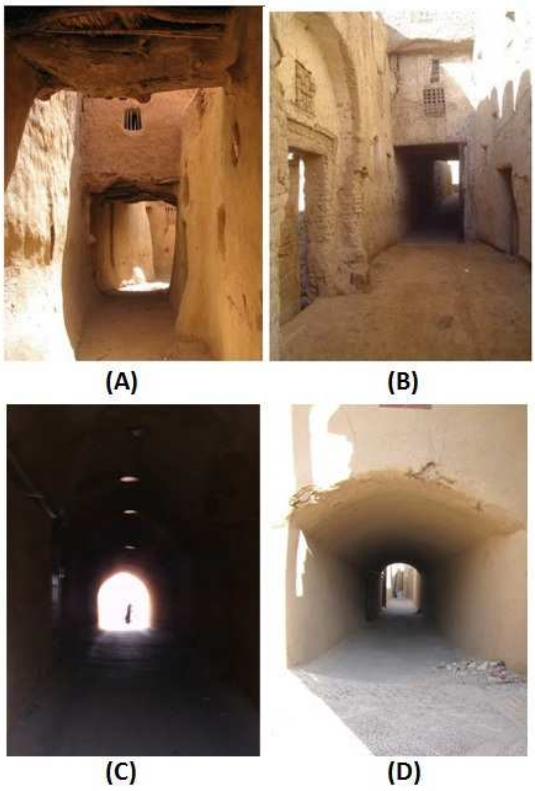


Figure 18: Usage of vernacular architecture in desert cities, (A-B) in Egypt, (C-D) in Iran

Desert vernacular in the oases has a unique identity and character which is the combination of natural desert topography, climate, and geography, along with accumulation of cultural, social, religious and historical factors (Correa, 2009). All

these criteria effect on their way of life and create particular distinction in the building patterns and forms as well.

Dwellers for overcoming the negative impacts of the harsh desert climate created suitable forms for their buildings and used in digamous material. The forms were developed by experimentation through the age. Based on Givoni's studies of thermal control in desert buildings (Givoni, 1994), he observed that vernacular dwellings in the in African desert areas were built to prevent heat gain, maximize heat loss and control removal of excess heat by using cooling air circulation. For example they utilized prevailing wind to minimize the effects of heat. They constructed their towns and villages with shaded and roofed alley, which protect pedestrians from direct sun and provide maximum shade for their buildings (figure 19) .These roofed alleys, also inbreed wind circulation and filtration of sand particles especially during sandstorm.

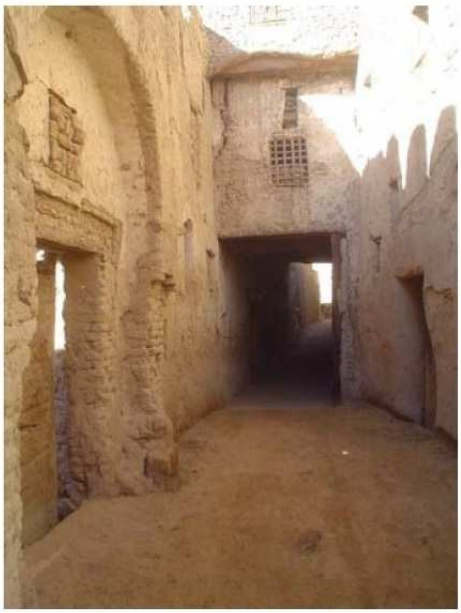


Figure 19: Roofed alley in urban texture of Egypt

Social formation in the oases is based on family and kin-oriented. Most families prefer to live in the same neighborhood as relative (Jencks, 1998). The social structure of desert societies and evidence of the community strength is shown in the organizing of space (figure 20). A strong architectural base has evolved to enrich the life of inhabitants through reflecting their socio-cultural structures and values.

Figure 20: Social communication in roofed alley of Yazd/Iran

The compact organization of space, with high density, narrow streets and small buildings, was a response to the society and climate (Hakim, 2000).In addition compact uses of urban space provide maximum shades and protection of walls from sun radiation and sandy winds (Kennedy, 2004). The compact organization also determines the distinction between public, semi-public, semi-private and private areas, which is established by varying the degree of accessibility and enclosure (figure 21-22).This urban layout was used in a way that even a tight city plan can be expanded. For example when there is a need for extra functional spaces for a family, a room or more can be built on top of existing ones often overlapping rooms of their

neighbors' roof. These extensions may be built over a part of a street (King, W. J. Harding, 2000).

Figure 21: Semi private area in Yazd/Iran

Figure 22: Semi private area in desert cities of Egypt

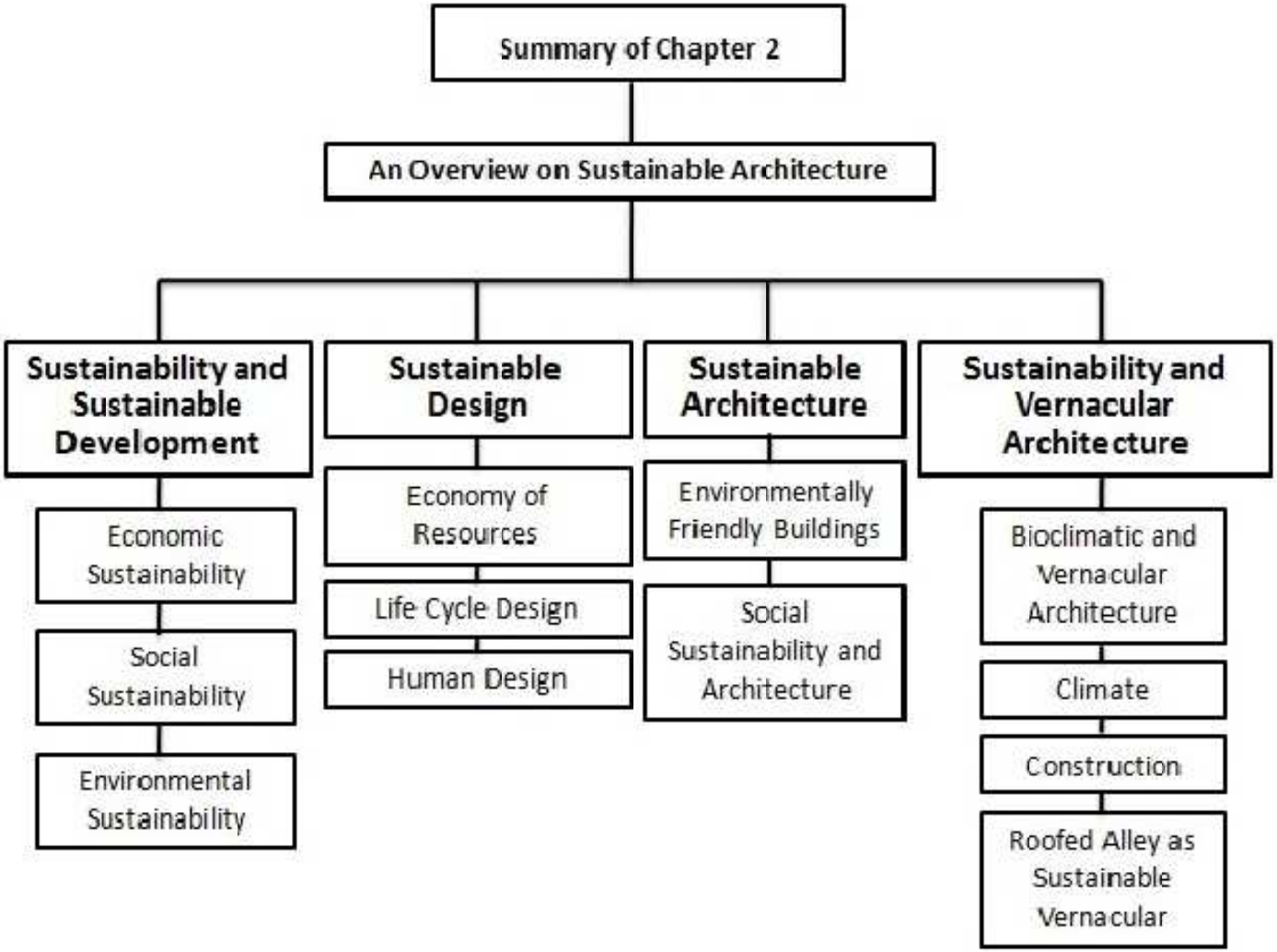


Figure 23: Summary of Chapter 2

Chapter 3

EVALUATION OF ROOFED ALLEY IN YAZD CITY OF IRAN AS CASE STUDY

3.1 Methodology for Case Study Evaluation

As mentioned in the previous chapter, roofed alley is one of the architectural solutions for vernacular architecture which can be useful in hot and dry climates by providing comfortable zones for environmental and social activities. Roofed alley has a vernacular specification based on sustainable architecture leaded by its environmental and social role. This chapter has focused on roofed alley in Yazd city of Iran, because of hot and dry climate in Yazd city where roofed alley can have high performance so to increase the quality of outdoor spaces in hot days. Roofed alleys in Yazd city can provide specific features for the city such as giving it an identity.

The methodology of evaluating roofed alleys in Yazd is based on some keywords which were discussed in the literature review of this study. As mentioned previously, there are studies about sustainable architecture, but the current thesis has focused on environmental and social sustainability of architecture. Hence, roofed alleys in Yazd are evaluated based on principles of environmental and social sustainable architecture. The methodology of evaluation of roofed alleys in Yazd is described in figure 24.

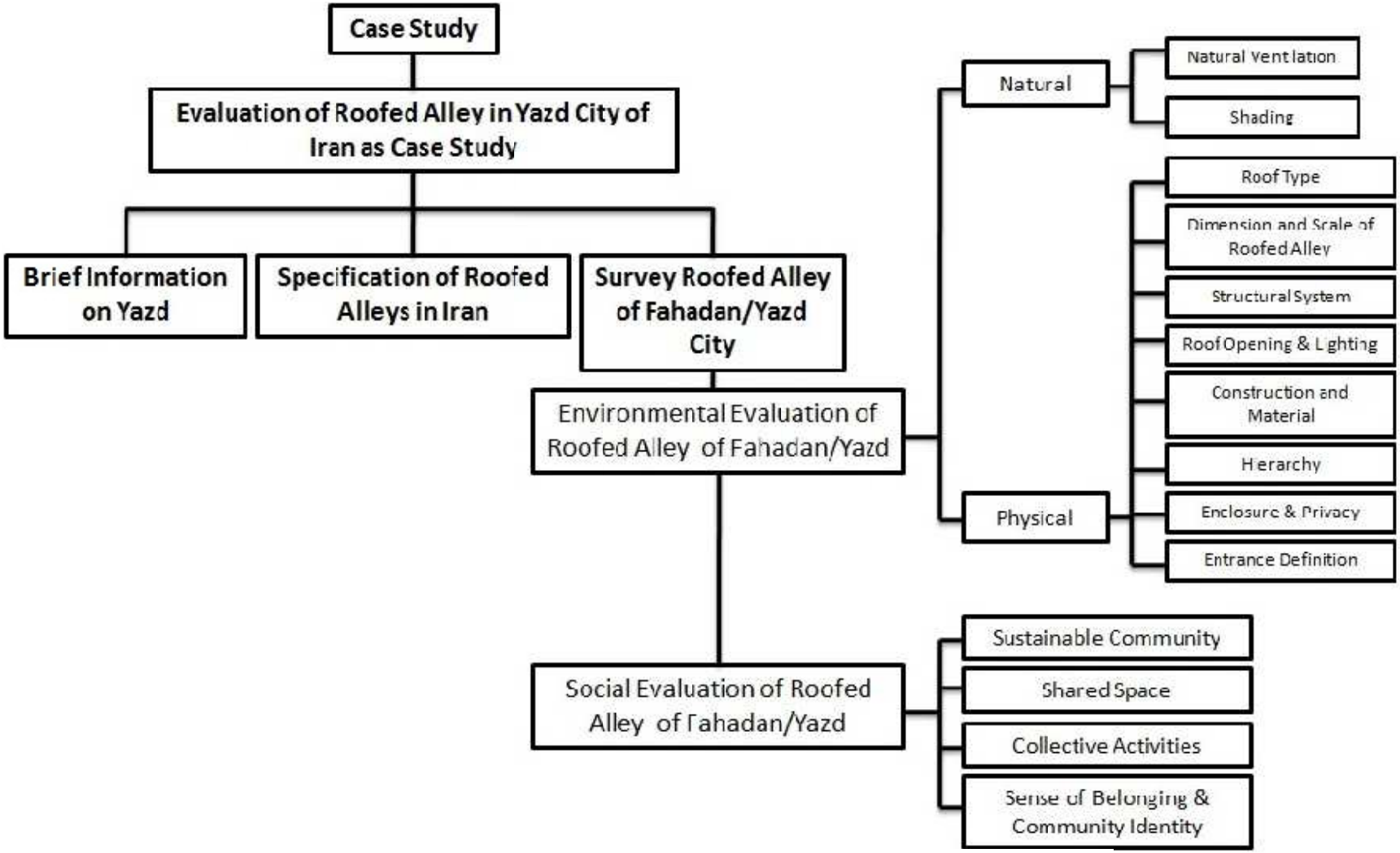


Figure 24: General view of the methodology to evaluation of case study

3.2 Brief Information on Yazd City

City of Yazd is an important example of Iranian urban history. With thousands of historical buildings and a large number of traditional structures, it contains the largest uninterrupted historical and sustainable urban fabric which is well adapted to regions with dry and hot climates (figure25-26).

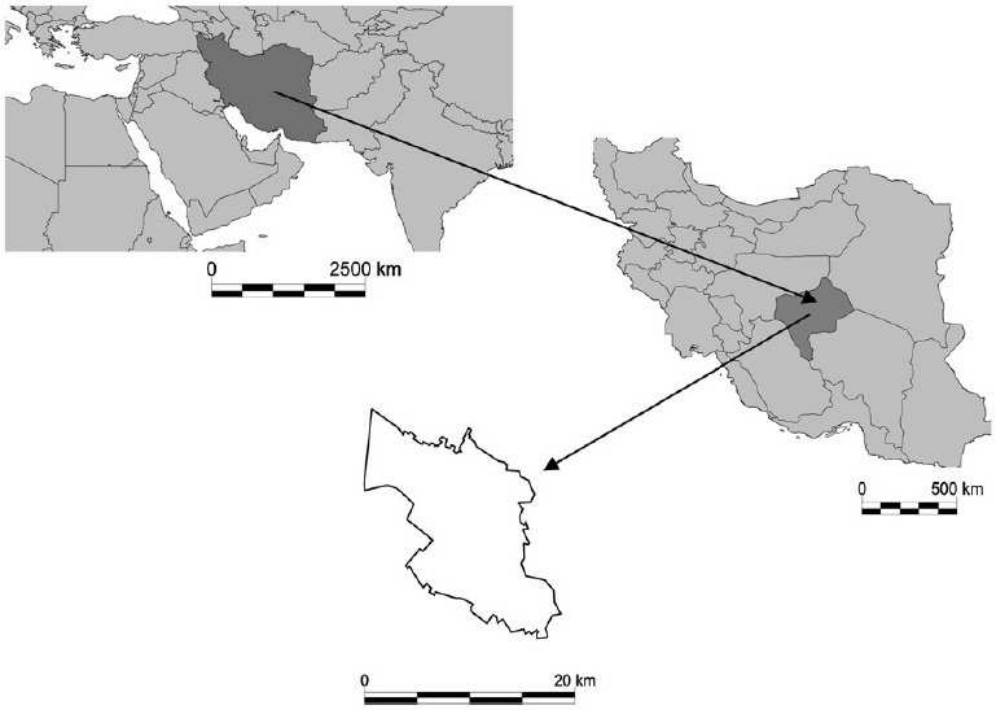


Figure 25: Geographical position of Yazd city in Iran, (Shahraki, 2011)

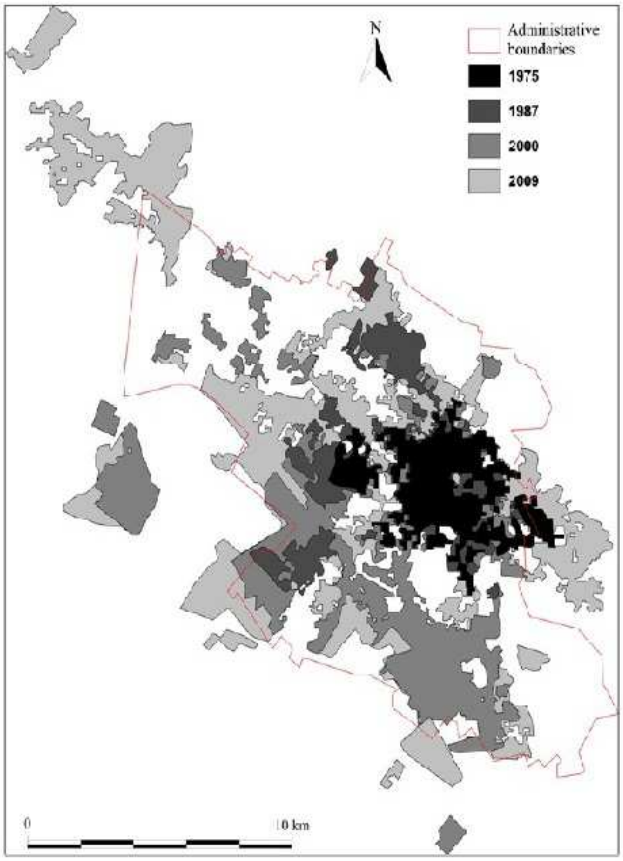


Figure 26: Plan of Yazd city development from 1975-2009, (Shahraki, 2011)

There are common structural and physical features in the layout of cities located mostly in desert areas. The complicated and interrelated factors that have shaped urban form in the desert regions are mostly affected by climatic characteristics.

The urban and architectural features in Yazd also expresses the particular life style which is an initial principle of architectural and urban planning, and to which adaptation has been taken place with the specific climate conditions in the relevant areas. The urban form of the traditional city of Yazd is highly centralized or inward looking. Certainly, the orientation and its relation to the environment were of high importance in the formation of city (figure27) (Forsat, 2004). It is clear that the particular climatic problems had leaded the people of the hot arid zone to find solutions through their especially settled architecture.

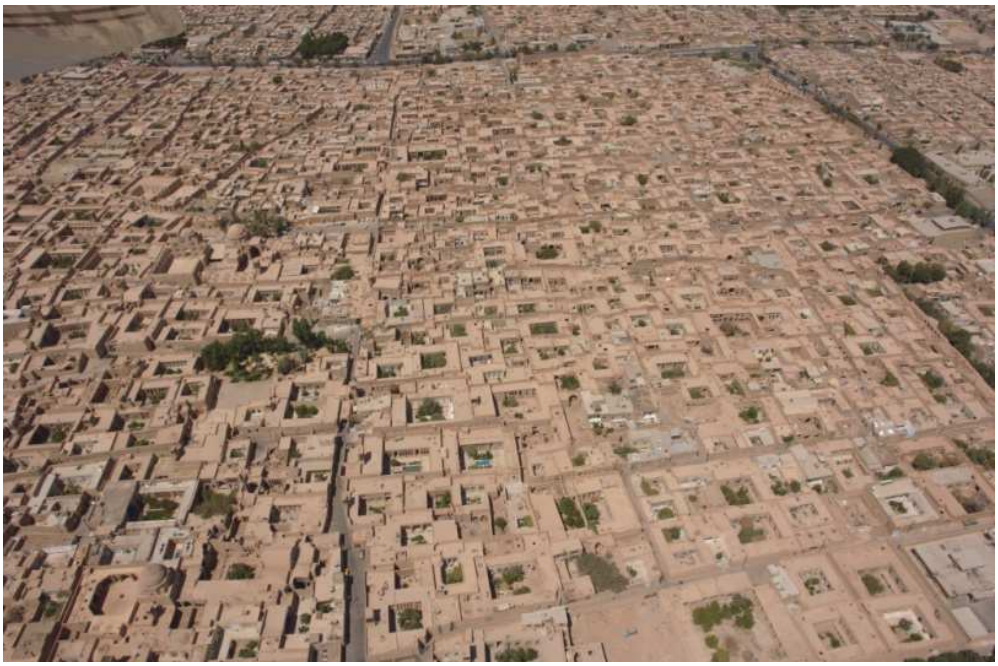


Figure 27: General view of historical parts of Yazd city

Sunrise, excessive heat, high daily temperatures and low night temperatures, hot summer and cold winter, and the arid weather are of the major problems of the people in Yazd province for which they have looked for effective solutions so to benefit the most from the rainfalls. Creating shady areas has been proposed as a solution for protection against heat and burning sunrise in summer (figure28). Moreover, connecting houses, realized as a dense mass, minimizes the exposure to direct sunlight (M. Mehdi Maeiyat, N. Movahed, 2009). Construction of the buildings in a dense and complex form provides maximum protection from the bad weather conditions and creates shadows on the houses and across the streets which can be one of architectural solutions in this region..

Figure 28: Roofed alleys in Fahadan area, Yazd/Iran

This city with the domes and vaults of mud and baked brick has been formed in different levels: street, court, balcony, and roof. Roof turns in to be a surface, as active as any other element on the ground (Figure28). The tenuous relationship of levels animates the fabric of the city just as the roofs cape animates the horizon with its domes, balustrades, wind towers, and steps. In this “compact city”, high-density urban structures of mixed land used are thought to promote walking and cycling as the main modes of movement for short destinations(Tavakoli, 2005). While on an urban scale, the street appears as if carved out of a mass, in reality, the wall defining it is a thin membrane at the building scale. As it is clear in Figure26, traditional urban texture of Yazd city has compact features which were caused by the harsh hot and dry climate of the city. Yazd city is located at the central part of Iran and is surrounded by deserts which affect its environmental conditions. This climatic situation has caused different types of vernacular architecture design to be created, putting further attention on the climatic and environmental situation to provide comfortable zones for humans. In Figure29, there are climate charts of Yazd city.

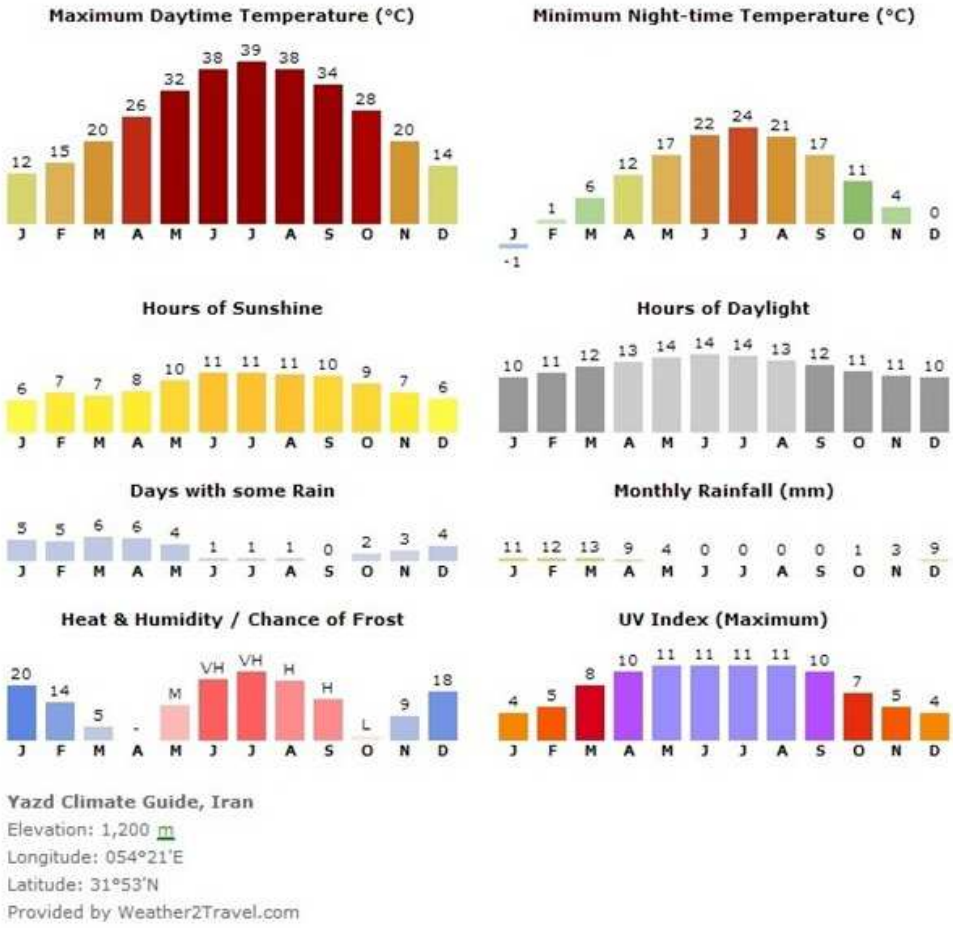


Figure 29: Climatic charts of Yazd city, Iran (www.Climateguide.com)

3.3 Specification of Roofed Alleys in Iran

Natural situations play determinant roles in the fabric of the cities in hot and arid climates (Dabaieh, 2011). The Iranian traditional city fabrics were compatible with climatic, geographical, cultural and other general traditional factors. Iranian cities are classified into four main groups; the cities located in hot-arid and cold areas of the country with connected fabric; the cities located in the moderate and humid climate of the north with disconnected urban fabric; and the ones in the hot-humid climate of the Persian Gulf with compact urban fabric. Although the basic criteria for the urban fabric are similar, each city has its own special characteristics in structure. In hot and humid climates, wind and shadow play important roles in adjusting summer heat. The buildings are separated from

each other as an important urban planning strategy to employ wind so to establish a micro-climate. The cities with continuous fabric are located on the coastal edges or in desert areas. These cities' physical structures demand surrounded and covered spaces to neutralize desert effects on the people's lives. To do so, houses are completely connected to each other and roads and alleys are narrowed and covered with roofs where only pedestrians and small vehicles can pass through (Forsat, 2004).

The roofed lane and porch passage called roofed alley, is one of the outstanding and important elements of urban planning in old areas of cities with hot-dry climates. A roofed alley is designed in order to protect human beings against direct radiation of sunlight by providing shadow for some periods of the day, especially in desert areas. Especially in the case of Iranian cities and towns, architects have constructed houses on lanes with one or more protruding rooms with the same eaves, under which the passage let the pedestrian to move. A Roofed alley can adjust a transient temperature in such a way that any pedestrian can benefit from the shadows somehow on his/her way to a destination. There are several connected entrances in most of the roofed alleys which are important in creating sense of neighborhood and local continuity (Shahraki, 2011) (Figure30).

Figure 30: Roofed alley in Fahadan area/Yazd city

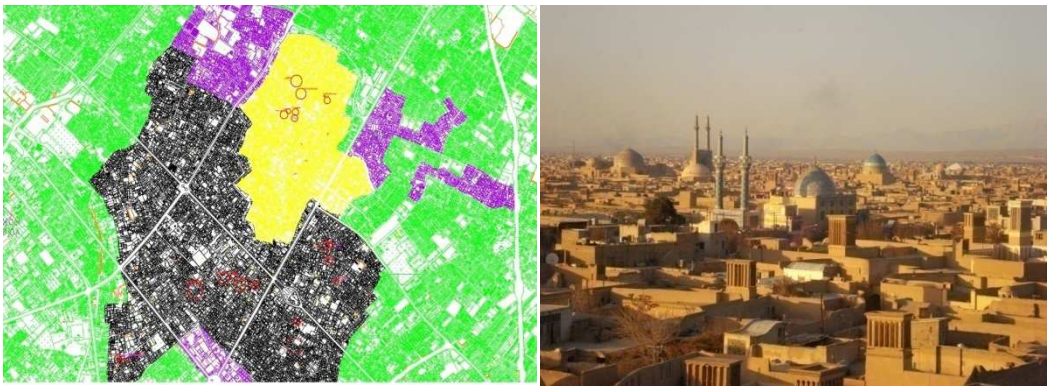
Roofed alley is one of the symbols of the traditional texture in south provinces of Iran which have hot and dry or hot and humid climates. One of the functions of a roofed alley is to make shade and cool places in a sense of a comfort zone for pedestrians. Because these places are semi-roofed and the temperature heterogeneity allows wind movement through, the temperature inside is cooler than the outside. It also helps in keeping the place warmer for pedestrians in winter times. Roofed alley is an ingenious creation which helps in stabilizing house structures against the forces arising by pressure (Ashraf, 1974).

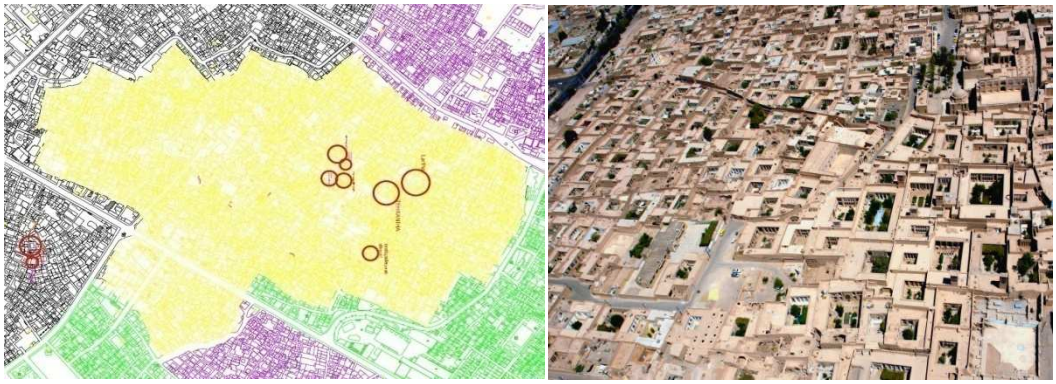
3.4 Survey on Roofed Alley of Fahadan /Yazd city

Fahadan area is the primary base of development in Yazd city and contains so many traditional architectural elements that roofed alley is only one of them. Fahadan is a historical area where its urban design has created the basis of sustainable design. Fahadan has a compact urban texture because of its locating in a hot and dry climate so to provide shade by walls.

As mentioned, Fahadan is one of ancient and historical areas of Yazd city, and based on this issue, this study has focused on roofed alleys in Fahadan. The current study has selected four different types of roofed alleys in this neighborhood to evaluate them based on three main parameters: social, environmental and physical which were mentioned in the previous chapter as a part of literature review. This study has selected one of the main streets of Fahadan area that has a central role. The reason behind the selection of these four types of roofed alleys is the popularity of their types. Most of the alleys and streets of Fahadan area have these types of roofed alleys because of the functional quality of roofed alleys as a vernacular architecture solution. There are some plans regarding the case study demonstrated in the followingTable16.

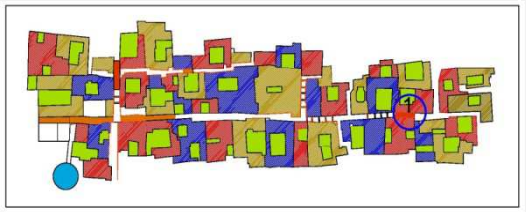
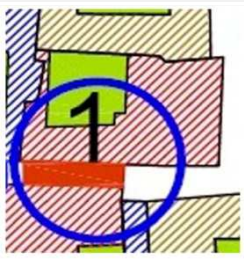
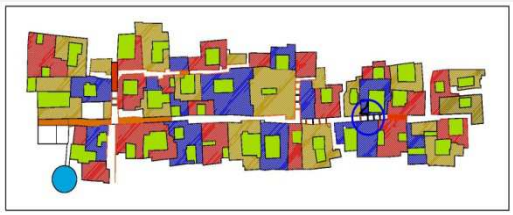
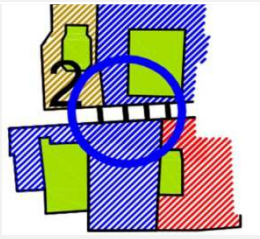
Table 16: General view of Yazd City and Fahadan Area

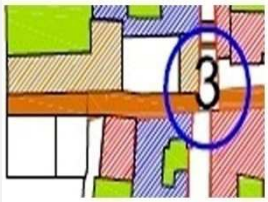
General View and Urban Plan of Yazd City

General View and Urban Plan of Fahadan Area in Yazd City



This study is focused on four main type of roofed alley in Fahadan area to evaluate the three main parameters (social, Environmental). These roofed alleys are in the same neighborhood which is working as passage network of neighborhood (table 17).

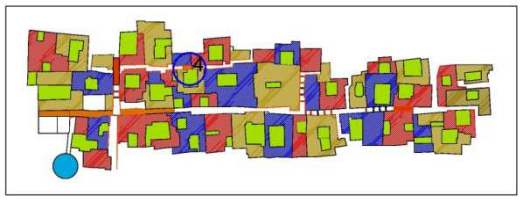
Table 17: Position Information of Four of Roofed Alleys as Case Studies in Fahadan Area

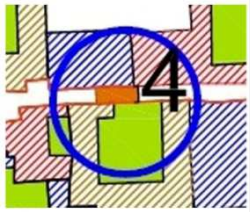
Case Study Number 1		
Position in Neighborhood	Photo	Plan
		
Case Study Number 2		
Position in Neighborhood	Photo	Plan
		
Case Study Number 3		
Position in Neighborhood	Photo	Plan



Case Study Number 4

Position in Neighborhood	Photo	Plan





The evaluation of roofed alleys in Fahada area of Yazd has three main parts such as physical, environmental and social. Base on these factors which each of them has own factors. Table 18 is following these main evaluation parts and their factors.

Table 18: Parameters and Subset of Roofed Alley Evaluation

Environmental	Physical	Dimension, Structure, Privacy and Enclosure, Land Mark, Hierarchy, Neighborhood, Roof Opening & Lighting, Construction & Material, Roof Types
	Natural	Natural Ventilation, Shady Area & Reduce Energy Gain
Social		Sustainable Community, Shared Space, Collective Activities, Belonging & Community Identity

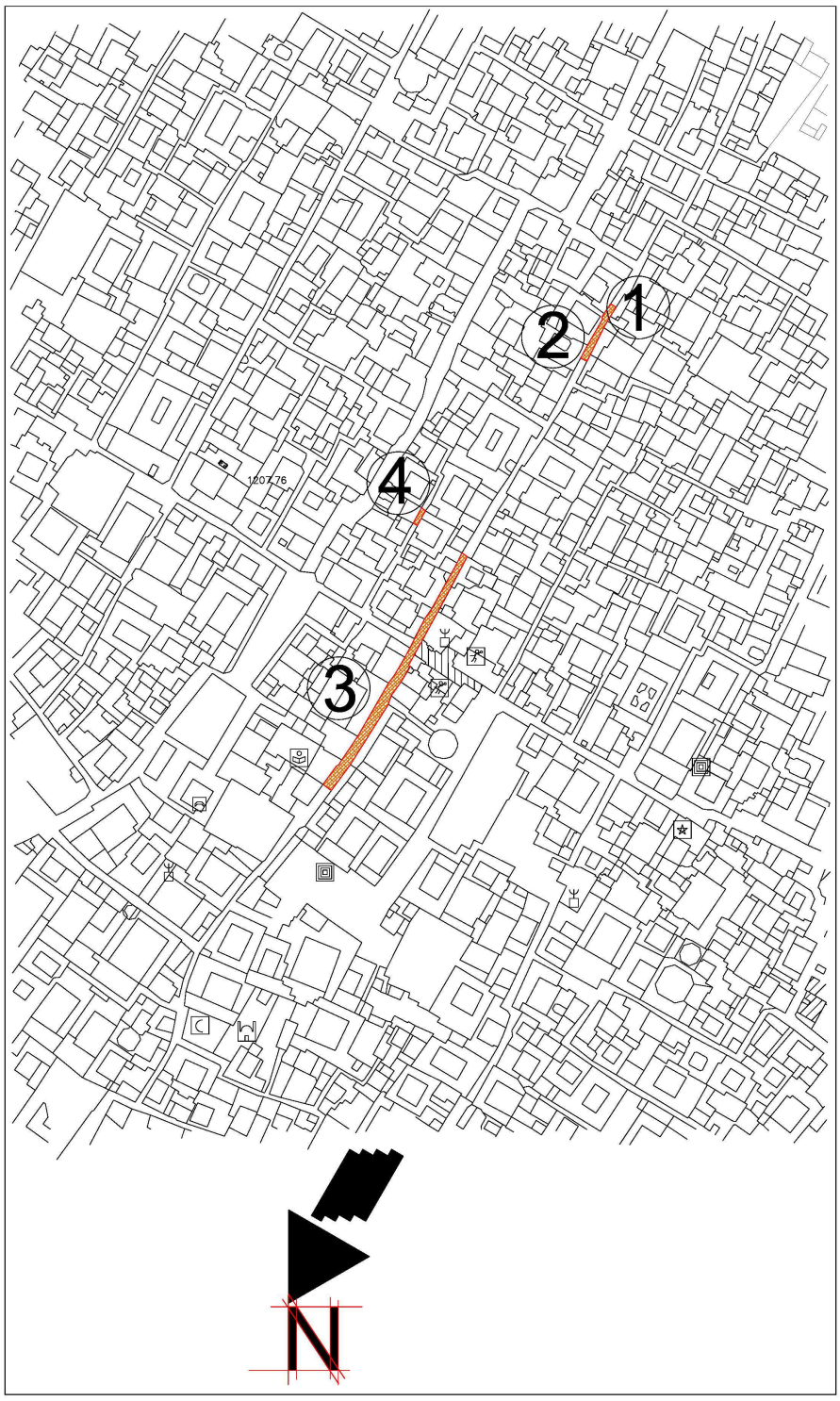


Figure 31: General view of case studies in Fahadan area of Yazd City

3.5.1 Evaluation of Environmental Sustainability of Roofed Alley of Fahadan

Roofed alley has an environmental aspect in desert cities, especially in Yazd city and Fahadan area. Roofed alley in this city has an important role in creating comfort zone for residents and visitors in hot days. Roofed alley, as an architectural solution, is providing an acceptable area in hot days for people where they can have daily communications. This role of roofed alley can be divided into two major groups. The first group can be described as the natural impacts of roofed alley on environment such as providing natural ventilation and shady areas for generating comfortable zones where natural conditions and systems have the main roles. The second group consists of some solutions made by roofed alleys which were created by their physical situation that is manmade. The effect of these parameters has a direct relation to quality of comfort zones created by roofed alleys, such as roof type, its dimension, structure, and etc. Based on this explanation, the environmental evaluation of roofed alley can be explained in two types: natural and physical.

3.5.1.1 Natural Factors of Environmental Evaluation of Roofed Alley

3.5.1.1.1 Natural Ventilation

As mentioned before, natural ventilation as an environmental parameter is important in providing a comfort zone. In case 3 and 4, the issue of natural ventilation has a more deep effect on creating comfort zones. There are four main issues when comparing cases 3 and 4 with 1 and 2. The volume of shade, length of roofed alley, height of passage and also roof opening are very important. As discussed in the previous part, roof opening can provide stack effect to increase the rate of natural circulation of indoor air.

In cases number 3 and 4, there are some roof openings which work based on the stack effect, but in case 1 and 2 there is no opening. Another issue is height of the passage which has a direct effect on indoor air quality. In case 3, the height of the passage is higher than the other ones. This issue has a direct relation to polluted and cool air. Clearly polluted and warmed air in any place goes to upper levels because of its being lighter. In case 3, the high height of the passage can provide a free space in upper level of the passage where polluted air goes up and cool air would be able to come inside, down to the human level (figure 32).

In the other cases, especially in case 1 and 2 this function type cannot be observed, but case 4 has the same role as case 3. There are two differences between cases 3 and 4 which are length and volume of the shade. The length of a roofed alley has a direct effect on indoor air quality. Turbulence effect can increase the wind speed and can be a reason to catch the heat energy saved in wall side. Moreover, the rate of wind speed in desert area has a direct relation to the comfort zone. In all cases except for case 3, the length of the passage is not long.

Another point is the volume of the shadow. This parameter is useful in the amount of solar energy achieved. The rate of solar energy achievement in cases number 1, 2 and 4 was higher than case 3. As in case 3 the volume of solar energy gain is lower than the other cases, in night time, all heat energies which were saved during day time come back to the natural environment which is very useful. In this regards, case 3 has better condition compared to the other cases, especially case 2; because side walls of the passage in case 3 were in more shady condition during the day, while in case 2,there is a high amount of solar energy gain by passive solar ways.

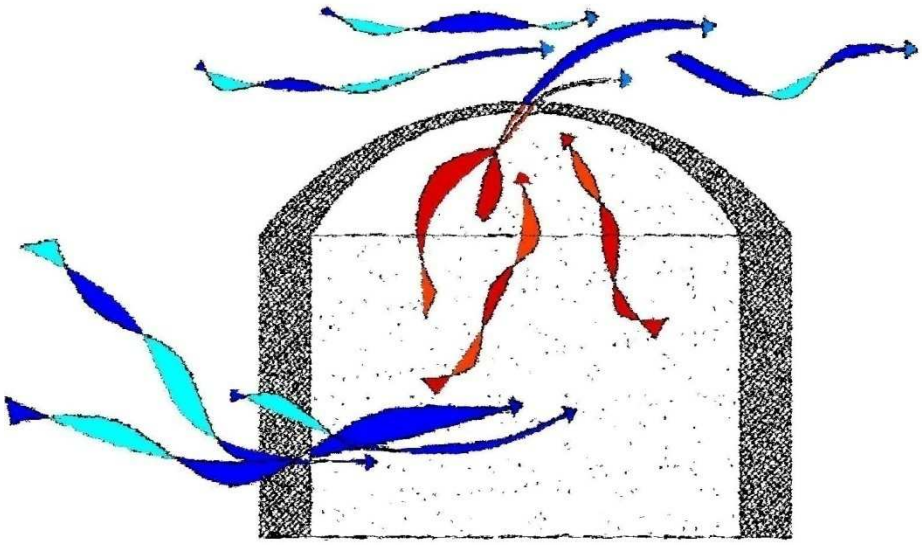


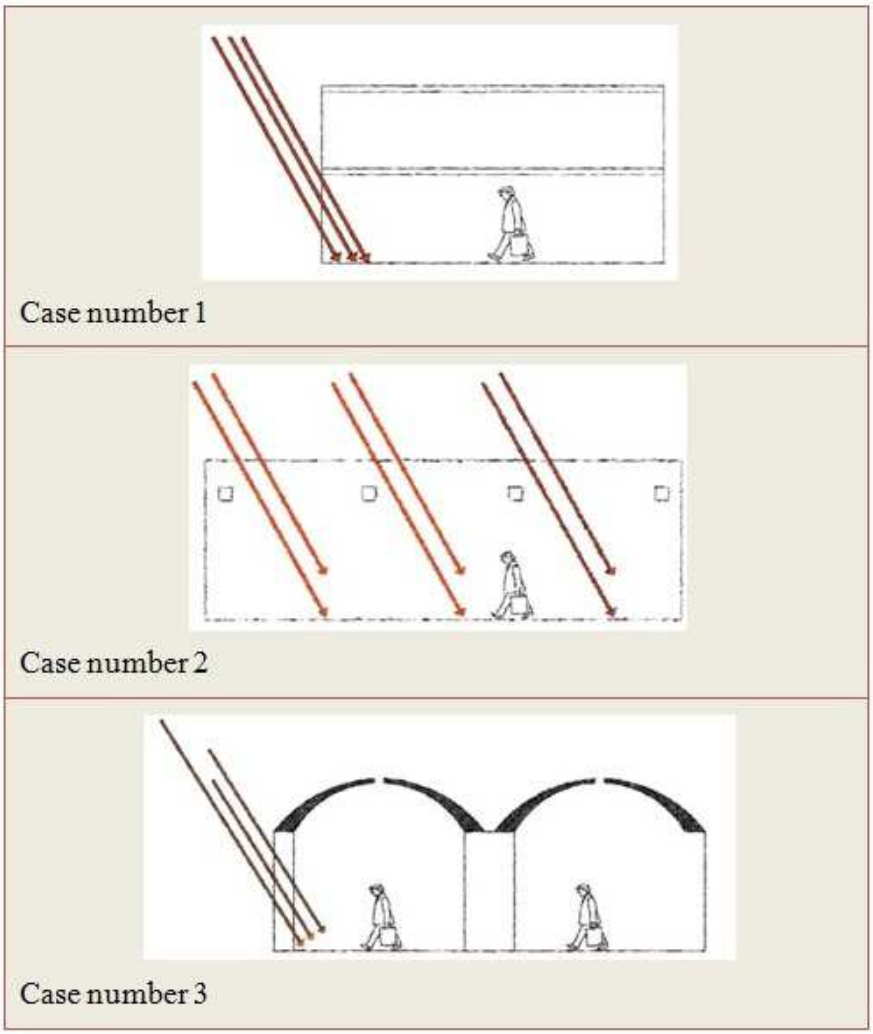
Figure 32: Natural circulation of indoor air quality

3.5.1.1.2 Shading

Mentioned in the previous part, shady area and amount of solar energy gain by passive ways have a direct relation with each other. Evidently, in any situation, if the amount of shady area is high, it can affect the temperature of indoor spaces. And it should be noted that the amount of solar energy saved in materials of side walls are very low. In this regards, case 3 has a better condition compared to the other cases, because the depth of roofed alley based on length is higher than the other cases which can help to prevent saving solar energy in materials of the passage walls and ground. On the other hand, in case 2, the amount of open spaces that solar radiation can be achieved is higher than the other cases. In case 2, each distance of the beams is around 5m so that solar radiation can be achieved during the day. This issue has a direct effect on the comfort zone for passers can be protected much from the sun in case 3. Case 1 has a better situation compared to case 4 because of its height. The height of case 1 is lower than case 4 which leads to gaining more solar radiation in side openings (table 19). Based on this reason, the depth of solar radiation in case 1

is lower than case 4, and with this discussion, case 3 has a better condition for creating a shady place by the roof alley.

Table 19: Depth of solar radiation gain of case studies



3.5.1.2 Physical Factors of Environmental Evaluation of Roofed Alley

3.5.1.2.1 Roof Type

Roof configuration is a vernacular solution for Yazd city and architectural creation in hot and dry climates of Iran. The type and shape of a roof has a direct relation to the comfort zone because of two main reasons: creating a shade and clash with external natural ventilation. One famous type of roof in Yazd is an arch roof which in most

cases has an opening in middle so to catch natural light and provide a better condition for natural circulation of indoor air.

As it is clear in figure 33 and 34, in some places that indoor air quality was important because the high number of users, architectures had designed a domical shape with two special parameters of creating a shade in half of the domical roof because of the sunshine direction, and opening in middle of the roof. As mentioned, these two points can increase the quality of indoor air by natural air circulation, moreover, during hot days half of the roof is not able to gain solar energy.

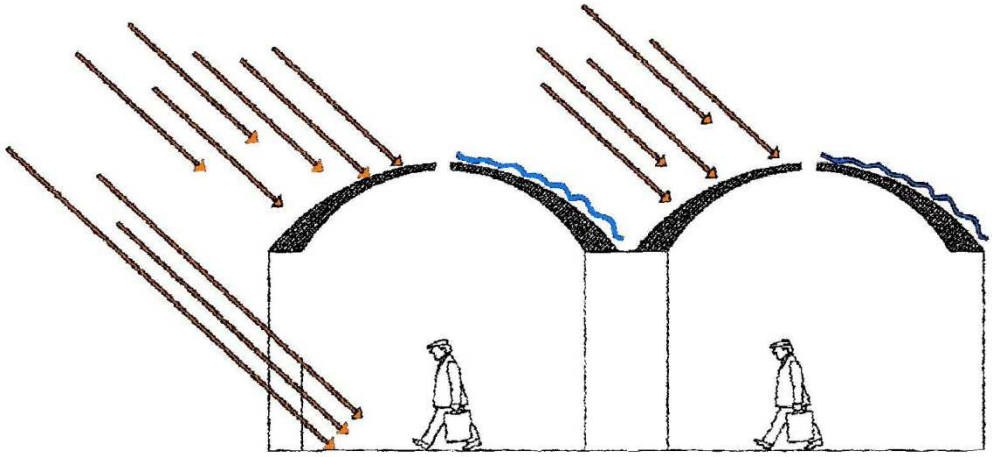


Figure 33: Roof configuration of case number 3

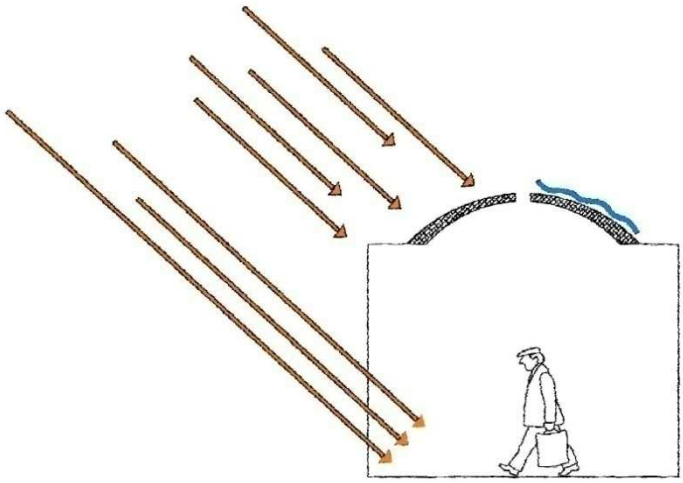


Figure 34: Roof configuration of case number 4

In these case studies, only cases 3 and 4 have this type of roof that traditional architects had designed to increase the indoor air quality. This solution cannot be seen incase 1 because of its top floor function. Case 2 also has not this type of roof because of the special characteristic of its roofed alley that was explained in previous sections. The main reason behind using a domical roof in cases 3 and 4 is based on the high number of users and also different types of function that can cause high amounts of polluted air. As described, the height of passage in cases 3 and 4 is higher than the cases 1 and 2. This issue can be useful to improve natural circulation of indoor air, because the polluted air is light and goes up naturally. In this situation stack effect will happen because natural air movement on top of the roof can catch the inner polluted air which goes outside. This method can be useful to increase the quality of indoor air circulation by stack effect.

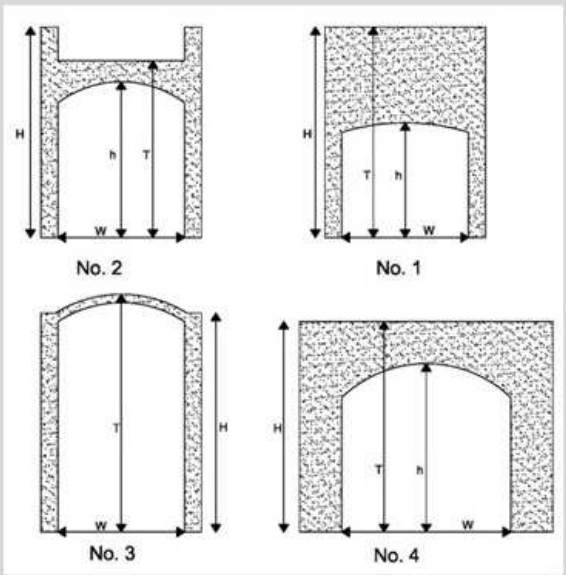
3.5.1.2.2 Dimension and Scale of Roofed Alley

Proportion is the relationship between different dimensions of a space and an object. The relation, independent on its real size, has a ratio of 1:1. In a space, the ratio of buildings height and width, enclosure and semi enclosure constitute the main discussion of the proportion. If the proportion is correct based on human need, it leads to peace of mind. Scale relates to the relationship of the space or object size, to spaces or surrounding objects. It can be said that a space or a monument is based on scale or out of scale with its surrounding. If a space has a proper relationship with human body, it is said that it has human scale. This relation is considered as a powerful factor in determination of an external space specification and the observer’s visual perception.

The visual effect of a space from the observer viewpoint regarding the enclosure and possession of human scale depends on the observer's sight angle. For achieving human scale, consecutive designed spaces are separated visually. Any space should not be so big that weaken visual contact with surroundings and not so small that cause phobia. The western designers believe that vey wide, very closed or monotonous linear spaces are far from human scale. This viewpoint can be accepted in urban and residential complex designing in Iran too.

Based on this discussion, there are different effects concerning the dimension and scale of roofed alleys, especially in different situations based on their various functions. Below is some information about the dimension of case studies (table20).

Table 20: Dimensional Analysis of Roofed Alley as Case Study



Case Study Number	Top of Arch (T)	Width (W)	End of Arch (h)	Height(H)
No. 1	5m	3m	2.5m	5m
No. 2	5m	3 m	3.60m	4.20m
No. 3	5.60m	3m	----	5.20
No. 4	5m	4m	4m	5m

There are some differences in dimension and scales of roofed alley in various cases. For example, in case 1, the height of arch is 2.5m that is because of top function on the roof. This dimension caused more shady places to be created because, compared to case 2, passage in case 1 is more dark which means it is cooler.

In case 2, the end point of arch is 3.60m based on its some structural requirements. In case 3, the height of the arch is the same as case 1 and 2, but the difference of this case is the function of inside room on top floor. The height and width of case 4 is dissimilar to the other cases because of its cultural function. The height and the width are the same and are 4m. In three other cases, the width was 3m because the roofed alley had covered the passages, but in case 4 there is also the effect of cultural function of roofed alley on the width of the passage which provided the roofed alley with an aggregation point. This area hence has created a vaster shadyarea in front of the mosque entrance by the roofed alley. In caparison with proportion factor, there are three main parts.

Comparing case 1 with case 2, it is clear that the difference in dimensions is because of their functions. Case 1 has housing function and also function on top floor, but case 3 is a public space with so many varied functions that it leads to keeping high rate of population. The high roof of case 3 provides a better condition for natural circulation which in case 1has not importance. Comparing case 3 and case 4, the main difference is their width that as mentioned before, is because of aggregation point of case 4, so in case 3 most passers have movement conditions.

3.5.1.2.3 Structural System

A structural system is the backbone of how the physical structure is constructed and how

forces are transmitted from its components of homogeneous network, from top to bottom, in a structure where all components are working properly together. The claim that climatic reasons are the main reasons for the evolution of the roofed alleys is not true; this argument structure is one of the shelters that ancient architects had always considered. There is a creative and aesthetic innovation about roofed alleys that maybe at first glance, their functions cannot become evident. Shelter structure operating is an example which architects had used deliberately.

Due to the length (height) and thickness of the outer walls, roofed alleys are used as strengthening elements, supporting against earthquakes and wind forces. Where shelters are not necessarily contiguous, maximum distance of 5 meters in a single arc is embedded; and because the upper level walls are not equal, the form of roofed alley to wall junction depends on the architect's will.

As mentioned, a roofed alley in some parts of passages has a structural role in protecting side walls from horizontal forces such as earthquakes or wind forces. Sometimes there are wind forces in Fahadan area, because of the geographical situation of Yazd city where desert area is surrounding it, and as a result of which desert winds can become a storm sometimes. On the other hand, the height of walls is high so to create shades. In case 2, the role of roofed alley can be described as both making a shadow as well as being a structural reason to support side walls as a beam. As it is clear in case 2, the roofed alley is in the highest level of side walls (figure 35). In other cases, the structural role of roofed alley is not the same as case 2, because of the other structures which are connected to roofed alleys that can support the backside of structural parameters.

Figure 35: Structural role of roofed alley as beam

3.5.1.2.4 Roof Opening and Lighting

As it is clear in photos of the case studies, just case 3 and 4 have openings in roof. Case 1 does not have any roof openings because of its function on top floor which has a room. But cases number 3 and 4 have roof openings in the middle of the roof. This opening provides natural light for inside as well as creating stack for increasing the indoor air quality spaces. As mentioned, the main role of a roofed alley is to create a shady place during hot days, but in case 3 and 4 there is a special situation. In these cases the length of roofed alley is too long and with full cover of the roofed alley, the visual quality of space would decrease. In this situation, a roof opening can be an architectural solution to access the natural light. The second issue is indoor air quality which can be enhanced by openings on roof to use the stack effect (figure 36). In both cases, number 3 and 4, the main reason of opening is related to public use. As mentioned, case 3 and 4 are central public spaces in the neighborhood, hence, some architectural solutions should be there to provide a comfort zone during

hot days. Case 3 has a high public use a day compared to other places which reflects the value of such kind of a solution. In case 4, it sometimes, depending on the mosque next to the roofed alley, has a high number of visitors because of religious celebrations. At this time, roof openings can be fine solutions to keep residents in comfort zones by creating fresh air and increasing indoor air quality.

Figure 36: Roof opening in middle of roof in case number 3

3.5.1.2.5 Construction and Material

The construction system of roofed alleys in Yazd city as one of the desert cities in Iran is very similar. The main materials of construction are brick and mud which are vernacular materials of Yazd. The main issue in architectural design of Yazd is high temperature. Hence, it is important to use high heat capacity brick and mud which are useful in creating comfort zones. It is also essential to use materials so to minimize the use of new material, design for minimal material waste through modularization, and use materials with the potential for long live.

The usage of material in covering the passage by a roof is much important than the others, because of the arch shape of the roof, high height of passage, and also length of the passage which should be covered by the roof. In the other cases, the amount materials used are not so much, because the roof is just covered with the structure of side walls. There are some specific parameters to evaluate the construction of roofed alleys such as minimizing construction expenses, optimization the building envelope, connectedness, designing for component update, minimizing waste of spaces, and supporting pedestrian. Based on these parameters, a roofed alley can be related to each of these factors. For supporting passers during hot days, case 3 has a higher quality because of its long length. Also in design for component update, this method can be useful to cover the long passage with a layout incase 3.

Optimization of the building envelope is an important issue in roofed alleys which has an acceptable function in case 1. In this case, the roofed alley has provided three main functions at the same time which are: neighborhood sharing, providing landmark for home entrances, and also creating a shady area for passers. In minimizing construction expenses issue, the roofed alley in case 2 has an acceptable role. In case two, side walls are very sensitive in the structural issue because of their height. The roofed alley in this case, creating some regular beam, can protect the structure of side walls along with creating a shadow for passers. Connectedness is an interesting issue in roofed alleys and all cases can create an acceptable function with other constructions in the environment. As a result of evaluating roofed alleys by construction and material, case 3 has a better condition encompassing most of these parameters at the same time. The only problem with case 3 is that the amount of used materials in this case is higher than the other cases, and this is related to its function and special type of design.

3.5.1.2.6 Hierarchy

The core of hierarchy is conditions that it is used diversely in all natural complex and dynamic contexts which can be divided in three main groups: hierarchy in spatial structure (city-quarter), access hierarchy, and space hierarchy from public and private viewpoints. Hierarchy used for case studies of this thesis is space hierarchy from public and private viewpoints. In each of case studies, there is a principle on grounds of which the roofed alley was created.

In case study number 1, there are two main reasons behind its creation; one of which is sharing a house space with public passage which can be a type of combination of private and public spaces. The second one is entrance of neighbors that in this situation, roofed alley can be useful in giving some services to owners and passers. In case 2, the aim of the roofed alley is based on two logics; creating shadow and protecting the structure of side walls. As mentioned, the aim of desert cities is to create more shadows. One solution in this regards is to narrow passages with high side walls. But on the other hand, a high wall with masonry structure can be sensitive against horizontal forces. Therefore, in some parts of streets where it was necessary to protect side walls, they have used roofed alleys as a beam which can create shade at the same time.

In case 3, the creation of roofed alley is based on using a shady place to protect residents and passers from hot sunshine. The roofed alley in this case has provided a comfortable public space for neighborhood with attention to environmental conditions. The roofed alley in case 3 has provided a public place that in harsh outdoor environment residents can improve social communication in town by this public facility and without which, it was hard to find a comfortable place.

The main reason behind building the roofed alley in case 4 is social community and cultural events. As mentioned previously, the mosque in this case is an attractive issue to resort the residents at some special times. This main reason has also considered this issue that people need a shady place outside. Moreover, the value of this cultural place has led to building a roofed alley considering these issues as well as the roofed alley in this case becoming a landmark. In any of these case studies, roofed alleys with special layouts have specific reasons behind their building to create some services in urban scale, and it is possible to substitute these roofed alleys with the other types.

3.5.1.2.7 Enclosure and Privacy

Enclosure of space is the first principle in designing urban places. If a space cannot be enclosed in optimal way, it cannot provide a secure area with urban attraction. If the space is big, it loses relation with its surroundings and in this case, there is fear of having too open or too closed spaces. Lack of fenced space is also problematic, not only in city structure but also in residential complexes. Enclosure of the space is popular in most of the historical cities all over the world. The manner of enclosure is different from size, shape, accessibility, and body in houses and alleys. In most cases urban elements such as roofed alleys, being symmetrical and balanced, limit the spaces. The enclosed or semi enclosed spaces should excite human being. Quality of any big and small spaces with high and low height or width, from visual point of view, possesses characteristics that can be related to human reactions. Combination of these surface and urban space in Iran’s hot and dry cities has created such characteristics. Feeling of being enclosed in space is based on the relationship between the observer’s eye distance and the space’s enclosed height (figure 37).

Figure 37: Enclosure sense of human in roofed alley of Iran/Yazd (Tavasoli, 1990)

Privacy is a complex and cultural concept that can be defined as a personal right to transfer the information in specified conditions. It implies fundamental concepts of scope, realm and scope of influence. There are four steps in privacy: loneliness privacy that the person hides him from others, which is the complete visual privacy that only the God attends. The next step is artificial space that the person creates an intimate gathering with his friends. The third step involves time that is when the person is in a public space and needs to be unfamiliar. Except famous individuals, common people want to be in unfamiliar places, for fear of supervision takes away the sense of freedom and peace. The fourth step is the creation of mental privacy against any disturbance. It is considered in optimal conditions where privacy network covers urban spaces. This hierarchy begins from residential complexes and ends to central spaces. The concept of privacy has been used skillfully not only in traditional houses, but also in organic urban fabrics and it was an effective principle in shaping

private and public spaces. The role of cultural and religious values such as Iranian and Islamic interiority in shaping it is also undeniable.

These case studies can provide some examples of privacy and enclosure issue by roofed alleys. There is a semi private area in front of the entrance of neighborhood in case 2 where it has provided some seats and shady areas for the owner of the house. This area has a potential to be decorated in public areas based on owner's will. In case study number 3, there are some seats placed in front of some shops and this solution provides semi private areas for the owners of the shops to give some special or normal services to customers such as a sitting place or some free area where a specific exhibition can take place in relation to the shop. Moreover, in the case study number 3, there is a cistern where the residents of the neighborhood can collect their daily water from this water store, in addition to this cistern giving some services such as cool water or a rest area for passers and also customers. This area was created by a small free space and seats in both sides of the entrance of cistern. There is the same situation in case study number 4 where the free area has functioned as a rest area in the entrance of the mosque. There is a specific difference between this rest area and other ones for there are exact times when this rest area can be used. At the times that there are some cultural and religious celebrations, this area provides a semipublic space without any clash with the main movement of passage (table 21).

Table 21: Figures of case studies about private spaces

A) Semi private space of house

B) Semi private space of shop

C) Semi private space of cistern

D) Semi private space of mosque

3.5.1.2.8 Entrance Definition

Roofed alleys have been used to define the entrances to some of the important buildings and public spaces. The symbolic presence (including the roofed alley index), has been used to introduce the urban spaces. In a likewise manner, roofed alley has been used for a symbolic or index presence so to introduce the building to the urban space. An example of this type of roofed alley is seen in a Mosque in Ardestan area. Furthermore, they point out arches, gate-ways, passages and shades. Lots of Mediterranean atmosphere shows those definitions in the urban areas as well as in the Middle East.

There are three main case studies about land marking issue that can be divided into three groups: housing, marketing and cultural. Case 1 has a function of landmark for two neighbors and roofed alley, by covering the entrance area, has separated the entrance area of the houses from other spaces of the passage. With this roofed alley, residents and passers can easily find the entrance of the houses. Another point to be mentioned about the roofed alley in case 1 is that it is different from other roofed alleys by its decoration and layouts. Each owner of a roofed alley or the neighbors who share the shady area of roofed alley is able to use a special kind of structure system, layout and decoration. These features provide specific roofed alleys based on each owner's will, hence there are various roofed alleys in different places.

The principle of roofed alley in case 3 and 4 are the same. Both of them have public space characteristics and because of this function, the number of their users is more than the other cases. Case 3 functions like the market of neighborhood where most of the residents should go to collect water or something from the cistern. This issue has caused this type of roofed alley be famous and become a land mark in the neighborhood where the residents of the town can refer to, because of its popularity and visibility. However, case 4 has a different subject; the main issue of this case is its religious and cultural function. Most residents of the neighborhood know this roofed alley because of the sense of the area and mosque where roofed alley has covered the entrance of it.

Table 22: Environmental evaluation of roofed alley case number 1

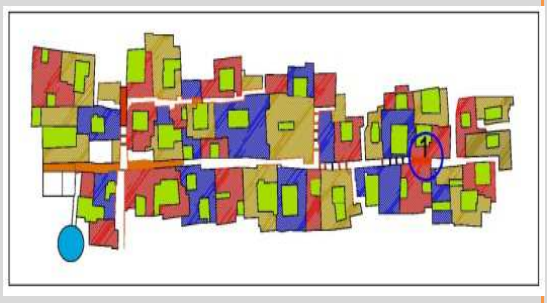
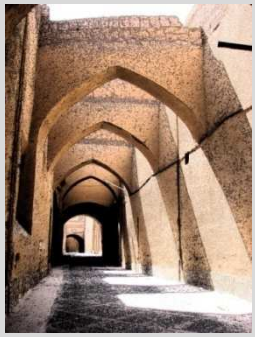
Environmental Evaluation of Roofed Alley Number 1		
Natural	Natural Ventilation	Just by cross ventilation through the passage
	Shady Area	The amount of shady area is acceptable
Physical	Dimension	Short height of Passage, Normal width of passage
	Structural System	Provide connection middle of side of walls and buildings
	Privacy & Enclosure	Create semi private entrance for owners
	Land Mark	Build sign for entrance of neighborhood
	Hierarchy	Creation landmark for entrance, structural support, neighborhood classification, gathering area
	Neighborhood Classification	There is function on top floor of roofed alley as neighborhood classification
	Roof Opening	There is not any roof opening
	Construction	There is complex construction because of two types of function
	Roof Types	There is not special roof configuration and it is flat

Table 23: Environmental evaluation of roofed alley case number 2

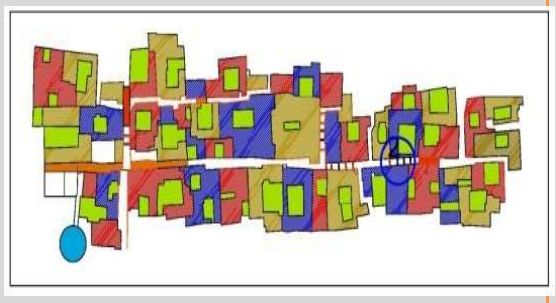
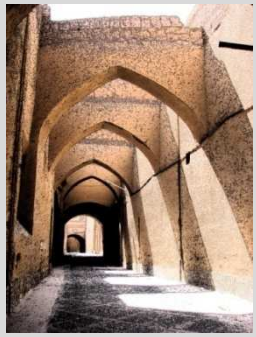
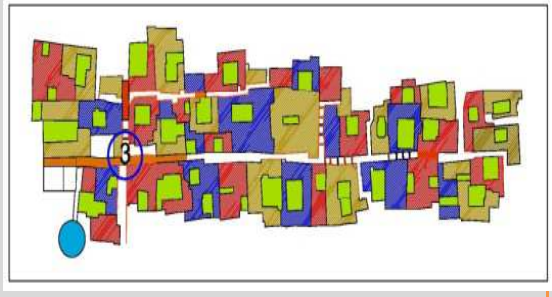
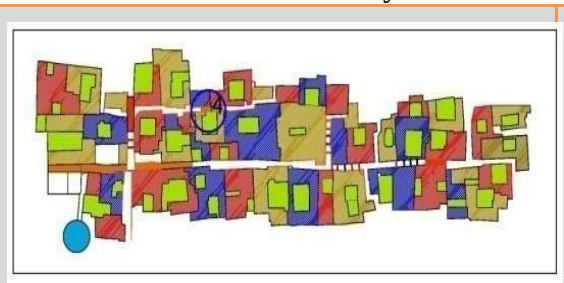
Environmental Evaluation of Roofed Alley Number 2			
Natural	Natural Ventilation	Just by cross ventilation through the passage	
	Shady Area	Amount of shady area is low	
Physical	Dimension	High height and huge openings middle of beams	
	Structural System	Support side walls in front of horizontal forces	
	Privacy & Enclosure	Create huge scale of walls and horizontal beam	
	Land Mark	Does not provide any landmark	
	Hierarchy	Create shade and structural support	
	Neighborhood Classification	There is not any Neighborhood Classification.	
	Roof Opening	There is not any roof	
	Construction	Just build numbers of beams	
	Roof Types	There is not roof configuration	

Table 24: Environmental evaluation of roofed alley case number 3

Environmental Evaluation of Roofed Alley Number 3		

Natural	Natural Ventilation	There is natural ventilation by roof opening base on stack effect
	Shady Area	There is huge and long length of shady area
Physical	Dimension	Highest height of passage and normal width
	Structural System	Connection side walls by roofs
	Privacy & Enclosure	Provide semi private and semi public spaces
	Land Mark	Create landmark as center of neighborhood
	Hierarchy	Provide landmark, public place
	Neighborhood Classification	There is not any Neighborhood Classification.
	Roof Opening	Roof opening in middle of roof and pointy sun light
	Construction	It build by more usage of material and biggest scale of construction
	Roof Types	Domical to create shadow and more cooler

Table 25: Environmental evaluation of roofed alley case number 4

Environmental Evaluation of Roofed Alley Number 4		
Natural	Natural Ventilation	There is natural ventilation by roof opening base on stack effect
	Shady Area	The amount of shady area can be acceptable in relationship with function
	Dimension	High height and more width
	Structural System	Support side walls by roof
	Privacy & Enclosure	Does not provide any Privacy and Enclosure

	Land Mark	As cultural and religious center of neighborhood
	Hierarchy	Provide public space with cultural atmosphere
	Neighborhood Classification	There is not any Neighborhood Classification.
	Roof Opening	Roof opening in middle of roof and pointy sun light
	Construction	Domical roof and think walls
	Roof Types	Domical to create shadow and more cooler

3.5.2 Social Evaluation of Roofed Alley of Fahadan/Yzad City

Social community function of roofed alleys is one of the important roles of this architectural element to increase the quality of public urban spaces in Yazd city. As mentioned before, hot and dry climate of Yazd is an important issue that can prevent human beings from having social activities. However, roofed alley in some defined places can create some public places, with attention to comfort zone, by making shades.

There are some parameters such as sustainability of community, shared spaces, collective activities and belongings, and community identity which will be evaluated in this section.

3.5.2.1 Sustainable Community

Most of roofed alleys have a function to provide some facilities about a sustainable community such as a neighborhood or a landmark (figure 38). Case study number 1 provided a roof and a shady place for owner of the houses as a gathering place that the owners or some of passers in the neighborhood were able to sit there. The same condition can be seen in cases 3 and 4. In case 3 which is the central public space of

town, the residents prefer to spend some hours during a day in there. This situation was created only by a shady area under the roofed alley which is useful for passers to have social community around places in case 3 such as the cistern or main shops.

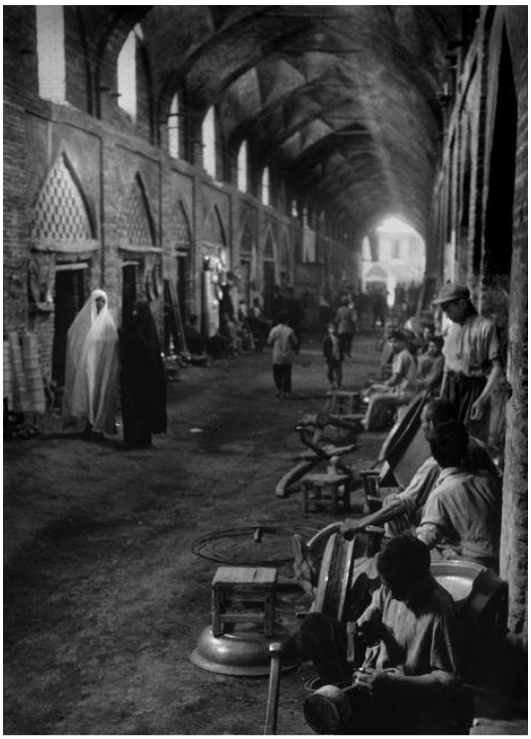


Figure 38: Social community of roofed alley in desert cities of Iran

Case 4 has the same situation by the same facilities such as seats and a shady place; however, there are two main usages for this area in case 4.Firstly, around special times in a day, the place is used for religious celebration where the residents come together, and secondly, passers or neighbors who want to sit in a shady area get use of the place. The social community in case 2 is different with the other cases, which is because of the characteristics of case 3 as a roofed alley. The width of case 2 is narrow and most of the time shade covers only half of the roofed alley. These limitations, as being narrow in space or the shady area create a special situation for passers to walk closely. In this type of movements that passers move closer, some social behavior may happen.

3.5.2.2 Shared Space

Sharing in architectural design of hot and dry climates is very popular. Sharing leads to building new types of architecture method both in housing and urban scale. As it is clear in case1 there is a sharing space by the function on top floor of the roofed alley (figure 39). This sharing assisted in saving the area till the next house as a room that in the other examples is a yard. Another fact is roofed alleys being created as architectural solutions. There are examples of shared spaces in case 3 and 4, where in both, some places were shared with the main passage such as seats in front of the mosque, shops and cisterns as semipublic places. These sharing corporations can increase the quality of public spaces by creating some rest areas that are important in providing comfort zones and conditions. Generally, these facilities can improve outdoor and public spaces to become lively.

Figure 39: Seat place for passers as a shared area in case number 1

3.5.2.3 Collective Activities

Collective activities in Yazd have a direct relation with human comforts because of its hot and dry climate. Based on this climatic condition, any shady area that has a cooler environment condition can be useful to create and develop collective activities. That is why roofed alley has a function as a comfortable position to collect residents of the neighborhood for social and collective activities.

Based on this explanation, case 3, as a central public space in the neighborhood has the highest performance of a roofed alley in providing acceptable conditions for public activities. As mentioned, case 3 has a better environmental situation based on specific architecture design, and it brings human comfort by having some national and cultural celebrations during the year and actually works as a public space. Case 4 has the second position compared to case 3. This case is attractive for residents because of the mosque which is in front of the roofed alley, and the shady area provided helps to create and develop some religious activities at special times in a year. Generally, it is better to say that in case 4, there are some public activities in the mosque but the roofed alley has developed these activities outside which caused to increase the quality of these activities. Collective activities which takes place in the roofed alley in case 3, has resulted the semipublic place sometimes to develop to a public space main passage. Case study number 1 could not generate public activities such as cases 3 and 4, because of residential conditions of case. The highest level of collective activities in case 1 is neighbors sitting together just for some hours. Unfortunately, there are no public activities in case 2 as well, because of its environmental condition which has too much sunshine during hot days.

3.5.2.4 Sense of Belonging and Community Identity

Roofed alley is one of vernacular architecture design parameters that can be an identity element of Yazd city along with the wind catchers. Based on the usage of roofed alleys in different places, roofed alleys have different effect depths, i.e. the residents of neighborhood have different history in the same place because of different conditions and times which could happen in other kinds of roofed alleys.

With attention to this issue in evaluation of roofed alleys, all types of case studies can have different effects. Case study number one can be a dwelling identity that has provided some public facilities. Case 2can create some identity and special sense of neighborhood for residents, for the owners of houses have some histories for long times and have built some seats under this roofed alley, providing social conveniences for owners. But scale of case 3 is different than the other cases. As mentioned, in this town of Fahadan area, case 3 is a central public space of neighborhood. This case has some different types of public facilities such as the main shops, cistern and some free places to sit. By these reasons, most public relations and communities were created and developed by this huge roofed alley.

Evaluating case 3, it is clear that this type of roofed alley is a symbol of identity for this neighborhood; also residents of the town have some respectable senses toward it because they can achieve some main human relations with the other residents. Based on this discussion, case 3 has a deeper role in providing belonging and community identity in this town. Another case under study was case 4 which provides a cultural and religious identity for the town. There were some events from past up to now which were created by the roofed alley number 4. The main point of evaluating case

4 with these factors was the types of social activities which were all related to the mosque near the alley and has a direct effect on this roofed alley. Based on this analysis, it is clear that communication types happening around this roofed alley have cultural and religious characteristics; hence, the identity of this roofed alley is based on these types of social activities.

Table 26: Social evaluation of roofed alley number 1

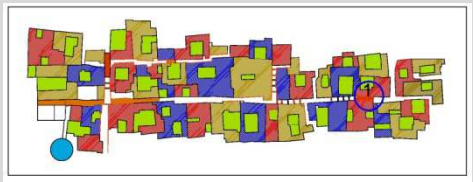
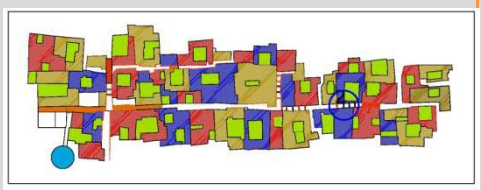
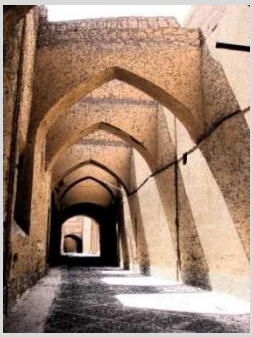
Social Evaluation of Roofed Alley Number 1		
Social Evaluation Factors	**Explanation and Keywords**	
Sustainability of Community	Just as neighborhood gathering	
Shared Spaces	Share home area with passage and build top floor on the passage	
Collective Activities	Small scale of collective action that it is not rich	
Belonging and Community Identity	Small scale of community identity just for neighbors	

Table 27: Social evaluation of roofed alley number 2

Social Evaluation of Roofed Alley Number 2		
Social Evaluation Factors	**Explanation and Keywords**	

Sustainability of Community	Walk in narrow passage and creation some behaviors in close relationship of passers
Shared Spaces	There is not any shared space
Collective Activities	There is no any collective activities
Belonging and Community Identity	This case cannot be as community identity

Table 28: Social evaluation of roofed alley number 3

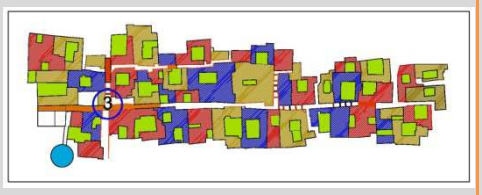
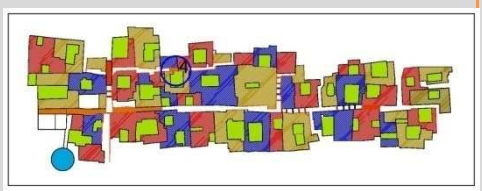
Social Evaluation of Roofed Alley Number 3		
Social Evaluation Factors	**Explanation and Keywords**	
Sustainability of Community	As central community area of neighborhood	
Shared Spaces	There is not any shared spaces	
Collective Activities	The highest potential for collective activity	
Belonging and Community Identity	Identity of neighborhood for most types of community	

Table 29: Social evaluation of roofed alley number 4

Social Evaluation of Roofed Alley Number 4		
Social Evaluation Factors	**Explanation and Keywords**	
Sustainability of Community	As cultural and religious community	

Shared Spaces	There is not any shared spaces
Collective Activities	In some special time and it is not permanent
Belonging and Community Identity	Identity of cultural community of town

Table 30: General Evaluation of Case Studies by Environmental and Social Sustainable Key Words

Key Words Evaluation			Case Number 1	Case Number 2	Case Number 3	Case Number 4
Environmental	Natural	*Natural Ventilation*	Cross Ventilation	Cross Ventilation	Stack Effect	Stack Effect
		Shading	Shady	Not Shady	Shady	Not Shady
	Physical	*Roof Types*	Flat Roof	Without roof	Domical Roof	Domical Roof
		Dimension & Scale	Low Height & Regular Width	High Height & Regular Width	High Height & Regular Width	High Height & Regular Width
		Structural System	Connection for Both Sides & Top Floor	As Beam for Side Walls	Connection Side Walls By Roof	Connection Side Walls by Roof
		Roof Opening & Lighting	Without Roof Opening	Without Roof Opening	In Middle of Roof	In Middle of Roof
		Construction & Material	Complex Construction	Just Build Numbers of Beams	More Usage Of Material & Scale	Domical Roof & Think Walls
		Hierarchy	Entrance Landmark, Gathering, Structure	Create Shade And Structural Support	Provide Landmark, Public Place	Cultural Atmosphere
		Privacy & Enclosure	Semi Private Entrance	No Privacy	Semi Private And Semi Public Spaces	No Privacy
		Entrance Definition	Sign For Entrance of Neighborhood	Without entrance	As Center of Neighborhood	As Cultural And Religious Center
Social	*Sustainability of Community*		Neighborhood Gathering	Narrow Passage & Special Behaviors	Central Community Area of Town	Religious Community
	Shared Spaces		Shared Top Floor By Alley	No Sharing Area	No Sharing Area	No Sharing Area
	Collective Activities		Small Scale of Community	No any Activity	High Level of Community	Special Times & Issues
	Belonging and Community Identity		Identity For Neighborhood	No Any Belonging Identity	Central Identity of Community	Cultural Community

- Regular width is a round 3m to 4m

Chapter 4

CONCLUSION

The traditions of vernacular architecture have been constructed in a long time with the abilities and experiences of local architects who have specific knowledge of their region. As mentioned before, there are known values and properties within the traditions of vernacular architecture which have been applied to modern constructions and buildings.

This study has been conducted to research roofed alley as an element of architectural sustainable design. Unfortunately, with the emergence of modernism development, some values about vernacular and regional design have been forgotten. These values, which include sustainable development parameters, could create a permanent relationship with the natural environment taking into consideration the climate and geography of the particular environment. Yazd city, which is the case study of this thesis, has a harsh, hot and dry climate and is located in the central region of Iran. Based on its climatic condition, there are different types of architectural sustainable solutions in order to provide human comfort, considering Yazd's climate conditions. Roofed alleys are one of these examples that provide human comfort in the hot and dry climate of Yazd, to increase the quality of social and environmental activity in the outdoors and public spaces. As it has been mentioned in this study, there are different types of roofed alleys which differ according to their functions and locations. Several kinds of roofed alleys have been serving for different issues which

have resulted in social and environmental effects in a public scale. Therefore, the differences of these roofed alleys have been a focus of this study. The differences between the roofed alleys have a direct link with their function and usage which establishes the aim to study the differences.

Environmental and social factors are the two main sustainable factors looked at while evaluating the roofed alleys. The environmental role of the roofed alley consists of two significant aspects which are the natural and physical aspect. The natural role of the roofed alley, includes the establishment of facilities that provide comfort zones in the outdoor spaces while the physical system is based on man-made solutions. The physical solutions such as differences in the dimensions which create roof openings, different construction etc. is beneficial because it results in an increase in the performance of the roofed alley. Social sustainability is the second major role of the roofed alleys. As it has been mentioned, Yazd has a harsh climate that is a significant effect on the public and outdoor spaces of Yazd city's architecture.

As it has been discussed, in order to evaluate the architectural vernacular solution based on sustainable environmental and social factors, four types of roofed alleys have been selected from Fahadan, which is a historical area of the Yazd city. In Table 1, the social and environmental factors for all four types of roofed alleys have been clearly expressed. Case 1 of the roofed alleys has both disadvantages as well as advantages. As it has been mentioned in the previous chapter, neighborhood classification, gathering, identity etc. make up the beneficial aspects of the roofed alleys for case 1. Although the negative points of this case consists of the height of the alley and the roof opening. Some of the solutions such as neighborhood classification and gathering place for owners of houses nearby are beneficial

solutions in terms of sustainable architecture. The low height of the wall and the lack of roof openings decrease the quality of comfort when compared to the other cases.

In this comparison, the beneficial aspects of case 3 is that it has a more profound effect in each of the three factors as a central roofed alley but on the other hand, case 2 physically has a structural role and an environmental role by providing shadow. While mentioning case 3, it should be noted that it has three major disadvantages. The first one is that the alley is dark at night because it can't benefit from moon light, which may lead to negative feelings such as fear on people that use the alley. Another point is that some facilities for passers such as the seat places and the functional clash between theses seating areas and movement. As it has been discussed, the roofed alley number 3 is a central community place; unfortunately the number of facilities for collective actions is not sufficient in terms of seats. On the other hand, some of the available seats clash with the major movements within roofed alley. The negative aspects of case 2 are the high amount of natural light and the low level of shady area. Due to these reasons case 2 lacks possibility for social communication. Additionally the level of quality for human comfort is low.

Case number 4 is one of successful roofed alley which the number of advantage is more than disadvantage one. This case has some features such as natural ventilation, landmark, social community, shady area and gathering place and also, the length of this case in not too long the same as case number 3 and it can be possible to use moon light at night times.

Case 4 is an example of a successful roofed alley since the number of advantages exceeds the number of disadvantages. This case has features such as natural

ventilation, landmark, social community, shady area and gathering place. Similarly to case 3 its length is not too long and it is possible to benefit from moon light at night times.

Table 31: Advantage and Disadvantage of Case Number 1

Evaluation Parameters		Advantage	Disadvantage
Environment	Natural	- Shading - Cross Ventilation	- Low Height - Without Roof Opening - Weak Ventilation
	Physical		
Social		- Identity - Gathering	

Table 32: Advantage and Disadvantage of Case Number 2

Evaluation Parameters		Advantage	Disadvantage
Environment	Natural	- Cross Ventilation - Shading - Structural Support	- High Volume of Sun Light
	Physical		
Social			- Without Any Social Activity

Table 33: Advantage and Disadvantage of Case Number 3

Evaluation Parameters		Advantage	Disadvantage
Environment	Natural	- Natural Ventilation - Roof Opening - Structural Support	- Low Height - Without Roof Opening - Weak Ventilation
	Physical		
Social		- Central Public Space - Social Community - Collectives	- Dark Place at Night - A Few Number of Seating Place

	Activities	

Table 34: Advantage and Disadvantage of Case Number 4

Evaluation Parameters		Advantage	Disadvantage
Environment	Natural	- Natural Ventilation - Roof Opening - Structural Support	- Without Any Social Activity
	Physical		
Social		- Cultural Community - Social Community	- Without Any Social Activity

To conclude, it should be mentioned that modern developments can benefit from particular vernacular values. Roofed alleys, as part of the vernacular construction in different cases, could create a harmonious relationship between human and natural environment. As it has been discussed in this thesis, issues can be solved, regardless of climatic conditions of some regions such as areas with hot and dry climates by using simple architectural solutions in order to increase the quality of outdoor spaces. This thesis can be useful to introduce a forgotten vernacular construction that could be used to provide human comfort in terms of using some simple architectural solutions. For further research, other researchers can develop ideas on this issue by using computer software to focus on developing the physical and environmental role of the roofed alley.

REFERENCES

Abidin, N. (2009). Sustainable construction in Malaysia developers' awareness. *World Acad. Sci. Eng. Tech. 53* , 807-814.

Abouei, R. (2006). Conservation of Badgirs and Qanats in Yazd, Central Iran. *PLEA2006 - The 23rd Conference on Passive and Low Energy Architecture.* Geneva, Switzerland.

Addis, B. (2001). *Sustainable construction procurement: a guide to delivering environmentally responsible projects.* London: CIRIA, C571.

Adems, J. (2011). Balancing the Urban Fabric. *Sustainable Urban Design Journal* , 70-80.

Alex, M. (2001). *Domestic 1: Vernacular Houses* . Manchester : English Heritage .

Alexander, C. (2004). *A Pattern Language: Towns, Buildings, Construction.* London: Oxford University Press.

Alnaser. (2008). Model for calculating the sustainable building index (SBI) in the kingdom of Bahrain. *Energy and Buildings 40* , 2037– 43.

Ancell, S. (2008). The Social Sustainability of Medium Density Housing: A Conceptual Model and Christchurch Case Study. *Housing Studies, 23* , 423–441.

Ayyoob Sharifi, Akito Murayama. (2013). Changes in the traditional urban form and the social sustainability of contemporary cities: A case study of Iranian cities. *Habitat International 38* , 126-134.

Baladi, L. (2000). *The desert.* London: Thames & Hudson.

Balbo, R. (2006). Shape, culture and environment: a lesson of urban design from Dakhleh oasis. *The 23rd Conference on Passive and Low Energy Architecture* , 6-10.

Barr, S. (2003). Strategies for sustainability: citizens and responsible environmental behaviour. *Area* , 227–240.

Barton, H. (2000). *Sustainable Communities: The Potential for Eco-Neighbourhoods.* London: Earthscan.

Bentley, I. e. (1985). *Responsive Environments: A Manual for Designers.* London: Architectural Press.

Boyko, C., Cooper, R. (2006). Addressing sustainability early in the urban design process. *Manage. Environ. Qual. An Int. J. 17 (6)* , 689-706.

Bramley, E. (2009). Promoting Public Health Research, Policy, Practice and Education. *Public Health 96* .

Bramley, G. (2009). Social sustainability and urban form: evidence from five British cities. *Environment and Planning A, 41* , 2125-2142.

Bruntland, G. (1987). *Our Common Future: The World Commission on Environment and Development.* Oxford : Oxford University Press.

Burgess. (1998). Environmental communication and the cultural politics of environmental citizenship. *Environment and Planning* , 1445–60.

Burnskill, R. (1998). *Illustrated Handbook of Vernacular Architecture* . Great Britain: Faber and Faber.

C.R.Kothari. (2004). *Research Methodology.* Jaipur, India: New Age International Ltd.

CADUFF, D. (2008). On the Assessment of Landmark Salience for Human Navigation. *Cognitive Process (9)* , 249-67.

Cardinale, T. (2013). Evaluation of the efficacy of traditional recovery interventions in historical buildings. A new selection methodology . *Energy Procedia 40* , 515 – 524.

Chen, J. (1999). Sustainability and the impact of Chinese policy initiatives upon construction. *Cons. Manage. Econ. 17* , 679-687.

Choguill, C. L. (2008). Developing sustainable neighbourhoods. *Habitat International, 32* , 41-48.

Chu, P. (2003). Factors influencing household waste recycling behavior: Test of an integrated model. *Journal of Applied Social Psychology, 33* , 604-626.

Coaffee, J. (2008). Risk, resilience,andenvironmentallysustainablecities. *Jon Coaffee* , 4633–4638.

Coch, H. (1998). Bioclimatism in vernacular architecture . *Renewable and Sustainable Energy Reviews* , 66-87.

Coch, H. (1996). Bioclimatism in vernacular architecture. *Renewable and Sustainable Energy Reviews* , 67–87.

Colantonio, A. (2009). Urban social sustainability themes and assessment methods. *Urban social sustainability themes and assessment methods 163* , 79-88.

Correa, F. (2009). *Inventionl Transformation ,strategies for the Qattara-Jimi oasis in Al Ain.* Cambridge: Harvard GSD/ Abu Dhabi Culture & Heritage.

Dabaieh, M. (2011). *A Future for the Past of Desert Vernacular Architecture.* Lund, Sweden: Faculty of Engineering, Lund University.

Dabaieh, M. (2011). *A Future for the Past of Desert Vernacular Architecture.* Sweden: Lund University .

Datschefski, E. (2001). *The Total Beauty of Sustainable Products.* Rotovision.

Dave, S. (2011). Neighbourhood density and social sustainability in cities of developing countries. *Sustainable Development, 19* , 189e205.

Davidson, K. (2009). *A critical assessment of urban social sustainability.* Adelaide: The University of South Australia.

Dempsey, N. (2011). The social dimension of sustainable development: defining urban social sustainability. *Sustainable Development 19* , 289-300.

Denel, B. (1990). *Maximum and Traditions: Anatolina Vernacular in Turan* . UK: Gower Publishing Company.

Dili, A. (2010). Passive environment control system of Kerala vernacular residential architecture for a comfortable indoor environment: A qualitative and quantitative analyses. *Energy and Buildings 42* , 917–927.

Dumreicher, H. (2008). Place as a social space: fields of encounter relating to the local sustainability process. *Journal of environmental management, 87(2)* , 317–28.

Farr, D. (2008). *Sustainable Urbanism: Urban Design with Nature.* New York: John Willey and Sons.

Gaitani, N. (2007). On the use of bioclimatic architecture principles in order to improve thermal comfort conditions in outdoor spaces. *Build Environ 42* , 43–54.

Ghaffarian Hoseini, A. (2013). Sustainable energy performances of greenbuildings: Areview of current theories, implementations and challenges. *Renewable and Sustainable Energy Reviews25* , 1–17.

Ghani, F. (2012). Issues in Sustainable Architecture and Possible Solutions. *International Journal of Civil & Environmental Engineering IJCEE-IJENS Vol: 12 No: 01* , 21-24.

Givoni, B. (1994). *Passive and Low Energy Cooling of Buildings.* New York: Van Nostrand Reinhold.

Godfaurd, J. (2005). Sustainable building solutions: a review of lessons from the natural world. *Building and Environment 40* , 319–28.

Goebel, A. (2007). Sustainable urban development? Low-cost housing challenges in South Africa. *Habitat Int. 31* , 291-302.

Green1992*City Shape* New York

Hackett, T. (2011). *Design for Social Sustainability: A framework for creating thriving new.* Future Communities.

Hakim, B. S. (2000). *Arabic-Islamic cities: building and planning principles.* London : KPI.

Heath, K. (2009). *Vernacular Architecture and Regional Design: Cultural Process and Environmental Response.* Oxford: Architectural Press.

Heerwagen, D. (2004). Passive and active environmental controls: informing the schematic designing of buildings. *Building and Environment, 42* , 203-210.

*Historical properties of Iranian Urban in Islamic time*1974Tehran

Hosany, N. A. (2002). Sustainability approaches for incarceration architecture. *Renewable and Sustainable Energy Reviews 6* , 457–470.

*Introduction to Urban Design*1982New YorkHarper and Row

Islam, A. K. (2003). *Patterns and Changes of Vernacular Architecture in Bangladesh* . Stockholm, Sweden: The Royal Institutes of Technology.

Jacobs, J. (1961). *Death and life of Grean American cities* . London: Amazoon press.

Jani, V. (2003). Architecture Time Space & People. *International Journal of Civil & Environmental Engineering* , 34-42.

Jencks, C. (1998). *Architecture today.* London: Academy Editions.

Jiang. Y,Chen. Q. (2002). Effect of fluctuating wind direction on cross natural ventilation in buildings from large eddy simulation. *Building and Environment 37* , 379–386.

John, D. (2005). *Code for Environmental Sustainability of Building* . Stockholm : Building and Construction Press.

Jovanovic, M. (2012). Aesthetics of Vernacular Architecture. *Opportunities, Limits & Needs Towards an environmentally responsible architecture.* Peru: PLEA2012.

Kadir, S. A. (2013). Universal Design as a Significant Component for Sustainable Life and Social Development. *Social and Behavioral Sciences* , 179 –190.

Kennedy, J. (2004). *Building Without Borders: sustainable construction for the global village.* Gabriola, B.C: New Society Publishers.

Khan, I. (1999). *An Alternative Approach to the Redevelopment of Old Dhaka.* Belgium: Catholic University of Leuven (K.U.L).

Kim, J.-J. (1998). *Introduction to Sustainable Design* . Michigan, USA: College of Architecture and Urban Planning The University of Michigan.

King, W. J. Harding. (2000). *Travels in the Libyan Desert.* London: The Geographical Journal.

Lombardi, P. (2001). Responsibilities towards the coming generations: forming a new creed. *Urban Design Stud. 7* , 89-102.

M. Mehdi Maeiyat, N. Movahed. (2009). Sustainable housing in semi-rural settlements; A known pattern to low carbon city Case study: Yazd, an ancient example of low carbon city. *45th ISOCARP Congress 2009*, (pp. 45-49). Istanbul .

MAK, M. Y. (2011). Social Sustainability: A Comparison of Case Studies in UK, USA and Australia. *17th Pacific Rim Real Estate Society Conference.* Gold Coast.

Master university thesis: Survey of Yazd urban morphology 2004Yazd Yazd university

McKenzie, S. (2004). *SOCIAL SUSTAINABILITY: TOWARDS SOME DEFINITIONS.* Magill: University of South Australia.

Mirmoghtadaee, M. (2009). Process of Housing Transformation in Iran. *Journal of Construction in Developing Countries, Vol. 14, No. 1, ,* 69-79.

Newport, D. (2005). The “environmental sustainability” problem. *International Journal of Sustainability in Higher Education* , 357-363.

Norton, J. (1999). *Sustainable architecture: A Definition.* New York : The United Nations Centre for Human Settlements, vol.5, no.2.

OBE, L. S. (2012). *The RIBA Guide to Sustainability in Practice* . London : Royal Institute of British Architects.

Oktay, D. (2012). Diversity for Better Quality of Community Life: Evaluations in Famagusta Neighbourhoods. *Social and Behavioral Sciences 35* , 495 – 504.

Oliver. (1997). *Encyclopaedia of Vernacular Architecture of the World.* Uk: Cambridge University Press, Vol 1.

Oliver, P. (2003). *Dwellings: The Vernacular House World Wide.* London: Phaidon.

Pacheco, T. (2012). Earth construction:Lessons from the past for future eco-efficient construction. *Construction and Building Materials* , 512–519.

Pacione, M. (2005). *Urban Geography: A Global Perspective.* New York: Routledge.

Parkin, S. (2000). *Sustainable development: the concept and the practical challenge.* New York: Paper Presented at the Proceedings of the Institution of Civil Engineers, Civil Engineering.

Plemenka. (1982). Vernacular architecture: a lesson of the past for the future. *Energy Build* , 43-54.

*Quality in Design*1993SydneyThe University of Sydney

Rapoport, A. (1990). *Defining Vernacular Design* . UK: Gower Publishing Company Limited.

Richardson, V. (2001). *New Building Architecture* . London : Laurence King Publishing.

Robins, F. (2006). The challenge of TBL: a responsibility to whom? *Business Society Rev. 111(1)* , 1-14.

ROGER, M. (2009). Improving Navigation Messages for Mobile Urban Guides: Effects of the Guide's Interlocutor Model, Spatial Abilities and use of Landmarks on Route Description. *International Journal of Industrial Ergonomics (39)* , 509-15.

Roufechaei, K. M. (2014). Energy-efficient design for sustainable housing development. *Journal of Cleaner Production 65* , 380-388.

Sachs, I. (1999). *Social sustainability and whole development: exploring the dimensions of sustainable development.* London: E. Becker, & T. Jahan.

Schuck, A. (2006). *Promoting Safe and Healthy Neighborhoods: What Research Tells Us about Intervention.* Washington D.C: The Aspen Institute.

Seyfang, G. (2010). Community action for sustainable housing: building a low-carbon. *future. Energ. Policy 38* , 7624 -7633.

Shahraki, S. Z. (2011). Urban sprawl pattern and land-use change detection in Yazd, Iran. *Habitat International 35* , 521-528.

Sharifi Yazdi, Jabbari. H. (2012). Primary drug resistance patterns in newly diagnosed tuberculosis patients in Yazd, Southern Province of Iran. *African Journal of Biotechnology Vol. 11(3)* , 702-706.

Sharifi, A. (2013). Changes in the traditional urban form and the social sustainability of contemporary cities: A case study of Iranian cities. *Habitat International* , 126-134.

Singh, M. (2009). Bioclimatism and Vernacular Architecture of North-East India. *Build Environ 44(5)* , 878–88.

Spangenberg, J. H. (2004). *Reconciling sustainability and growth: criteria, indicators, policies* . 74-86: Sustainable Development, 12.

Stephen, M. (2004). *Social sustainability: towards some definitions.* London: Oxford University Press.

Szekely, F. Knirsch, M. (2005). Responsible leadership and corporate social reresponsibility:metrics for sustainable performance. *Europ. Manag. J. 23 (6)* , 628-647.

Taleghani, M. (2011). Sustainability in architectural education: A comparison of Iran and Australia. *Renewable Energy 36* , 2021-2025.

Tavakoli, N. (2005). THE ROLE OF PHYSICAL IDENTITY OF CITY IN URBAN SUSTAINABILITY (THE CASE STUDY: YAZD,IRAN). *1 4 t h IN TE RN ATION AL P LAN NIN G HI STORY SOC I ETY CON F ER EN C E*, (pp. 1-17).

Tavasoli, M. (1990). *Principles and Techniques of urban design in Iran* . Tehran-Iran: Ministory of Housing and Development Islamic Republic of Iran.

*Towards a theory of city form*1982LondonUnpublished MPhil thesis, University College London

Turan, M. (1990). *"Vernacular Design and Environment Wisdom", in Vernacular Architecture Paradims of Environmental Responses* . UK: Avebary, Gower Publishing Company Limited.

Turan, M. (1999). *Vernacular design and environmental wisdom.* UK: Gower Publishing Company Limited.

Ultav,Zeynep. Sahl, Sare. (2004). *Hassan Fathy and Sedad Hakkı the two characteristics and two architectural view.* Istanbul : Gazi university faculty of architecture , Vol. 19, No. 4, pp. 365-374.

Ulusoy, M. (2012). The meaning and importance of the traditional architecture in Architecture education. *Procedia - Social and Behavioral Sciences 47* , 2120 – 2126.

UNDSD. (2001). *United Nations Division for Sustainable Development.* New York : United Nations .

Whitehand, J. (2011). Urban morphology and conservation in China. *Cities* , 171–185.

Zhai, Z. (. (2010). Ancient vernacular architecture: characteristics categorization and energy performance evaluation. *Energy and Buildings* , 357-365.