

**SUSTAINABLE HOUSING DESIGN IN SHIRAZ**

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*"To my beloved Wife & Family"*

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## ABSTRACT

Sustainable development is one of the most important issues which mankind is faced with these days. Using natural energy, not only lead us to save the Earth and protect the environment, but also will save the energy for future generation. To have a sustainable development, sustainable design is a necessity, and since the construction sections use the most energy in the Earth, planning for a sustainable design in construction would be one of the sustainability aims. Because people spend their most time in their houses, and housing -which is an important sector in construction- waste lots of energy, sustainable design for housing plays an important role in sustainable development.

In this thesis, sustainable housing design for Shiraz houses is identified. In the first step the concept of sustainable design and sustainable housing design are revealed and then, the characteristics of sustainable housing design are explained based on previous works and researches. Forward these works, same thesis for sustainable design in Putrajaya is modified and its methodology is analyzed. Total characteristics and modifications of Shiraz and Shiraz houses are explained in next step, and then the analysis based on the sustainable design characteristics is started. Each objective is analyzed based on each house condition and the results are determined.

The results show that, the best orientation for a house in Shiraz is East-West direction, which the length of a house faces North and South to gain the most solar lighting. Houses with large area of green spaces have a better situation toward preventing solar heating and prevailing wind, while roof shelters also help windows to prevent these harmful natural sources. The best form acting, that could prevent to lose less energy in the night and gain less energy in the day, is square housing form, which with having shading facades could prevent solar heat and prevailing wind.

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## LIST OF ABBREVIATIONS

ZEH	-	Zero Energy Homes
IEQ	-	Indoor Environmental Quality
VOC	-	Volatile Organic Compound
IT	-	Information Technology
LEED	-	Leadership in Energy and Environmental Design
BREEAM	-	Building Research Establishment Environmental Assessment Method
HVAC	-	Heating Ventilation and Air Conditioning

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Owing to the energy crisis and urgency of global warming and other environmental concerns, green or sustainable building has become a fast-moving movement across most of the world in recent years. (Yudelson, J. 2007, Ashrea, 2006).

Not very far from now human found him strong enough to use technology to prove himself and his society; so human being started to use the fossil fuels more and more to create whatever wanted. By that time it was very satisfying and good to use these fuels because improvement is needed and they did not care anything except their industries and manufactures. Suddenly human being found out that the earth is in dangerous situation and it is going to its end. In one hand the fossil fuels are going to be finished and in the other hand they polluted the earth and made it warmer and warmer. So they thought about having a sustainable earth with using some kind of energy without any pollution. From that time, up to now the sustainability became the main subject of many researches and almost everyone know something about it and try to act in a sustainable way.

An important step for building up a sustainable future is housing. Since people all around the world spend most of their time in their houses; houses become

one of the places that waste energy a lot. Nowadays and after understanding the sustainability by different governments, they try to encourage their people to use energy in the cost effective manner to protect the earth from pollution and also control the using of fossil fuels. In different places there are different projects and definitions to reach sustainability in housing and energy efficiency in buildings such as the Passive House Standard and Zero Energy House (ZEH).

A sustainable house is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. Sustainable houses are designed to meet certain objectives such as protecting occupant health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing the overall impact to the environment.

Providing for sustainable designs that meet all facility requirements is often a challenge to the building design, construction and operation community. With limited resources it is not always feasible to provide for the most secure facility, the most architecturally expressive design, or energy efficient building envelope. From the concept stage through the development of construction documents, it is important that all project or design stakeholders work cooperatively to ensure a balanced design. Successful designs must consider all competing design objectives.

The main objectives of sustainable design are to avoid resource depletion of energy, water, and raw materials; prevent environmental degradation caused by facilities and infrastructure throughout their life cycle; and create built environments that are livable, comfortable, safe, and productive. Designing major renovations and retrofits for existing buildings to include sustainability initiatives reduces operation costs and environmental impacts, and can increase building resiliency. Passive design strategies can dramatically affect building energy performance. These measures include building shape and orientation, passive solar design, and the use of natural lighting.



A house's location and surroundings play a key role in regulating its temperature and illumination. For example, trees, landscaping, and hills can provide shade and block wind. In cooler climates, designing houses with an south facing windows decrease the amount of sun (ultimately heat energy) entering the house, minimizing energy use, by maximizing passive solar heating. Tight building design, including energy-efficient windows, well-sealed doors, and additional thermal insulation of walls, basement slabs, and foundations can reduce heat loss by 25 to 50 percent (Environmental & Energy Institute, 2006).

## **1.2 Problem Statement**

Lack of researches in the sustainability of Shiraz Houses, makes a necessity to have some investigation on this subject based on Shiraz housing situation. Since the sustainability of houses has a direct relationship with its location, having a sustainable housing design needs to focus on house location to find out its potentials and limitations. Therefore in this study, after analyzing the sustainability of Shiraz houses, the study will concentrate on designing, to reveal a Sustainable Housing Design.

## **1.3 Objectives**

The aim of this study is determining Sustainability of Housing Design in Shiraz; to fulfill this aim the study is investigating the following aspects:

1. To study concepts of Sustainability in Housing and Housing Design in Shiraz;
2. To analyze the design of five houses or five plans;
3. To come up with the best characteristic of Sustainable Housing Design in Shiraz;

#### **1.4 Research Questions**

- 1) What is sustainable housing and what is the level of sustainability in Shiraz housing design?
- 2) What are the factors of sustainability in Shiraz housing design?
- 3) What is the best characteristic of sustainable housing design in Shiraz?

#### **1.5 Project Outline**

This thesis is divided into five chapters. The outline is as follows:

##### **1.5.1 Chapter 1- Introduction**

This chapter provides readers a first glimpse at the basic aspects of the research undertaken, such as an overview of Sustainability and its concept, the Housing Sustainability, problem statements, objectives and outlines.

### **1.5.2 Chapter 2 – Review of literature studies**

This chapter reviews the previous works on Sustainability and Sustainable Housing Design and the definitions and the objectives of Sustainable Houses and also other reviews related to this project.

### **1.5.3 Chapter 3 – Research Methodology**

This chapter presents the overall methodology and steps which are taken into consideration for sustainable housing design analysis. In this chapter the author will discuss the sustainability of five housing design in Shiraz to find out whether these houses which are samples, have sustainable design or not.

### **1.5.4 Chapter 4 – Results, Analysis and discussion**

This chapter shows the final results and analysis for sustainability of Shiraz sample houses. All results that have been achieved will be presented in chapter 4.

### **1.5.5 Chapter 5 – Conclusion, Recommendation and Limitation**

This chapter will conclude on the results gained and will make recommendations for future work and improvements that can be made. It also will present the limitation which the study faced with.

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