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## FULL LENGTH ARTICLE

# Investigating climate responsive solutions in vernacular architecture of Bushehr city

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**Abstract** As the main concern in sustainability is consideration to climatic conditions, climatically compatible design is the closest way of getting the maximum advantage of renewable sources of energy, while at the same time the design minimizes the undesirable effects of the construction in the environment and causes coordination with sustainability. From this point of view, the Bushehr traditional fabric, which is located in northern side of the Persian Gulf shore in south of Iran, is distinguished as a city with a unique vernacular architecture and climatically adapted urban design.

Climatic design in Bushehr traditional city is seen in several characteristics including urban morphology and urban orientation, as well as architectural design and architectural elements of buildings such as Shenashir. The main reason of using all these solutions and strategies in vernacular architecture of Bushehr was to be adapted to climatic condition (a hot and humid climate) and therefore using the environmental potential to provide comfort for its occupants, which are the main purposes of sustainable development.

As a result, this research attends to investigate these climatic solutions and their advantages as an idea to develop and use in contemporary architecture in order to reach sustainability. To this end, qualitative methodology based on a descriptive–interpretative approach is applied in this research for analyzing appropriate climatic solutions in vernacular architecture of Bushehr.

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## Introduction

Preserving environment is the most important issue of today's world in which human being has to reduce energy consumption [1]. As it is clear, worldwide around 40% of energy is consumed in buildings [2]. Due to population growth, increased urbanization and improvements of living standards most of energy consuming buildings will be located in the urban centers of the developing world. The depletion of energy resources and the risk of climate change are demanding for a sustainable development path based on renewable sources of energy and

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**Table 1** Some scholars' point of view about sustainability (Produced by the authors).

Scholars/ researchers	Sustainability
Martinez [4] SAM, HUI [5] Walsh [6] Munasinghe [7]	<ul style="list-style-type: none"> <li>• Considering the local climate conditions and the integration of the new building with the surrounding</li> <li>• Minimize the resource consumption and environmental impact through cooperation with external climate</li> <li>• There is a symbiotic relationship between the concept of sustainable development and the reality of climate change</li> <li>• Potential impacts of climate change on sustainable development</li> <li>• Climate change and sustainable development interacts in a circular fashion</li> </ul>
Emas [8]	<ul style="list-style-type: none"> <li>• Importance of intergenerational equity</li> <li>• Conserving resources for future generations</li> <li>• Protect the environment and natural resources</li> </ul>
Joshi et al. [9]	<ul style="list-style-type: none"> <li>• Sustainable development requires that the rate of depletion of non-renewable resources should foreclose as few options as possible</li> </ul>
Harris [10]	<ul style="list-style-type: none"> <li>• Maintain a stable resource base</li> <li>• Avoiding over-exploitation of renewable resource systems and depleting non-renewable resources</li> <li>• Promotion of values that encourage consumption standards within the bounds of the ecologically possible</li> <li>• Avoid threatening the natural systems that support life on Earth</li> </ul>
Zhang et al. [11]	<ul style="list-style-type: none"> <li>• Sustainable growth relies on the preservation and efficient use of the country's land, water, and forests, as well as other natural resources</li> </ul>
Salkin et al. [12]	<ul style="list-style-type: none"> <li>• Focuses on all laws and policies that affect environmental quality and the availability of natural resources</li> <li>• Provides a minimum standard of protection for human health and the environment</li> </ul>

energy efficiency [3]. Sustainability is a complex word and involves a lot of conceptions and considerations but one of the most important questions included in the meaning of this word is the tolerance of ecological pressure in buildings. In sustainability term, the most important thing to start is to build energy efficient and non-toxic houses and to eliminate the use of non-renewable resources [4]. Good energy efficiency homes provide better environments for people living in them as well as reducing the impact on the natural environment [4]. On the other hand, the basic philosophy of climate responsive design lies upon the evaluation of climatic influence and the optimization of building environmental performance [5]. In other words, we are trying to minimize the resource consumption and environmental impact through cooperation with external climate. As a result, climate responsive design can play a significant role in reducing energy consumption of buildings without compromising modern living standards [5]. Truly, people's environmental comfort in a building depends on adaptation with climatic factors such as wind, and sun. Hence, there is a link between sustainability and climate responsive design, in which both of them try to reduce energy consumption and create comfort for building's residents. Additionally, by the usage of climate responsive design we would be able to go further steps in sustainability and minimize energy consumption which is a nowadays discussion. Table 1 lists some scholars' point of view about sustainability.

All these scholars believe that adaptation with climatic conditions and reducing energy sources have significant impacts on reaching a sustainable development and sustainability.

Studies and experiences have proven that vernacular architecture of our ancestors had been an appropriate source for studying and re-using their solutions in designing buildings [13].

Foundations of Iran vernacular architecture have been derived from the nature and its great deal of energy (sunlight, water, wind and soil). Additionally, it is contextual, earth-dependent, which is an integral part of the environment [13].

Hence, studying vernacular architecture of our ancestors especially Bushehr could be a proper source for investigating their solutions for adaptation with climate conditions and reducing energy consumption. To this end, the research objective was investigating solutions and their advantages for designing vernacular architecture of Bushehr, which are in accordance with climate condition and sustainability.

As a result, the research attends to answer the following question.

What are climatic solutions in Bushehr vernacular architecture and their solutions to be adapted with climatic conditions and sustainability?

To answer this questions some measures should be taken into account:

First, the exact meaning of vernacular architecture to investigate its concept should be studied. Then, Bushehr city's background and its vernacular architecture in three scales of the urban fabric, the architecture unit and at the scale of architectural details should be investigated through library research and their accordance with Bushehr hot and humid climate condition should be analyzed. On the other hand, the relationship between climatic design and sustainability should be analyzed through library research for finding out that how climatic design in vernacular architecture of Bushehr reaches a sustainable development.

#### *Concept of vernacular architecture*

Vernacular buildings are architectural products that emerged as a response to the requirements of societies before the industrial period and to the insurmountable limits created by the region and climate, and because of the unique interaction between human mind and experience gathered by observing natural phenomena [14]. Vernacular buildings, either individually or a whole settlement, are the best examples of the harmony among human behavior, building and the natural environment [14]. It contains inherent, unwritten information

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