Sustainable Roofs in Iranian Vernacular Residential Buildings

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ABSTRACT

Increasing interests in sustainability has caused emerging new approaches in roofs design such as green roofs and rooftop garden. Principally, roofs are designed to provide shelter and protect indoor from effects of weather, while roofs in the vernacular residential buildings (VRB) in Iran served more than protective function. Vernacular roofs were efficient spaces that provided many environmental benefits as well. This paper has conducted a review research to investigate the sustainable roofs of the vernacular residential buildings in Iran. The results shows that in comparison to the new sustainable movements, Iranian master builders reconciled environment, economy and society and considered sustainability criteria and concepts in the roofs design and construction. Vernacular roofs were built according to the climate and they provided comfort for residents. They were energy efficient, economic, durable, and comprised recyclable materials with minimum impact on the environment. The vernacular roofing materials were locally obtained, natural and cost-effective. Moreover, the roofs served as living spaces, public areas, social and cultural interaction centers, and workplaces. This study recommends professionals to have a re-look back to the whole concept of the vernacular roofs of Iran, learning, adopting and reusing the concepts of those sustainable roofs in the new architecture.

INTRODUCTION

Sustainable buildings consider climate, environment, natural resources and traditional construction of the region. Moreover, they provide comfortable indoor temperature through with using natural methods for cooling and heating purpose [1]. Roofs are the most exposed surfaces to ambient among the external envelopes of buildings [2]. Hence, roofs are designed to provide shelter and protect indoor against extreme weather. A sustainable roof is durable and comprises recyclable materials with minimum impact [3,4,5]. Vernacular roofs in Iran that were built around 200 years ago, served more than shelter. Iran is a vast country, which the geographical and cultural characteristics of it caused creating diverse architecture designs [6,7]. People-oriented, introverted architecture, self-sufficiency, avoidance of futility, sustainability and construction technology were five architectural principles in Iran, which were considered during the vernacular construction [8]. Iranian traditional architecture was sustainable but the principles of this style have disappeared, recently [9]. Vernacular buildings in Iran were environment-friendly, used natural resources [10,11].

METHODOLOGY

This study has focused on the central areas of Iran as a case study with the hot and dry climate, flat, domed and arched roofs built by clay, mud and straw. Most of VRB in central Iran were located in villages [10] and half of them were constructed based on the vernacular architecture principles. Many factors affected the vernacular architecture and design of residential buildings [12]. There are various climatic conditions in Iran [13], including mild and humid, cold, hot and dry, hot and humid [7, 14], mild semi-desert climate [12,15,16]. Various shapes of the rooftops and materials were used in the different regions.

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RESULT AND DISCUSSION

Reconciliation of three issues including environment, society and economy are required for sustainability [17]. The environmental, economic and social considerations in the vernacular roofs design and construction has been described in the following sections.

i. Environmental Considerations:

Environmental considerations of the vernacular roofs included roofing materials, climatic responsive roofs, and using natural resources, saving energy and providing comfort through the roofs. It determined natural and energy efficient strategies in residential buildings [18]. Vernacular roofs managed energy consumption and provided well-being and comfort of residents through the several approaches. These high thermal mass materials were chosen in hot and dry climate in order to provide thermal comfort, save energy and act as insulation layers in the both hot and cold seasons [18-21]. Domed and vaulted roofs were used in the VRB due to their thermal performance [22, 23]. The curved roofs lost heat more than flat roofs during the night, which caused reduction of indoor temperature [24]. Arches and domes with two or three surfaces performed as insulators for heating or cooling the interior air [6]. Well-designed arched roofs with ventilation cap at the top were proper choices for the hot and dry climate [25,26], which could discharge the indoor warm air through the opening. Admitting sunlight through the roofs openings was another environmental consideration. This particular strategy was used for closed spaces in west part of the VRB or for some spaces such as kitchen in order to capture daylight. The roof openings prevented direct sunlight penetration in afternoon [12,27,28].

ii. Economic Considerations:

Green roofs are cost effective only for the commercials and complex buildings and when social benefits are included [29], while, Iranian vernacular roofs were economical for every types of the buildings including residential buildings. Design of a building and selecting materials have to be according to the site and geographical conditions of land for more efficiency [30]. Extraction and production of materials in the region can support the economy of the area [3]. Hence, the time and cost for producing materials and emission pollution due to industries activities would be reduced. The master builders in the past, considered economy factor in the vernacular roofing in Iran. Using local material can reduce energy consumption and cost [18,31,32,33]. The materials used in the VRB of Iran were locally obtained, mixed and produced in the site without needed any transportation.

iii. Social Considerations:

Providing peace, security, and open spaces for occupants and linking people to nature were some social considerations of the roofs in the VRB. In the past, the vernacular roofs within the residential buildings in Iran served more than shelters. They were efficient open spaces in the VRB, which occupants could use them [32]. Rooftops provided open spaces for physical activities of residents in summers [33] (Fig. 1). Regarding the climate of the region, people took the advantages of the outdoor temperature through the roofs. The roofs were considered as living spaces with the particular functions. Residents slept on the roofs at night and watched the stars in summers in order to enjoy the cool weather and breeze. Some residents kept and bred pigeons on the roofs as a hobby. Furthermore, flat roofs provided possibility of observing the city, passage and neighbor communication. Roofs were places for holding rituals and religious ceremonies. People could watch the ceremonies on the roofs. Moreover, the vernacular roofs provided interaction of people with the environment and natural resources. People used the roofs for sun drying purposes. They dried their washed clothes, fruits and vegetables on the roofs. Additionally, residents did economic activities on the roofs such as producing dried fruits for sale. Likewise, dyers laid and dried the yarns on the flat or domed roofs [34]. Therefore, people could use the roofs as living spaces, social interaction centers, workplaces and public spaces in comfort and secure conditions.

Fig. 1: Neighbor’s communications on the roofs, Palangan Village, Kurdestan, Iran
CONCLUSION

The results have shown that the vernacular roofs reconciled environment, economy and society of the region and met the sustainability criteria. The roofs were climatic responsive, used eco-friendly roofing materials, utilized natural resources for providing comfort of the residents, and saved energy. The vernacular roofing was cost effective due to the using locally obtained materials. They also increased interaction of people and environment by ventilating air and admitting day lighting through the openings, and providing sun-drying spaces. This study recommends professionals to have a re-look back to the whole concept of some of the sustainable vernacular roofs of Iran, learn, adopt and reuse them in the new architecture in order to provide healthier cities. Vernacular roofs as parts of the buildings met the sustainability criteria and provided economic, social and environmental benefits and people in the past aware to their environment, climatic conditions, human needs and comfort.

REFERENCES


