Development of a sustainable cooling and ventilation system for hot-arid climate regions

With a brief introduction to traditional cooling and ventilation systems in hot and arid regions of central Iran

1. Introduction

It is fascinating, how the former architects knew to decrease the impact of extreme climate conditions in different climate zones by applying simple but very intelligent elements, leading to the development of sustainable and energy efficient architecture.

The architecture in hot and arid climate regions all over the world has many certain elements in common to provide more comfortable living environment for the inhabitants.

Unfortunately, today’s problem in these regions is that their inhabitants build more often in a wrong way, following inappropriate building techniques without taking climate conditions and cultural aspects into account. This has led to extremely high energy consumption in these regions. These buildings are not sustainable and due to their improper techniques for hot climate conditions are even in many cases barely comfortable to live.

In this poster, it is emphasized, that traditional architecture serves a better understanding and its intelligent elements should be assigned to the today’s architecture.

2. Traditional architecture in hot and arid climate regions of central Iran

City Yazd is located in hot and arid zone in the central plateau of Iran and is one of the best places to find and study the traditional architecture and building elements.

3. Weather data in Yazd

Figure 1: Relative humidity [L] in Yazd.

Figure 2: Average temperature [°C] in Yazd.

4. Natural cooling and ventilation system

Figure 7 illustrates the cooperation and the function of natural cooling and ventilation elements in a traditional house in Yazd. The hot and air is caught by the high adobe wind catcher and is led into the house. On its way through the long adobe chimney and with the help of evaporation principle, the air becomes moist and cool. Through the adobe wind canals inside the house, a part of the air is led into the basement and the other part into the summer residence and courtyard. The first part passes through the basement’s adobe wind canals under the courtyard and absorbs moisture from the canal walls. Accordingly, it blows to the courtyard through the small openings on the surface. The whole evaporation and also air circulation processes cause a more comfortable climate in house and in courtyard.

The trees in the yard are also elements of the natural cooling system. They provide a better air quality and more shade in courtyard. Furthermore, their roots keep the basement’s wind canals moist and it causes more evaporation. [2], [3]

5. Energy efficiency

In summer, when the air stream reaches the basement canals its temperature is about 26°C. After the air passes through the underground canals, which are about 25m long, its temperature decreases 3°C. It means that in extreme hot days (40°C, 10% relative humidity), the air is cooled down to 23°C (50% relative humidity) through the natural cooling system. Due to this fact, the building doesn’t need any additional cooling system during summer and 100% of energy demand for cooling will be saved.

6. References


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Note: This image contains a table and a diagram. The table provides temperature data for Yazd, while the diagram illustrates the operation of wind catchers.