Proposing Prototypes for Integration of Vernacular Windcatchers with Lightweight Tensile Structures in Contemporary Hot-Arid Urban Context

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1 INTRODUCTION

Windcatchers are part of the buildings in the hot-arid climates and they are classified as a human comfort cooling system for moderating the indoor temperature of the buildings. Windcatchers are usually found in the Middle Eastern countries. They use wind, as a renewable energy source and utilize thermal mass, and evaporative techniques to provide human comfort by natural ventilation. In recent decades they are rarely used in the contemporary buildings due to the disadvantages such as maintenance difficulties, lack of appropriate filtration, modifications in the building space utilization, and dependencies on mechanical air cooling systems.

The concept of using windcatchers as a passive cooling technology could be revived if only their functions are integrated with the contemporary urban context of hot-arid regions. Lightweight tensile structures could be possibly used as a method to integrate the functionalities of windcatchers with the modern urban utilization of hot-arid regions. With the recent advancements in the related technologies, tensile structures have the potential to be lightweight, transparent, self-cleaning, translucent, movable, and deployable. These beneficial aspects could be used in proposing innovative natural ventilation prototypes to be considered in the modern hot-arid urban context.

2 BACKGROUND

Membranes are thin skins, which can be made of fabric, foil or any other suitable materials. Tensile structures are light in weight because their structural stability results from their prestressed shape rather than the mass of the materials used. Consequently, they are much lighter than conventional building structures yet offer high stability. The combination of low mass and wide span provides the architect with opportunities of expressing lightness and stability in a coherent and unified way through the organization and shaping of each detail.

The lightness of tensile structures gives them clear preferences over other constructions like mobility, adaptability and being convertible. In fact, convertible structures can be seen as the most adaptive systems; these features make tensile structures to be flexible in their spatial arrangement and response to climatic variations. The resistance of membranes to soiling is considered as an outstanding criteria for their appearance and maintenance cost; nanotechnology can provide high durability for fabrics in order to be self-cleaning.

3 INTEGRATION CONCEPTS

In this integration of windcatcher with tensile structures, windcatchers would act like chimneys, because of the stack effect. There is a big difference between the temperature during the day and at night in hot and arid regions. At night, the thermal mass emits the heat that has absorbed during the day and becomes cool. The tensile structure in this proposal can be used as a shading which provides an environment for the social interactions of the dwellers. Also, using PCM material (Figure 5, b) helps to bring the natural daylight inside the building.

This concept uses cool tower for bringing the air into the building. Tower produces fresh cool air which sinks through the tower and then enter the openings of each floor in order to provide required fresh cool air for natural ventilation in each story of buildings. Also, in this proposal PCM materials are used as a thermal mass in glazing windows. The purpose of using PCM materials is to have natural light and thermal mass at the same time.

5 REFERENCES