

Sustainability through Wind Catchers

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Abstract. *Ventilation* is considered as one of the most important aspects in a successful architectural design. Distinguished designers dedicate a considerable part of the design process to develop this important aspect in their building design.

The design concept is based on suction of outdoor air through vertical wind catchers positioned on top of the buildings adjacently to staircases and directed to the North West. The imported air is directed into underground horizontal ducts where heat exchange takes place between the hot air in the ducts and the cooler soil, thus cooling the air and increasing the humidity level which ultimately results in colder air in the ducts. The hot air is then repelled into the courtyard or the outdoor.

Keywords: Wind catchers, natural ventilation

1 Introduction

1.1 Natural ventilation (Wind catchers)

Human comfort is determined by many factors such as health, activity, gender and time of the year. Some scientists have defined it to be around 24 Celsius. A human being needs a suitable climatic conditions, and illumination comfort and noise control that should be realized naturally and architecturally and complimented with mechanical and industrial means, which achieves maximum comfort and financial feasibility in the initial and operational costs of a building.

1.2 Wind Catchers: A historical Glimpse

Wind catchers usage for residential cooling and ventilation is considered an invention required by human and architectural needs in the pre-mechanical air-conditioning era. It ameliorates the impact of the harsh hot climate in the Arab region. There is no defined first implementation of the concept. It has been common in the Abbasids era, since all hospitals back then were equipped with wind catchers. Catchers also existed in houses.

1.3 Wind Catcher Definition

It is a tower with air inlets on the building's facade for cold outdoor air suction into the interior building spaces. The air movement results in negative air pressure, which assists in air supply to the interiors. The presence of the wind catcher along with the mashrabiya (a decorative window wooden grill) ensures a continuous air supply.

Although it varies in design, form and height its main purpose is consistent; catching cold air from the higher elevation of the atmosphere and direct it through vertical passages into the interior spaces. It is insulated from the exterior with a thick external wall, which is a necessity to lower the internal building temperature. It is also a living necessity for the inhabitants to accommodate the hot weather which is the characteristic of the climate in the Arab region.

Some wind catchers are furnished with a net or grill that filters air from pollutants and dirt.

1.4 Benefits and qualities of wind catchers

Wind catchers provide natural ventilation of air that is free from pollutants and dirt as its air source is the elevated strata of the atmosphere, which flows into the interior spaces, regardless of the buildings orientation and its relation to the wind direction.

Contrary to the case of window ventilation, ventilation through catchers does not lead to higher noise levels in the interior space.

The size of the cross-section of the wind catcher tower is determined by the surrounding temperature. It is reversely proportional to the temperature: as the air temperature at the catcher inlet is higher than the maximum comfortable internal air temperature, the cross-section must be smaller in size. This is given the condition that the air must be cooled down as it passes through it via wet fabrics or damped coal boards placed between steel grills. The airflow can also be directed over a water feature such as a fountain to increase its humidity.

2 Geothermal Heat energy

It is a type of embedded energy in the outer layers of the Earth's core. It contains energy that is equivalent to the human race's needs for 30 million years, which means it is an underground sun. The geothermal heat energy will become the spine of the renewable energy economy in the world, as it can be said that its amount is infinite. The temperature of the first 30-70 cm of the earth's crust varies according to the external air temperature, as is the case with the deeper 10-20 m which is affected by the season's temperature. This influence diminishes in deeper layers of the following 15-20 m. The Earth's core temperature is affected by many factors such as the soil's type, rocks, air humidity and the geographic location.

2.1 Historical glimpse

Human comfort is determined by many factors such as health, activity, gender and time of the year. The animals were the first to exploit the geothermal heat energy, since they dig underground tunnels for their hibernation. Doing so, these animals make use of the temperature in the deeper layers, which is around 10-12 Celsius.

Ancient Romans used to heat their houses using hot water springs. As such, the people of New Zealand cooked their food on hot water spring.

In addition, hot air current systems, used for residential heating purposes make use of the geothermal heat energy at depth of 1-2 m when a horizontal piping system is used. As for the vertical Piping system, the excavation is 100 m deep into the ground.

4 Conclusion

4.1 Qualities of Natural ventilation system

- 1- Increase of cooling and natural ventilation versus the reduction of loads on the typical mechanical air-conditioning system
- 2- Increase of the life-time expectancy of the cooling system as it is directly related to the building's life-time
- 3- Easiness of maintenance in addition to savings in operational costs in comparison to typical mechanical systems.
- 4- The system is environmentally friendly as it does not include Freon gas which is harmful to the environment. In addition, it lowers energy consumption.

4.2 Summary

- 1- Using natural underground ventilation system results in 60% savings in energy consumption.
- 2- This natural ventilation system provides filtered air free from pollutants and dust and allows for the renewal of the circulating air continuously, in addition to the removal of foul odors.
- 3- Using sound insulating light-weight block maintains privacy and reduces noise levels.
- 4- Using sun breakers on the building's facades allows for a better thermal insulation level which results in a better living environment for the inhabitants.
- 5- This natural ventilation system is characterized with a natural perspiration property, due to the air passage through multiple filters before reaching the inhabitants. The building blocks are also characterized with the ability to absorb excessive moisture from air and giving it off when air is drier.

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