

Natural Ventilation of Buildings Using a New Design of Wind-Catcher to Decrease Energy Consumption in Windy Regions

Madjid Soltani

Director of Renewable Energy Lab, DoE
Director of HVACR Lab, KNT University of Technology
Tehran, Iran

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Introduction

Small towers installed on top of the buildings.

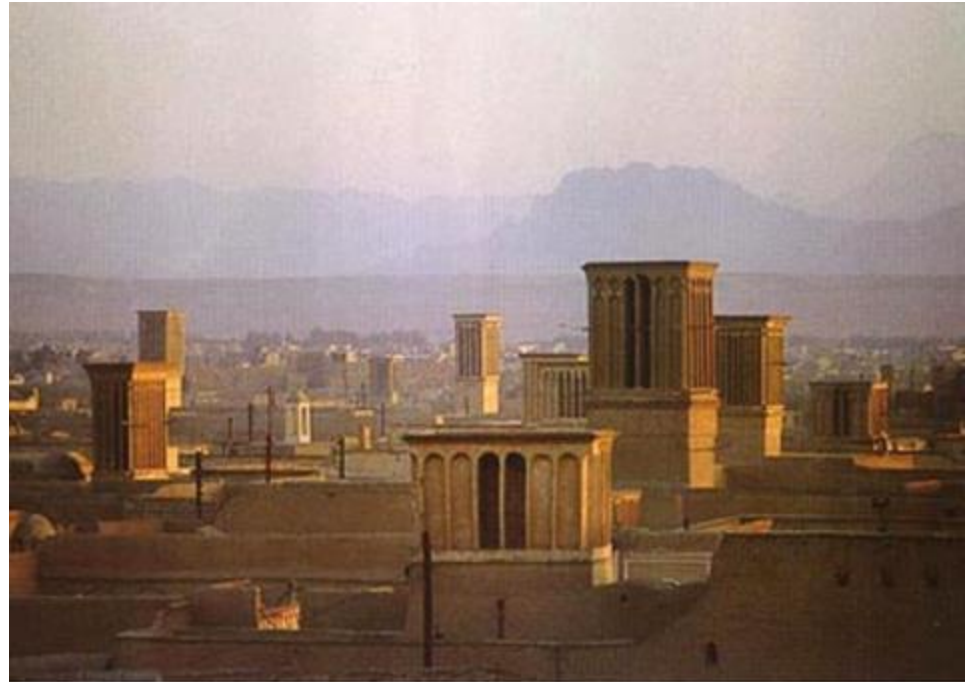
Different shapes and structures,

Used for ventilation and cooling of buildings in the hot and arid or humid areas.

Still used in some areas of Middle East and Egypt.



Cairo, Egypt

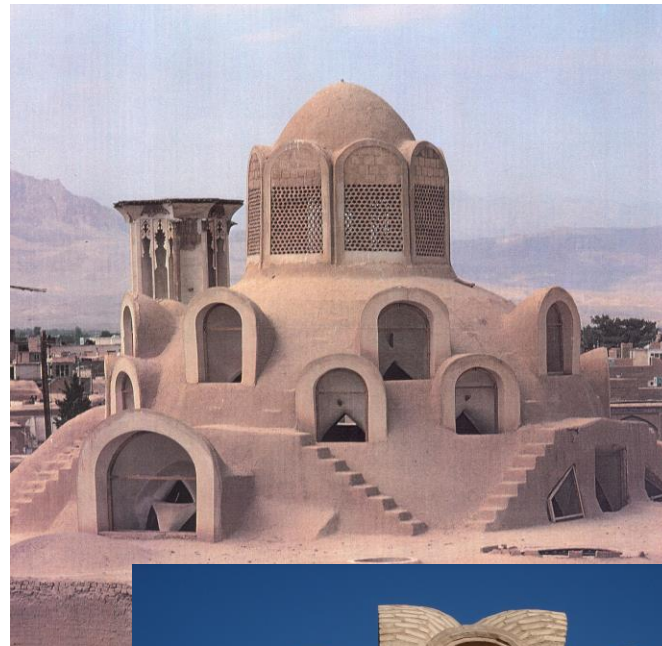


Yazd city, Iran

Introduction (cont.)



Taft City
Iran



Kashan City
Iran



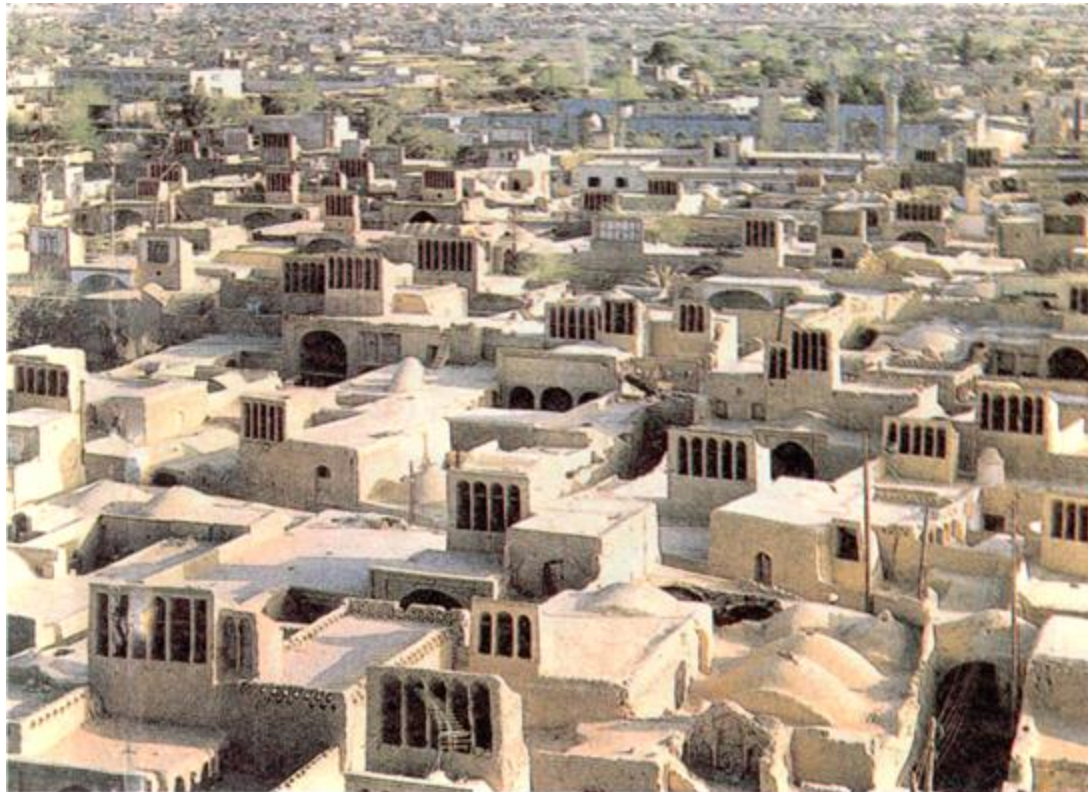
Ardestan City, Iran



Sirjan City, Iran

Conventional and Traditional Wind Towers

1- One-sided wind towers



Conventional and Traditional Wind Towers

2- Two-sided wind towers

More efficient for circulating airflow,
Blowing and sucking airflow into the building.



Conventional and Traditional Wind Towers

3- Four, six, eight-sided wind towers

Bigger and also usually taller than the previous two types.



Conventional and Traditional Wind Towers

4- *Cylindrical wind towers*

The most advanced type of wind towers with better performance than the other three types of wind towers



Conventional and Traditional Wind Towers

The regions in Iran and other Middle East countries as well as Egypt that use wind towers



Conventional and Traditional Wind Towers



Dubai, UAE



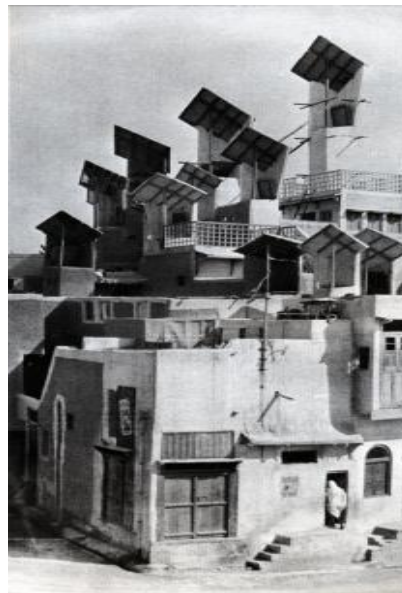
Duha, Qatar



Manama, Bahrain



Herat, Afghanistan



Heydar Abbad, Pakistan

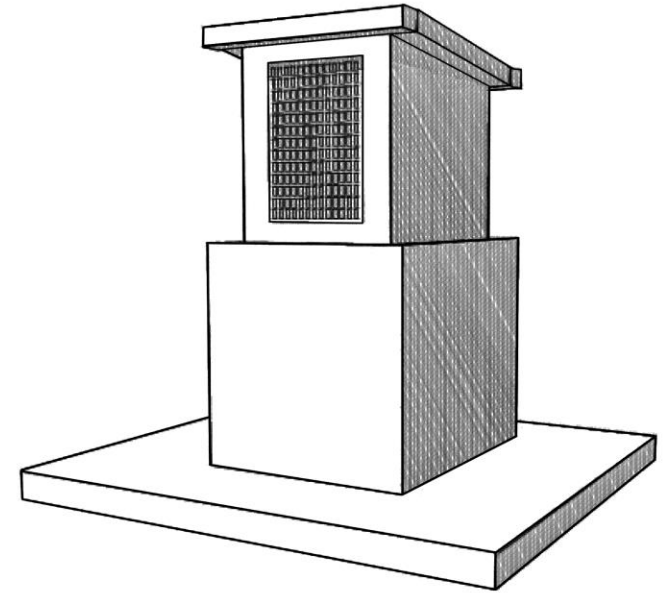


South Shuna, Jordan

Conventional and Traditional Wind Towers

Several limitations:

- They allow small birds and insects to enter the building,
- The head of wind towers is fixed,
- Part of inlet air flow exits without circulating,
- They do not have any application in regions with very low wind speed.



New wind tower is designed to address these limitations and to be installed in the maximum wind speed direction.

The Proposed Wind Tower

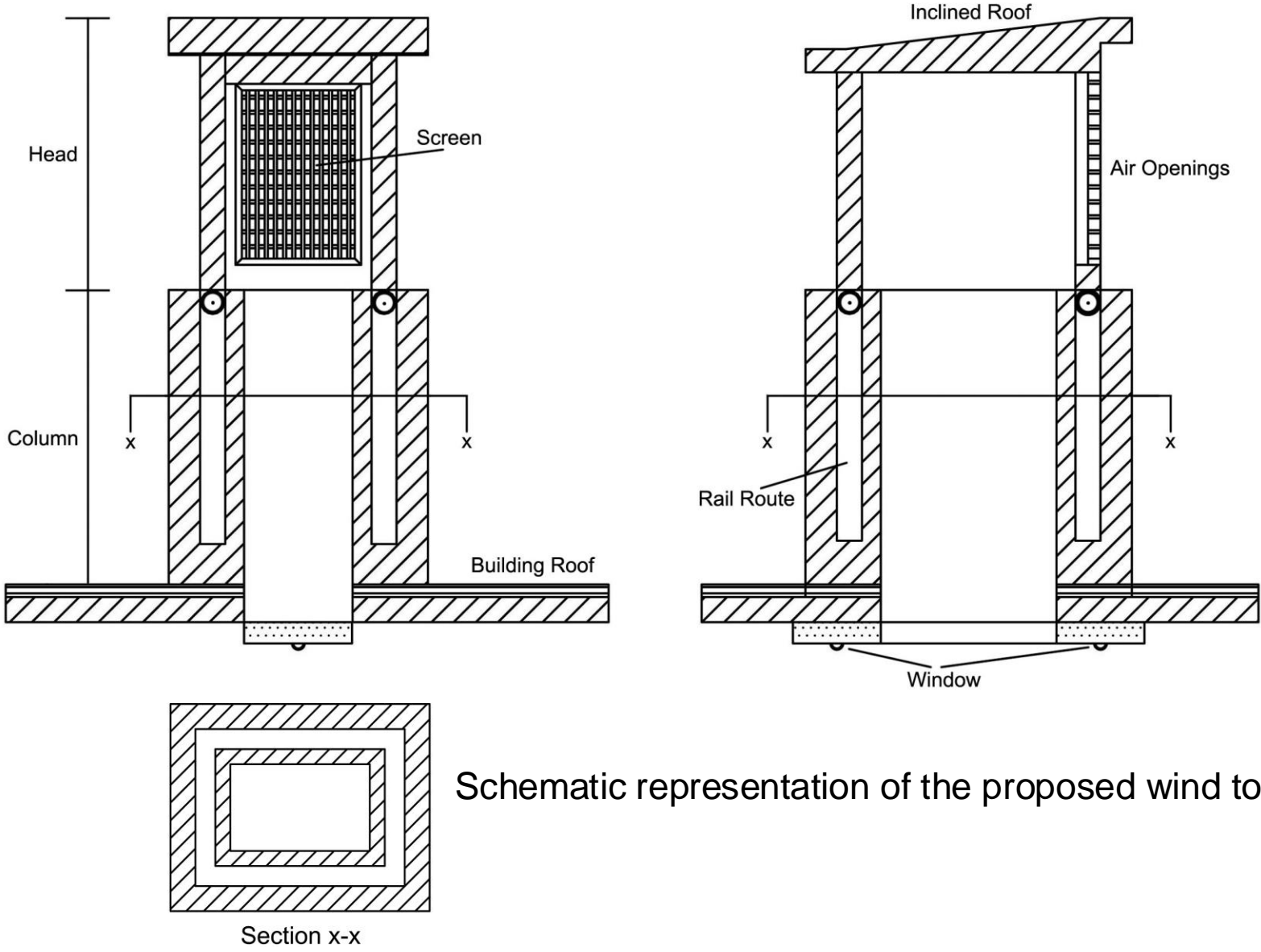
It has an air opening in the direction of the maximum wind speed.

The cross section of it can be a square, a rectangle, or a circle.

It has several components:

1. *Head*: It includes a moving column that can be opened and closed manually or Automatically. The screen prevents small birds, insects and solid particles to enter the building.
1. *Column*: This part is fixed and can be installed on the rooftop using bolts. The interior surface of this column is equipped with a rail route to allow easy movement of the head of the wind tower.
2. *Windows*: Two windows are installed at the lower end of the column to control the airflow.

The Proposed Wind Tower (cont.)



Schematic representation of the proposed wind tower

The Proposed Wind Tower (cont.)

The dimensions of the wind tower depend on several parameters:

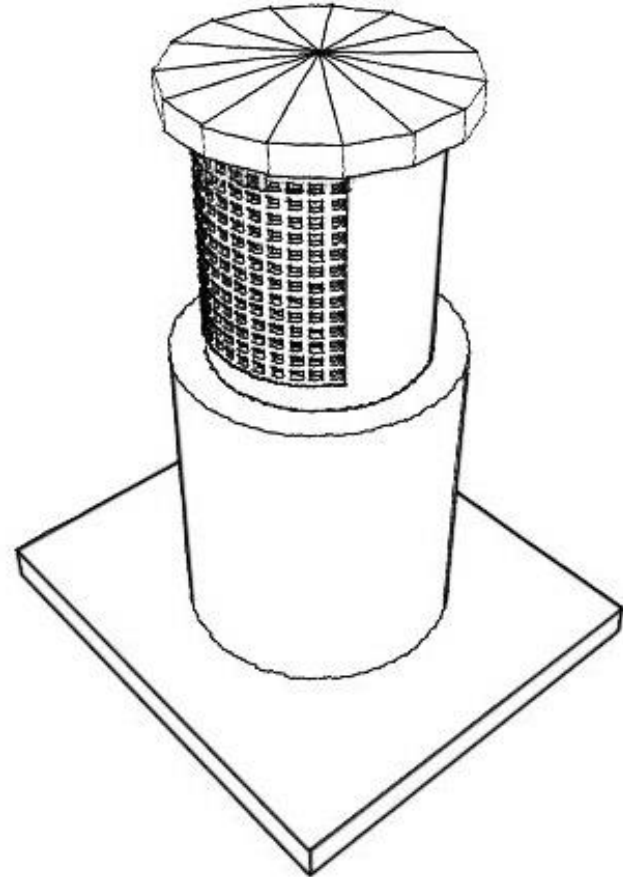
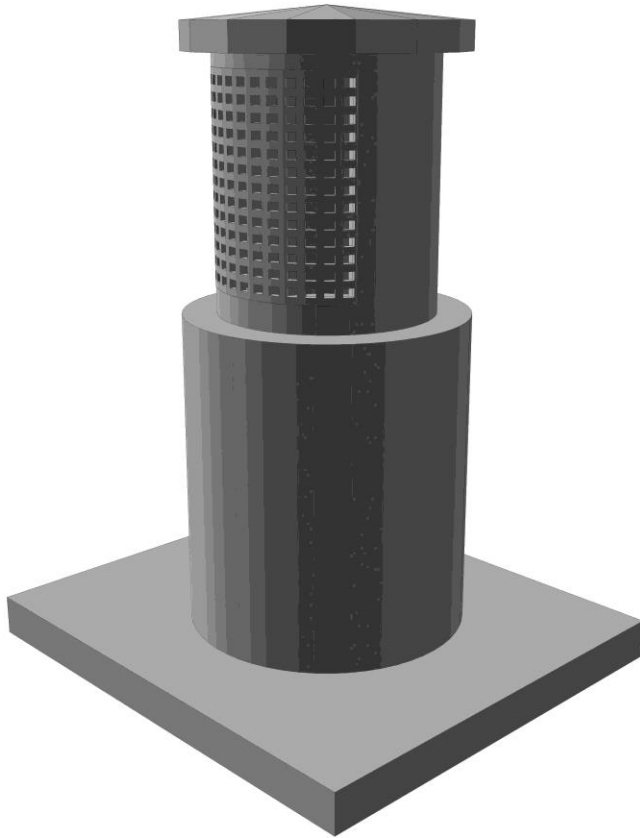
- (1) The mass flow rate required for air conditioning and thermal comfort,
- (2) The dimensions of the building and the material used in the building,
- (3) Wind rate in the region, and
- (4) Building security.

Installation points

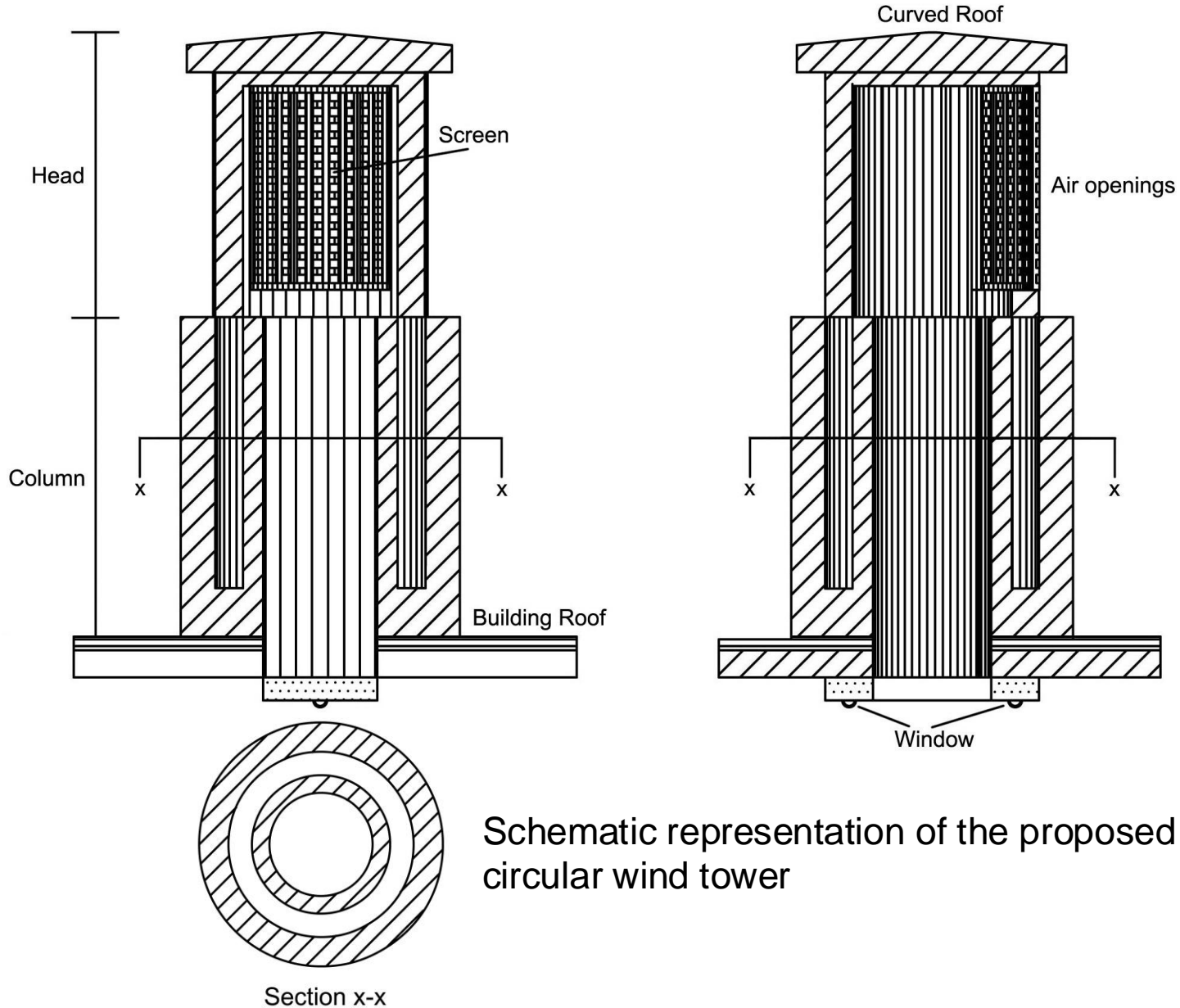
- Same material as the building,
- Weather condition in selecting the proper material,
- Transparent materials to maximize use of natural light,
- Wind tower with a rotating head.

The Proposed Wind Tower (cont.)

The view of the proposed circular wind tower



The Proposed Wind Tower (cont.)



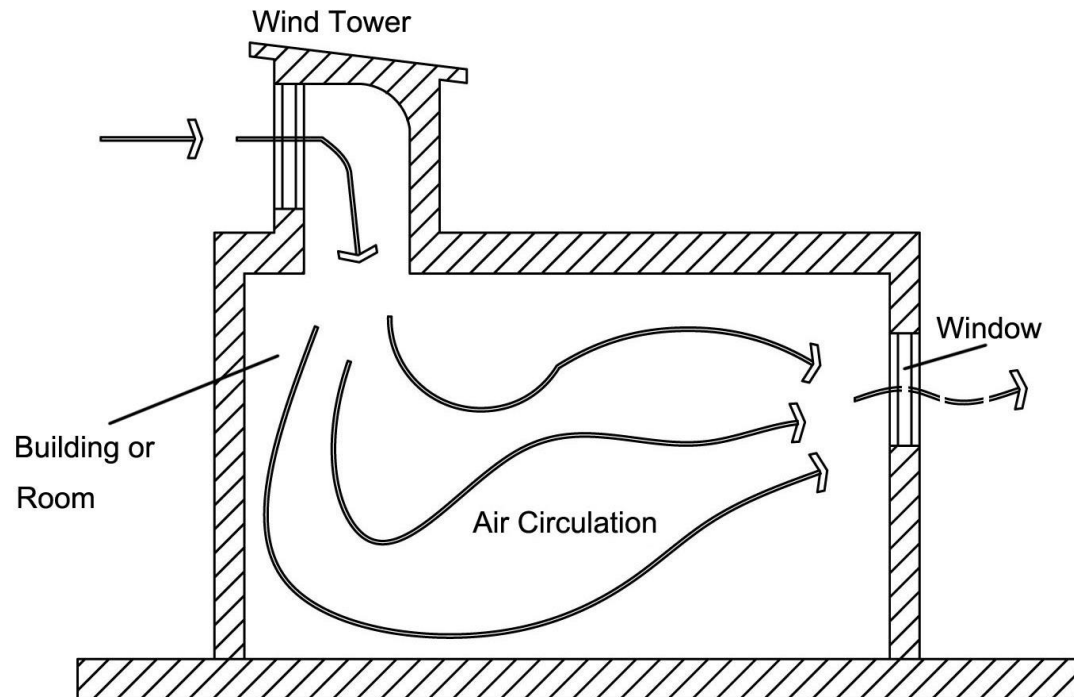
Schematic representation of the proposed circular wind tower

Applications

The proposed wind towers can be used for passive ventilation of residential buildings, closed arenas, and commercial and administrative buildings.

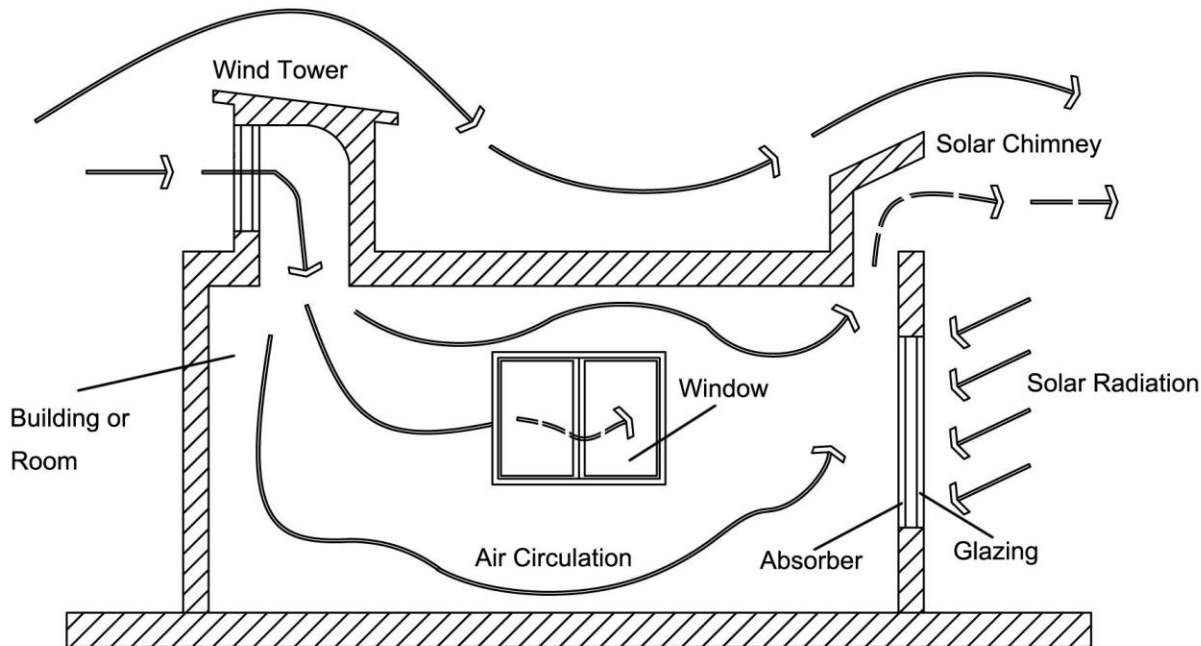
A combination of methods can be used to obtain proper ventilation and thermal comfort:

- (1) A wind tower and one or more windows,
- (2) A wind tower and a solar chimney or air heater,
- (3) Two wind towers in different directions.



Applications (cont.)

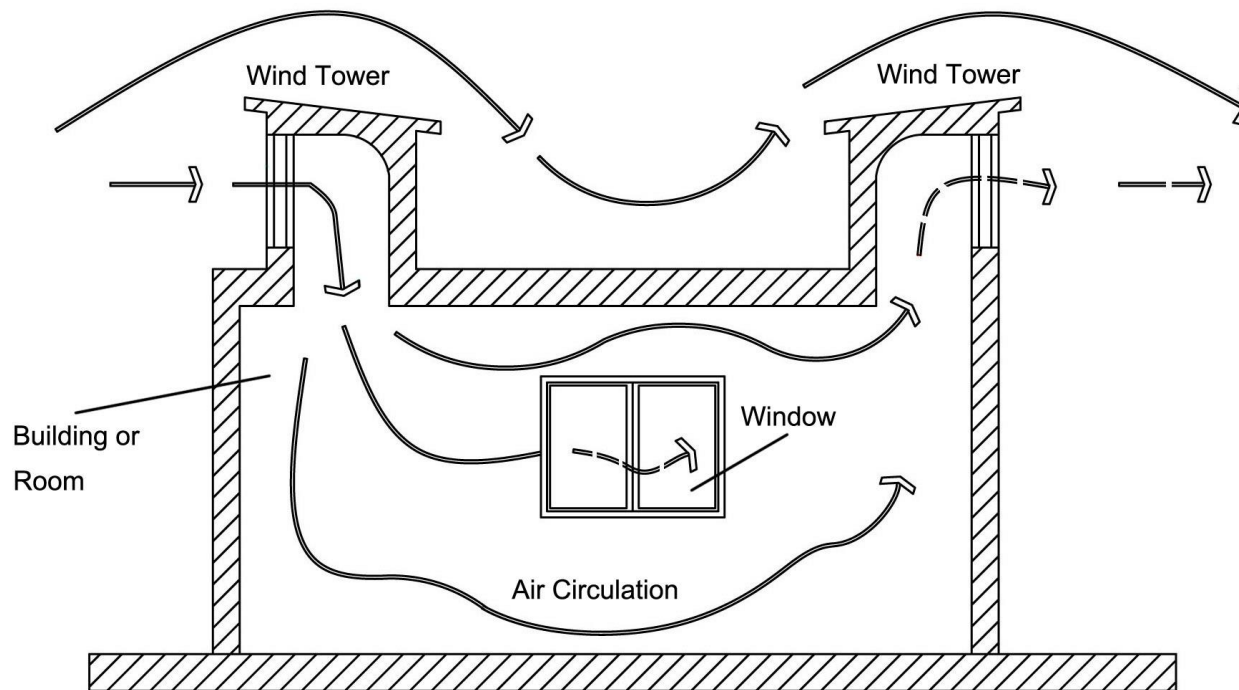
In the ***second method***, a solar chimney or an air heater is used in another part of the building. In this design, the air enters through the wind tower and exits the building through doors, windows, and the solar chimney.



Applications (cont.)

In the ***third method***, two (or more) wind towers are installed; one in the direction of the maximum wind speed and another in the opposite direction.

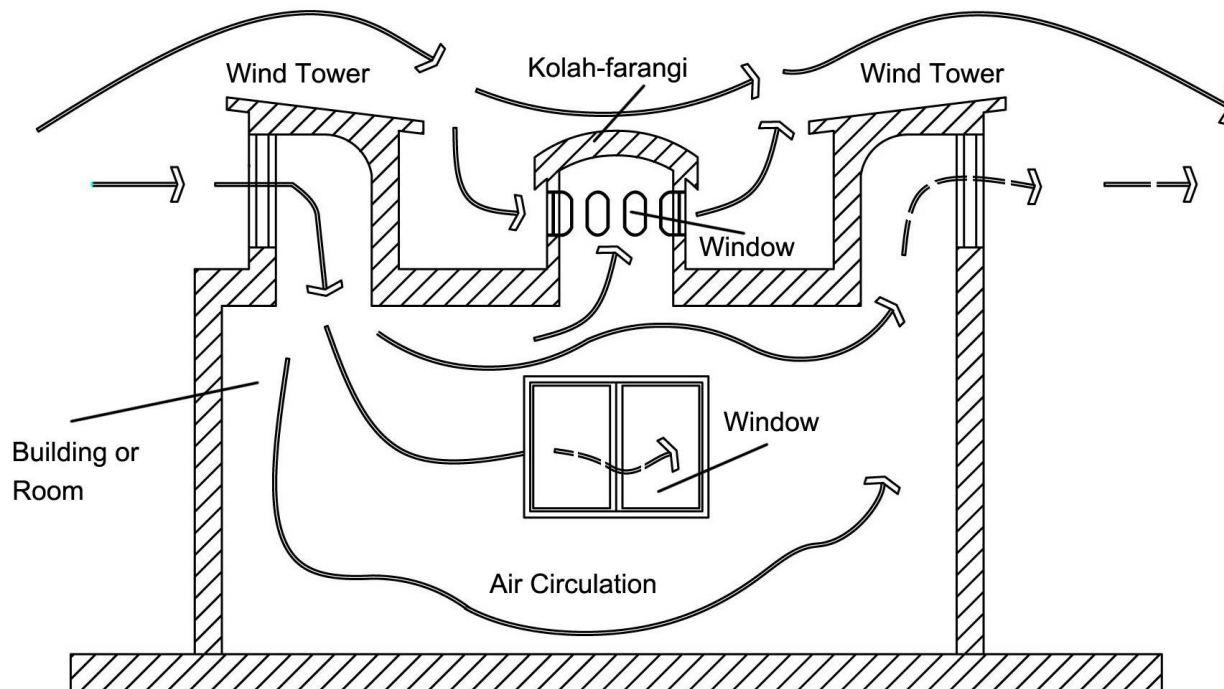
Based on the direction of the maximum wind speed, the proposed wind towers in the third method can be adjusted manually or automatically for best results.



Applications (cont.)

If possible, ventilation rate can be improved by installing a dome or Kolah-farangi.

Use of Kolah-farangi facilitates the use of natural light inside the building too.

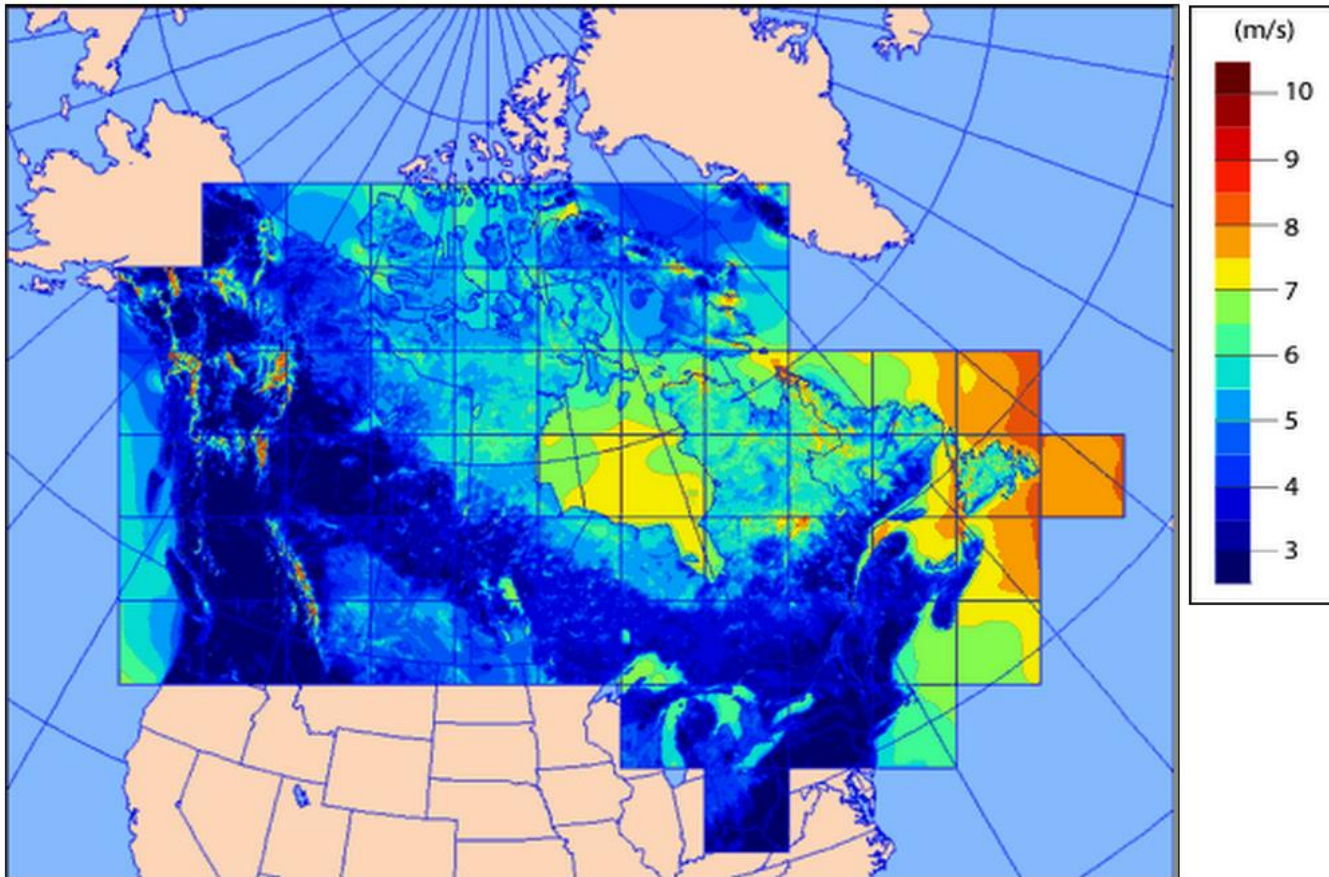


Applications (cont.)

- Buildings sector accounts for more than 40% of the world's total energy consumption (Saadatian, 2012 and Masoso, 2010), and
- The energy used for ventilation, heating, and cooling systems accounts for more than 60% of the total energy consumption in buildings (Saadatian, 2012 and Chan, 2010),
- The modern wind towers decrease the electrical energy consumption of the buildings, especially during the peak times, between 20 and 80 percent,
- Also, the proposed design can help to reduce environmental pollution.

Applications (cont.)

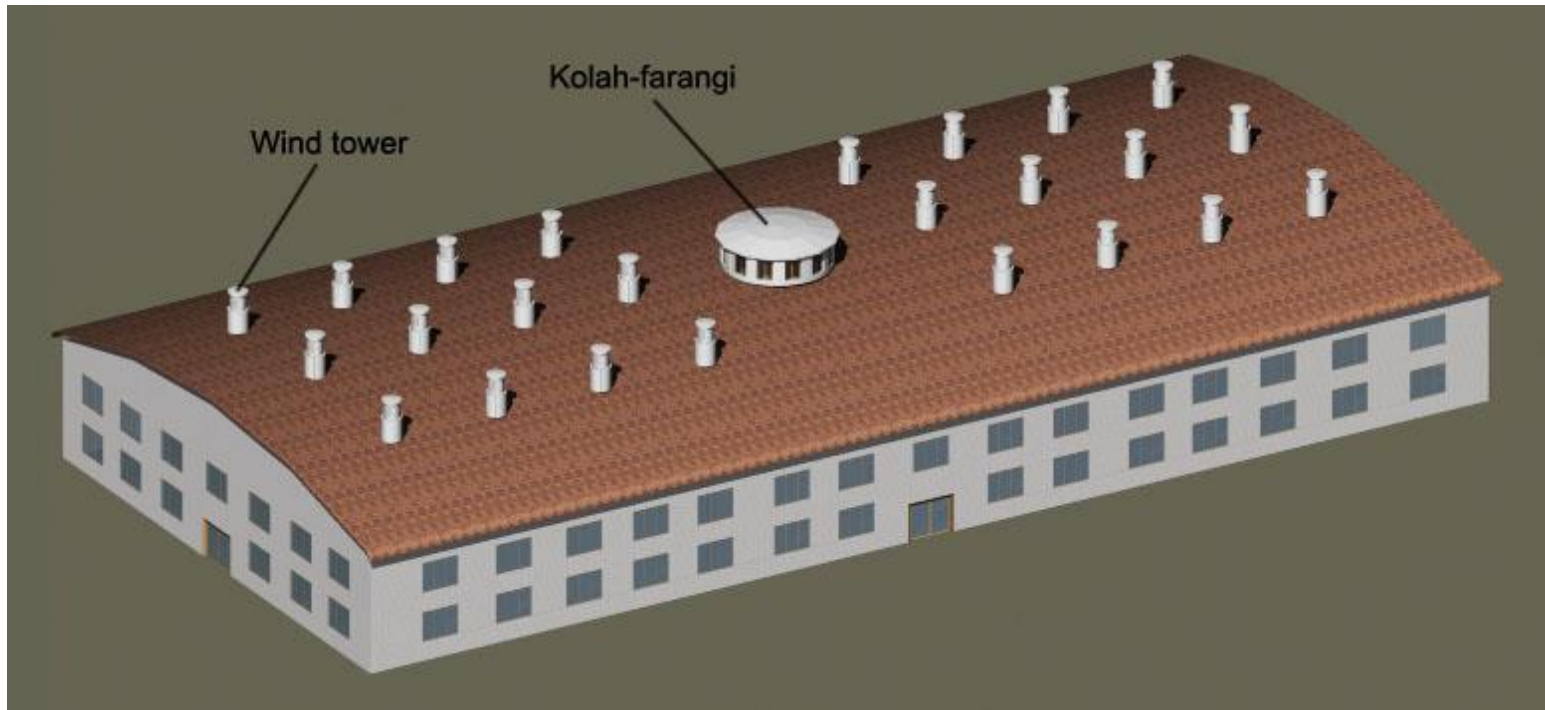
For example, in most parts of Canada wind speed is suitable for using the new designs of wind towers.



Numerical simulation of the Mean Wind Speed at height of 30 m above ground during summer across Canada
(<http://www.windatlas.ca>)

Applications (cont.)

This figure shows an example of using the proposed wind towers in a commercial building. The wind towers play two roles: air conditioning and lighting.



Conclusion

The proposed wind towers have several important features:

- Easy installation;
- Low maintenance cost;
- No sophisticated technology,
- The new ability of rotating,
- No electrical energy,
- Simple combination with an air heater or solar chimney, or another wind tower in the opposite direction and Kolah-farangi to increase the ventilation rate of the building.
- Transparent materials in wind towers for more natural light,
- Using channel, the air flows to any part of the building.

Thank You