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Studying Role of Wind Catchers as a Functional and Aesthetic Element an Architectural Design

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Abstract—*Currently in Indian context majority of the modern buildings is designed without considering the aspect of climate responsiveness. Wind catcher is one of a climate responsive strategy. This strategy is widely used in Iranian context. But in Indian context the effective use of wind catcher is required considering tropical characteristics of the region. Wind catchers can be utilized as a passive strategy to enhance natural ventilation. To maximize the implementation of passive design strategy requires framework of knowledge.*
The author conducted the study into two parts. The first one expresses the wind catcher as passive design strategy different types of wind catcher (vernacular/ modern), Factors affecting efficiency of wind catcher. In second part framework of knowledge develops the ability in the students to design with wind catcher.

Keywords- *Tropical, Wind catcher, passive design, framework*

1. INTRODUCTION

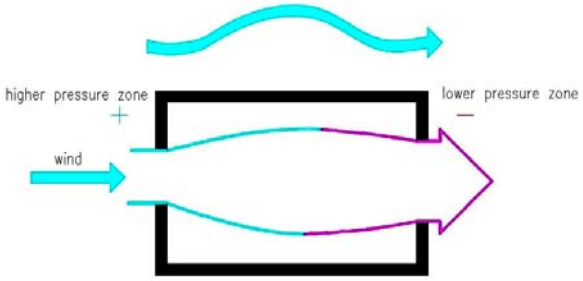
Wind catcher is a chimney shape aperture extended over the roof level to collect the wind from prevailing side and transfer it inside the building. Wind catchers are useful for mainly two climatic zones i.e. hot- dry and hot- humid. Wind catcher acts a functional element and aesthetical element. Architects such as Nimish patel and parul zaveri used these qualities of wind catcher while designing the passive downdraft evaporative cooling system for torrents research center, Ar. Girish doshi used the wind catcher in Dhara house as an evaporative cooling strategy.

In this research, the emphasis is given to review key theories, existing wind catcher technology and historical references of wind catchers. On the basis of all these aspects a framework is created to design with the wind catcher as a strategy. On the basis of this framework a design assignment is given to the students of architecture.

2. PRINCIPLES OF AIR MOVEMENT

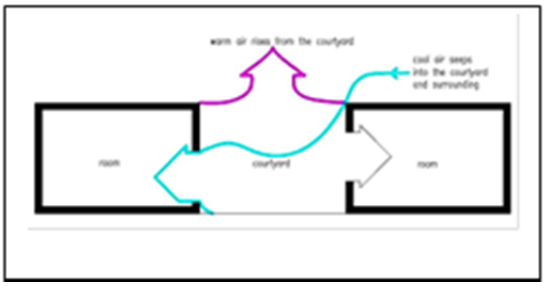
2.1 Air movement by pressure deferential

When wind velocity varies it produces a pressure differential, which causes air movement from a higher air pressure zone to a lower pressure zone. This is based on the Bernoulli theory and it's called "Venturi action," which explains that when the velocity of a moving fluid increases the pressure decreases [1].



2.2 ir movement by stack effect

The tendency of a liquid or gas to cause less dense object to float or rise to the surface is called buoyancy. Because of the difference in density between cool air and warmer air, warm air tends to move upward and escape due to its lower density. This air movement, called convection, can lead to a stack effect driven by buoyancy [1].

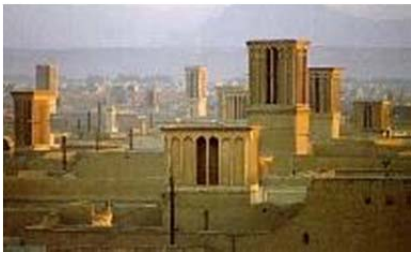


3. WIND CATCHER WORKING PRINCIPLES AND COMPONENT

3.1 Wind catcher working

A wind-catcher is a tower mounting above the building and has an aperture toward the prevailing wind. This device catches the air and brings it inside. Therefore, a window or a

door that acts as a wind-escape is needed to ensure that ventilation occurs.

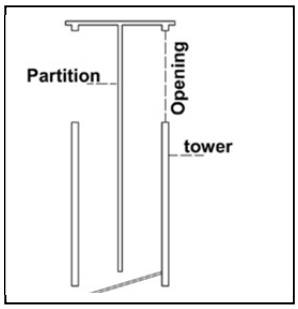


Source:http://www.solaripedia.com/13/205/wind_towers_catch_the_breezes_(mid_east).html

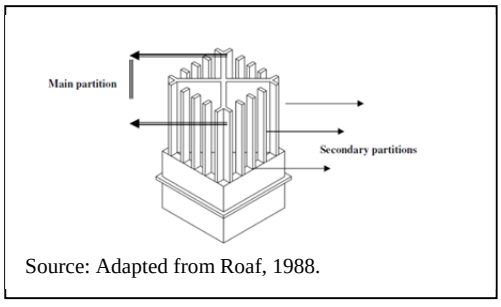
3.2 Components of wind catcher

The tower is the main part of the wind-catcher which is usually located above the building to be ventilated and its height depends on the location and the surroundings [3].

Vents or openings are located in the highest part of the wind-catchers' column to catch fresh and clean air and channel it down into the building. The number of openings depends on the wind-catcher's location and it's cross sectional area [3].



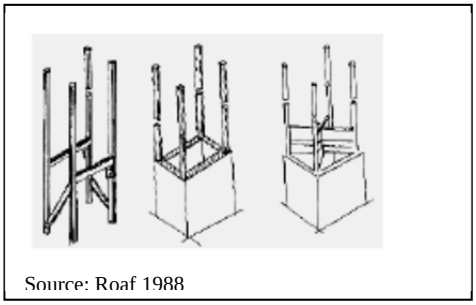
Partitions in a wind-catcher have been used to divide the wind-catcher's tower into several individual shafts [3].



Source: Adapted from Roaf, 1988.

3.3 Structure of wind catcher

To erect a wind-catcher traditionally, a wooden frame was built which is covered by mud bricks. And then bricked mud main partitions were built inside full length of the wind-catcher's structure [2].



Source: Roaf 1988

4. RESEARCH STUDY EXAMPLES

4.1 Dhara house Nashik

Source: Ar. Girish Doshi

Main aim of the study is to understand the basic working of wind catcher & how it is used in Indian context.

In this example three numbers of wind catchers are used of one sq. Meter each. This provides ventilation to common living spaces. Two wind catchers serve to dining and entrance space & rest one wind catcher serve to living area. Evaporative cooling system is used. Wind catcher tie up the whole structure into visual boundaries.

4.2 Jodhpur university hostel Rajasthan, India

Source:https://www.google.co.in/search?q=jodhpur+university+hostel+passive+design&espv=2&biw=1366&bih=

In literature study of university hostel building in Jodhpur single wind catcher is pleased and for the placement of wind catcher staircase tower was used.

Wind catcher is provided by single opening according to wind direction. Evaporative cooling system was used. Air passes through the tiny droplets of water and the temperature of air drops down.

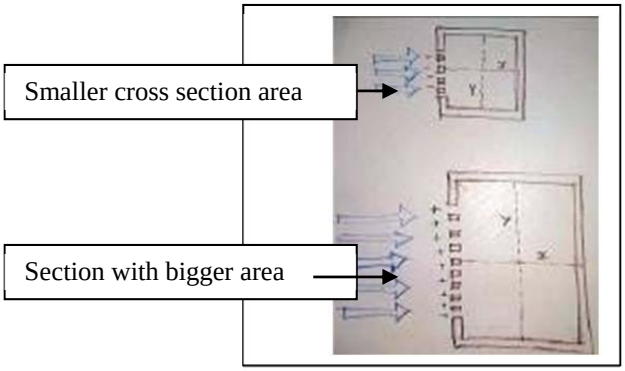
5. FACTORS AFFECTING EFFICIENCY OF WIND CATHER

5.1 Height of wind catcher

There is a direct relationship between height, wind speed and air temperature. Height of wind catcher is directly proportional to wind speed [4].

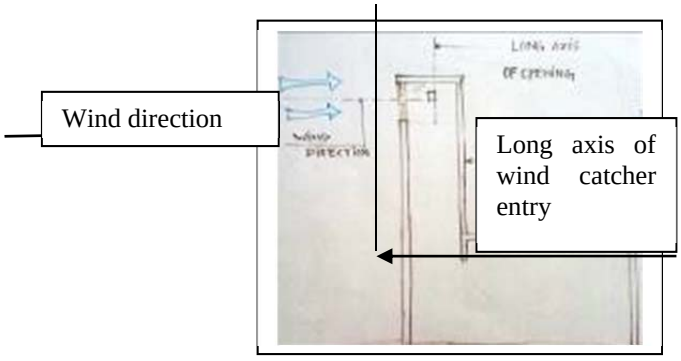
5.2 Cross section of wind catcher

Cross sectional plan affect the total volume of air and the speed of wind which is passing down. Size of the shaft is directly proportional to amount of air introduced inside of building [4].



Plan with different cross section bigger area receives more wind

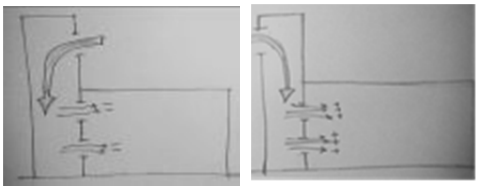
5.3 Air inlet and outlet opening



Source: Author

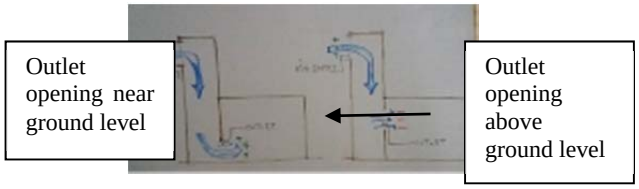
To achieve maximum air entry speed the long axis of wind catcher's entry opening is perpendicular to the wind direction [4].

To achieve maximum air speed the outlet opening should faces the inlet opening.



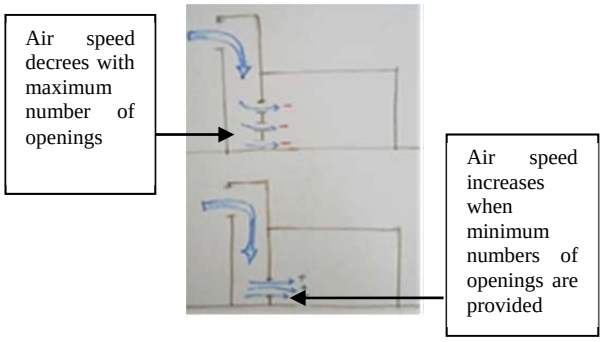
Source: Author

Air speed increases when the outlet opening is near to ground.



Source: Author

Air speed increases when there are minimum numbers of outlet openings.



Source: Author

6. DESIGN PROJECT

6.1 Methodology

To make use of wind catcher as a creative tool to enhance the aesthetics, work out appropriate wind catcher section for warm and humid climate and fix the position of wind catcher according to wind direction and Identification of additional strategy i.e. courtyard, solar chimney.

6.2 Design challenges

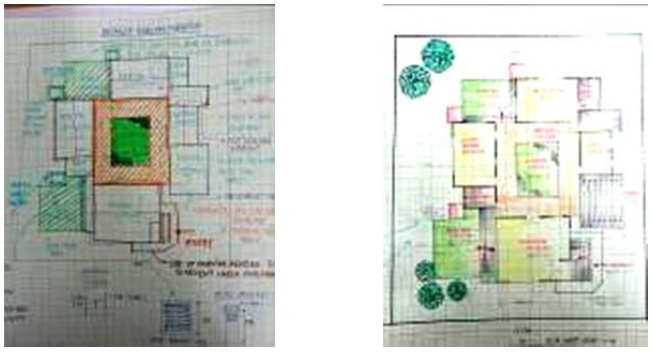
Student has to deal with both aspects of catcher (functional and aesthetical both) and justification as climate responsive design and Development of design concept keeping in mind the wind catcher its profile and impact on the air movement inside the building.

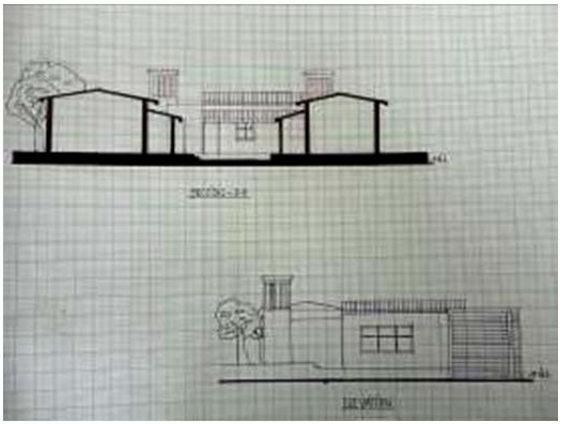
6.3 Design challenges

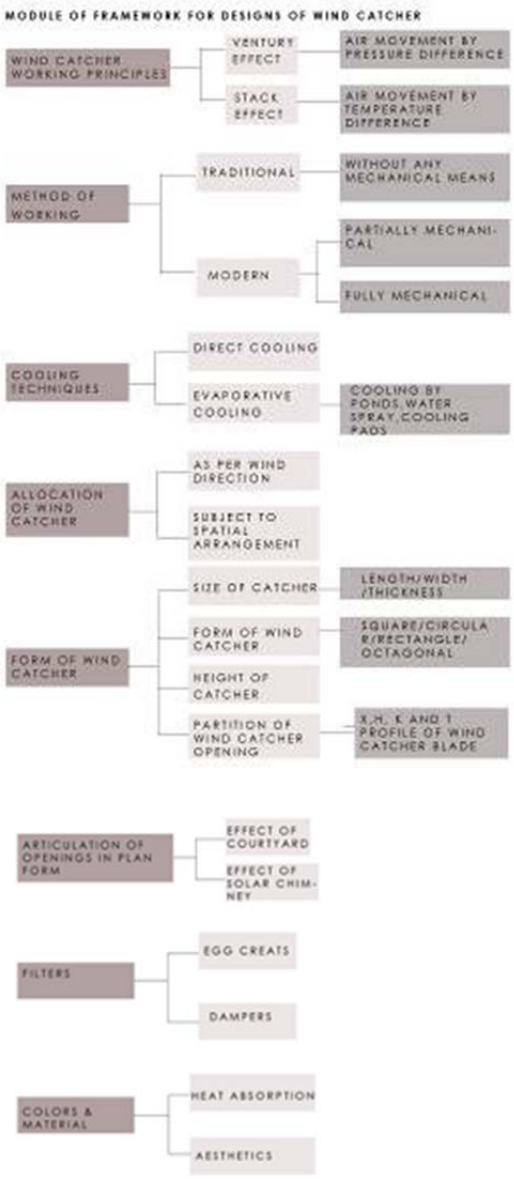
Creative exercise: Every student has to prepare three dimensional compositions.

Source: Author

In this composition, wind catcher is used as an aesthetical element and to give profile to the entire building. The functional part is also considered simultaneously in the development of plan form.







7. CONCLUSION

From this research it is found that how effectively wind catcher is used to enhance the functional and aesthetical aspect of a built structure .By this research a framework of knowledge is created to help the future designers for their design. This framework is used to understand different parameters of working of wind catcher.

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