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Cold Plane Innovative Method for Humidity Condition Control

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Abstract: *The green building what is announced today has identified principles and issues. These principles could interpret differently in different climates. What is important in all kind of buildings is environmental conditions control issue which is necessary for being in human comfort zone. Although different climate brings different architecture but the principles for being in ideal comfort condition brings many solutions that are looking to the specific climate. The tropical or hot and humid climate as a diverse climate of the world needs conditions that could defense against environmental annoying items. The solutions that work by mechanical systems and have more energy consumption must be resolved and replaced by more efficiently passive systems.*

In high-rise buildings which the wind effect is attractive in addition to building stability against side loads the importance of natural cross ventilation for being the building energy efficiency could be suggested by many innovative solutions. This paper is about one of the innovative solutions that suggested by using descriptive- qualitative approach. This new concept could take apart the humidity from the humid wind and let to use suitable natural ventilation in high-rise buildings by using double façade concept as cold plane which suggested by researcher and use in front of building by lower temperature than around and works as a multipurpose system for water cycling, suitable natural ventilation and insect prevention.

Keywords: *Humidity, Cold plane, Condition control*

1. Introduction

In some locations and building designs wind alone can be used as the principal driving force. In wind driven systems the air on the wind ward side of the building creates a positive pressure with corresponding negative pressure generated on the leeward side. Using this effect air can be easily drawn through the building. Although wind driven systems can be effective, building design, orientation and location factors are important here for a successful result [1].

Natural ventilation can save significant amounts of fossil fuel based on energy by reducing the need for mechanical ventilation and air conditioning. Reduced use of air conditioning reduces greenhouse gases released into the atmosphere from electricity generating plant that produces the energy used for cooling buildings. Air movement within buildings removes foul air and moisture provides cooling in summer, for human thermal comfort [2].

Most of these day buildings have been compromised by the addition of partition walls and mechanical systems. With an increased awareness of the cost and environmental impacts of energy use, natural ventilation has become an increasingly attractive method for reducing energy use and cost and for providing acceptable indoor environmental quality and maintaining a healthy, comfortable, and productive indoor climate rather than the more prevailing approach of using mechanical ventilation

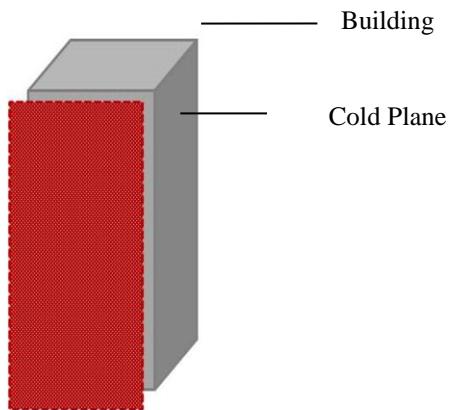


Fig. 1: Building with cold plane

2. Humid Climate

Natural ventilation systems rely on pressure differences to move fresh air through buildings. Pressure differences can be caused by wind or the buoyancy effect created by temperature differences or differences in humidity. In either case, the amount of ventilation will depend critically on the size and placement of openings in the building. It is useful to think of a natural ventilation system as a circuit, with equal consideration given to supply and exhaust.

Natural ventilation, unlike fan-forced ventilation, uses the natural forces of wind and buoyancy to deliver fresh air into buildings. Fresh air is required in buildings to alleviate odours, to provide oxygen for respiration, and to increase thermal comfort. However, unlike true air-conditioning, natural ventilation is ineffective at reducing the humidity of incoming air. This places a limit on the application of natural ventilation in humid climates. Wind can blow air through openings in the wall on the windward side of the building, and suck air out of openings on the leeward side and the roof. Temperature differences between warm air inside and cool air outside can cause the air in the room to rise and exit at the ceiling or ridge, and enter via lower openings in the wall.

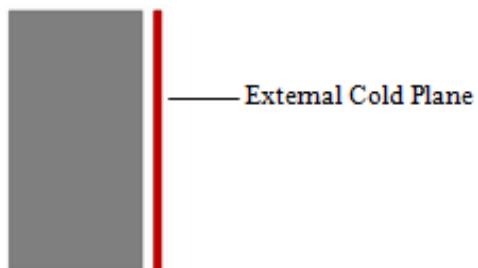


Fig. 2: Double Façade Building by External Façade as Cold Plane

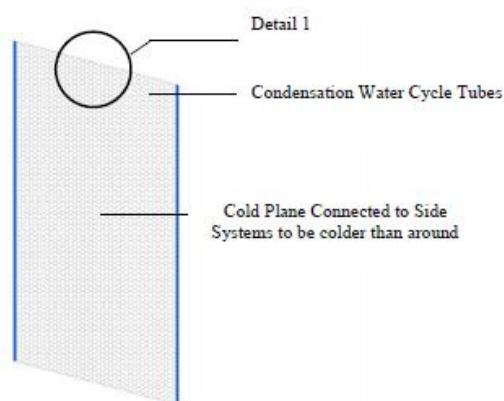


Fig. 3: Cold Plane and Water Cycling Tubes

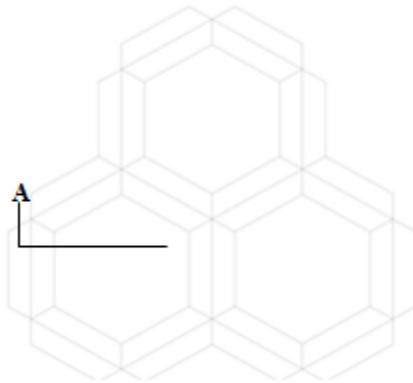


Fig. 4: Detail 1 of Cold plane

Similarly, buoyancy caused by differences in humidity can allow a pressurized column of dense, by evaporation cooled air to supply a space, and lighter, warmer, humid air to exhaust near the top. These three types of natural ventilation effects are further described below [1].

In warm, humid climates, natural ventilation is utilised to enhance indoor thermal comfort by reducing the effects of relative humidity above 60% [2].

In humid climate the humidity is harmful item and some thecinques must suggest to reduction that.

3. Natural Ventilation

Natural ventilation is a back to basics approach using nature as the principle driving force. It offers a straightforward low energy cooling strategy which can provide year round comfort, with flexible user control, but with a low capital and maintenance cost [1]. Natural ventilation is one of the strategies in passive approach that has some principles like building orientation and form, thermal mass, solar shading atrium and deep plan. Natural ventilation strategies are more effective when internal heat gains are minimized through the use of low energy lighting systems. If full natural ventilation is not possible, a mixed mode approach can still be highly effective in cutting carbon. Naturally ventilated buildings typically have lower capital costs for cooling and ventilation equipment, but some additional capital has to be spent on the façade and building fabric. Mixed-mode buildings require capital to be spent on mechanical services and the façade. New buildings can be orientated to take advantage of prevailing winds and reduce excess solar heat. The building form should allow a simple and effective path for the flow of air, which may mean that the designers need to rethink the layout of the internal space in the building. Building thermal mass into the design will help regulate air temperature. For example, exposed concrete soffit floors will absorb and release heat. All naturally ventilated projects used solar shading to control heat gains from the sun. Deeper buildings, needed atriums to provide cross-ventilation, allowing air from open plan offices to flow in and out of the building.

Natural ventilation exploits the ‘stack effect’, where warm air rises above cold air, and wind, which creates pressure differences across buildings. Buildings can be designed so that an atrium takes advantage of the stack effect. The atrium allows warmer air from the occupied spaces to rise and escape through vents at the top of the building. This air movement draws cooler air into the occupied spaces through open windows or vents. Wind-driven ventilation is most effective when there are openings on two different sides of the building. Wind creates a pressure difference and the openings allow air movement through the building. Wind and stack effect ventilation can be combined. Natural ventilation works best when supported by other passive design features or low carbon cooling techniques. For example, internal exposed thermal mass helps regulate temperatures and can also assist night cooling. Low energy lighting and solar control devices alongside natural ventilation help avoid excessive heat gain in the building. Ventilation methods should work with the building to optimise air movement. For example, cross-ventilation works with a ‘shallow plan’, while an atrium can allow air to circulate in a deeper plan building [3].

Ventilation of occupied spaces in buildings has two primary purposes. One purpose is to provide an acceptable indoor air quality (IAQ), which essentially is based on the supply of fresh air and the removal or dilution of indoor pollution concentration. The other is to provide thermal comfort by providing a heat transport mechanism. Consequently, we do not ventilate to supply oxygen (O_2) to the occupants in the building. The reason for this is that it is in principle hardly possible to lower the oxygen concentration in an ordinary building to a level that has implications for our up-take rate of oxygen. Nor do we ventilate to get rid of carbon dioxide (CO_2) in itself, as we do not normally reach concentrations that are harmful for humans in an ordinary building. The concentration of carbon dioxide is on the other hand used as an indicator on contaminants produced by the human body, e.g. odour and moist, which is perceived as stale air. Optimum IAQ may be defined as air which is free of pollutants that cause irritation, discomfort or ill health among occupants. In addition to providing good IAQ, ventilation plays a major role in maintaining acceptable thermal comfort. Use of natural ventilation during daytime has three objectives when it comes to thermal comfort:

- Cooling of indoor air by replacing or diluting it with outdoor air as long as outdoor temperatures are lower than the indoor temperatures.
- Cooling of the building structure.
- A direct cooling effect over the human body through convection and evaporation [4].

4. High-rise Buildings and Natural Ventilation

The most important thing to have natural ventilation in buildings is recognise wind direction [5]. Wind driven ventilation occurs as a result of various pressures created on the building envelope by wind. These pressure differences drive air into the building through openings in the building envelope's windward side, and drive air out of the building through openings in the building envelope's leeward side [4]



Fig. 5: Section A

In high-rise buildings with the consequence the velocity profile increases with height. That had the biggest influence on the ventilation concept. The conventional way to solve this building would have been to seal the façade, and to put a mechanical ventilation plant into it. Because of the height of the building, it can't be open the windows, and it can't have external shading because it flaps around in the wind. Other issues are of course that you in the middle of the city have got a lot of traffic, noise and air pollution. Therefore, the double façade concept could be suitable for this building to cross ventilating. Second layer which installed in front of main façade slow down the high velocity of wind in it because the direct prevailing wind might causes problems. So part of the concept is to use new wind screen in front of the building in the shape of a double façade. It controls the wind velocity and comfort through natural ventilation. What could be doing for humidity in this kind of building in temperate climates?

5. What is Cold Plane?

Cold plane is suggested method by researcher which use in front of building by lower temperature than around. It is multipurpose system for water cycling, suitable natural ventilation and insect prevention.

6. Cold Plane and High-rise Buildings

Natural ventilation is frequently utilised for tall buildings in warm humid tropical climates, windows should be located to receive the prevailing wind for summer conditions and, ideally, be installed on both sides of the occupied spaces to provide cross ventilated stack effects are small. In temperate climates during summer and in warm, humid climates, natural ventilation using wind pressure and/or stack effect are applicable for achieving airflow for indoor

thermal comfort [6]. Insect screens are desirable in many locations, particularly in the tropics where a number of serious illnesses such as Malaria and Dengue Fever are spread by insects. Smooth rounded wires or threads forming the mesh of insect screens have non-linear resistance to airflow. Airflow resistance is higher at low wind speeds. This approach also creates useful insect-free outdoor space. Where screens are placed close to openings there may be difficulty operating certain types of sashes with insect screens in place, but easily removed, magnetically held screens are now available. The newer approach that suggested by author is using innovative cold plane in high-rise buildings as describe below.

The external façade in double façade buildings could be used as an environmental control system. If it is possible to suggest external façade like a netty plane like depict in figure 1-4 and make this plane temperature lower than environment by closed side systems like refrigeration that take place through tubes that make this external façade because the refrigerant has the important role in cooling production [6]. By having low temperature façade the moisture that exist a lot in the humid climate wind being to condensation and come in by lower rate. So the natural ventilation in this way is without more moisture which is harmful item in this climate. This netted plane also could prevent of coming insects in which are more in this kind of climate. The drops of concentrated water can flow across the canopy shape profile that showed in section A (Fig.5) and integrate in tubes that reaches in the main source. By this innovative method the wholism [7] which attends in green building principles attract the attention by this sight that the world scores are finite and saving each one in each region could help the planet to revitalized. For example for this climate even though having too much water rate but could not be used extremely. In addition to what is said this integrated water is droplet and can be used as building necessities.

7. Conclusion

The innovative methods like cold plane described in paper could bring natural ventilation in human comfort zone. In humid climates where moisture is annoying item using a screen in front of wind blowing direction to high-rise buildings which being colder than around by side systems could absorb moisture from humid wind. In this manner in addition to have suitable natural ventilation the building could satisfy some of its water needs by integrating dropped water on cold plane to the water source by attending to green buildings principle about saving planet sources through wholism.

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