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Inducing Passive Ventilation in Muti-Storeyed Buildings in Small Cities of India

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ABSTRACT

The Big cities of India are upcoming with astonishing Buildings in terms of Planning and design. But when the small cities of India are taken into account buildings lack in proper planning and design in general. The main focus still rest with active ventilation in building while the passive ventilation system is not only lacking but totally absent. The Study covers the multi storeyed buildings of Aligarh, U.P. India. The present design of building was taken into consideration and the proper points to induce passive ventilation were identified. The Buildings were already completed and are under use. The study suggests the alterations to be done to enable the passive ventilation in the building without altering the building structure. The study concludes that the passive ventilation in the buildings can be done economically without any change in building utility by providing sack ventilation or solar chimneys.
Keywords: Planning and Design, Active ventilation, Passive ventilation.

I. INTRODUCTION

The Architecture planning and design in India is greatly influenced by the western designs. The wester concepts are replicated as such without necessary modifications in the design to suit the local climate and weather conditions. Especially the small cities of India suffer from these planning and design failures. The advent of Internet and Technology has made the scenario even worse as most of the planning and design is done by non-qualified persons which only copy paste the ideas of western Architecture. Even if the architects are designing the buildings their main focus lies on the active ventilation in the building while the passive ventilation system design is absent from the planning and design scenario. The study focuses on the feasibility of passive ventilation system in the multi storeyed buildings of small the small city of Aligarh, U.P. India.

Stack ventilation uses temperature differences to move air. Hot air rises because it is lower pressure. For this reason, it is sometimes called buoyancy ventilation. Bernoulli's principle uses wind speed differences to move air. It is a general principle of fluid dynamics, saying that the faster air moves, the lower its pressure. Architecturally speaking, outdoor air farther from the ground is less obstructed, so it moves faster than lower air, and thus has lower pressure. This lower pressure can help suck fresh air through the building. A building's surroundings can greatly affect this strategy, by causing more or less obstruction. [1, 2]

The advantage of Bernoulli’s principle over the stack effect is that it multiplies the effectiveness of wind ventilation. The advantage of stack ventilation over Bernoulli's principle is that it does not need wind: it works just as well on still, breezeless days when it may be most needed. In many cases, designing for one effectively designs for both, but some strategies can be employed to emphasize one or the other. For instance, a simple chimney optimizes for the stack effect, while wind scoops optimize for Bernoulli’s principle.

After wind ventilation, stack ventilation is the most commonly used form of passive ventilation. It and Bernoulli's principle can be extremely effective and

inexpensive to implement. Typically, at night, wind speeds are slower, so ventilation strategies driven by wind is less effective. Therefore, stack ventilation is an important strategy.
Successful passive ventilation using these strategies is measured by having high thermal comfort and adequate fresh air for the ventilated spaces, while having little or no energy use for active HVAC cooling and ventilation. [1, 2]

II. METHODS AND MATERIAL

Two Multi storeyed building New Rizvi Apartment and Rifa Complex were taken as model for study. Each Building is G+ 4 Storey with Basement for parking. Both the building block diagrams were made to mark out the feasible points for installing passive ventilation structures. The viable passive ventilation options of Bernoulli's principle and stack ventilation were analyzed to provide for necessary ventilation.

Result and Discussion: The major hurdle in providing any solution to induce passive ventilation in the buildings is that both the buildings are completed and are totally functional. Providing any solution requiring alterations to the building structure is practically not possible.

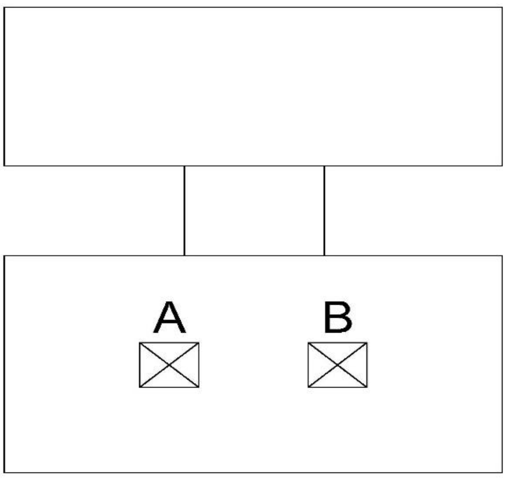

Figure 1. Block Model for Rifa Complex

The figure 1. Represents the block model of Rifa Complex. The complex Comprises of 5 Residential Flooring on Each floor, with basement supporting Car parking and 18 individual Garages. The Building is basically divided into two blocks the first comprising of three residential flats while the second comprises of only two residential areas. The second block cannot be provided with passive ventilation as it is already sun facing from three sides providing ample amount of active ventilation, the other fact that there is no interior areas in the second block the need of passive ventilation becomes unnecessary. When the first block is analysed the middle flat is having only two side to natural ventilation while two are blocked by the adjacent blocks. All the three flats have interior spaces where active ventilation is unavailable. These spaces are though provided with ducts which are not enough for providing necessary air circulation especially at the ground first and second floor. The ducts are indicated in figure 1 as A and B.

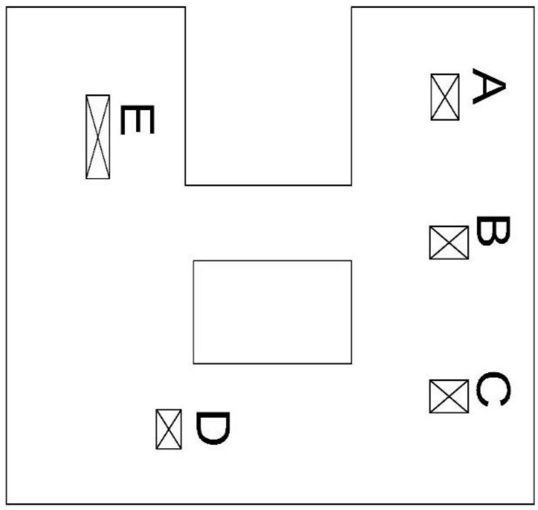

Figure 2. Block Model of New Rizvi Apartment

The figure 2. Represents the building block of New Rizvi Apartment. The Apartment comprises of 11 residential units at each floor with car parking in basement. The building is continues U Block comprising of 1BHK, 2BHK and 3BHK Units. The 2 BHK units have only one sided access to natural ventilation, 2 BHK units have natural ventilation on two sides while 3BHK units have natural ventilation from 3 sides. Since all these units are in one block each unit is adjacent to another one giving in rise to interior spaces where active ventilation is not available. These areas are provided with ventilation through ducts as shown in figure 2 where A, B, C, D, and E are the approximate positions of the ducts.

Since the study is cramped with the boundary line of not altering any building structure and the solutions have to be economical. The study can suggest of putting up ventilation stack or solar chimneys on top of each duct. These Stack should be provided upto the height of 3 meter from the level of roof coloured in black. The black colour will enable harnessing the maximum heat from sun radiation. The heated air in this stack will move up following Bernoulli's principle which will result in colder air residing in building complex to replace it inducing passive ventilation in the building.

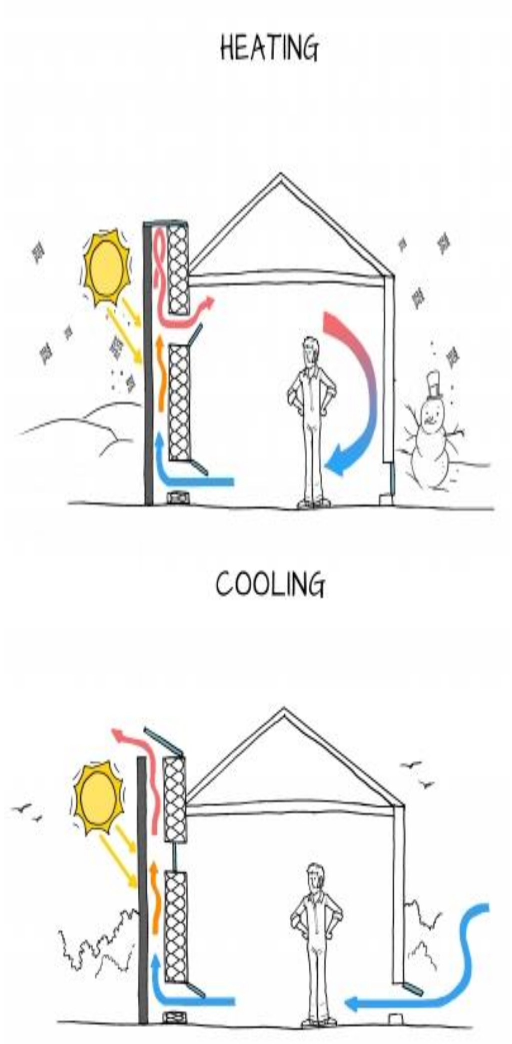

Figure 3. The effect of opening or closing of the stack or chimney [1]

The stack or chimneys should be provided with a cover. The opening of the cover will bring the temperature of the building down thus cooling the building. While in winters the cover should be closed which will help in increasing the temperature thus warming the building as needed in the cold weather.

The stack or chimneys both should be designed combining the principle of stack ventilation & Bernoulli's principle. The Bernoulli's principle will be effective in season with high wind speed or during daytime, while the stack ventilation can be effective during night time or low wind seasons such as monsoon.

III. CONCLUSION

The passive ventilation in multi storeyed buildings of small cities in India is feasible. The Number of Residential units per floor will increase the requirement of Passive ventilation in the building. The passive ventilation can bring in the much needed air circulation in the interior spaces of the building adjacent to ducts. The ducts are the potent solution to induce passive ventilation by means of stacks or chimneys raised above the roof level. If the passive ventilation system is taken into consideration for design the energy consumption can be greatly reduced. More Research work is needed to be done to provide proper guidelines for passive ventilation system design to suit and adapt as per the local needs of small cities and Town of India.

IV. REFERENCES

[1] Stack Ventilation and Bernoulli's Principle, Available Online at: http://sustainabilityworkshop.autodesk.com/buildings/stack-ventilation-and-bernoullis-principle Accessed on March 20.

[2] Solar Chimney, Available Online at: http://www.solarinnovations.com/solar-energy-products/solar-chimney/

[3] N. B. Geetha, R. Velraj," Passive cooling methods for energy efficient buildings with and without thermal energy storage-A Review", Energy Education Science and Technology Part A: Energy Sicence and Research, Volume 29, Issue 2:913-946, 2012.

[4] Mohammad Arif Kamal," An Overview of Passive Cooling Techniques in Buildings: Design Concepts and Architectural Interventions,' Acta Technia Napocensis: Civil Engineering and Architecture Vol. 55, No.1, 2012.

[5] Steven J. Emmerich, W. Stuart Dols and James W. Asley," Natural Ventilation Review and Plan for Design and Analysis Tools," National Institute of Standards and Technology, Technology Administration, U.S. Department of California, August 2001.