IMPACT OF RESIDENTIAL LAYOUT SIZES TOWARDS VENTILATION PATTERN OF HABITABLE SPACES

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ABSTRACT
Every design of a building evolves from available site area, access, requirements, climatic conditions and other constrains. This research paper analyses the change of ventilation pattern in residential buildings due to change in residential plot size.

Keywords: Rate of air exchange, Stack effect, Mechanical exhaust, Wind driven ventilation, Window, Cross ventilation, Single side ventilation, Duct ventilation, Courtyard, Clear storey.


http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=9&IType=10

1. INTRODUCTION
The demand of residential sector increases, due to the migrant population from rural areas to urban areas because of the availability of employment. Apartments and high raised residential complexes may be a solution. On the other side, individual villas or residential plot sizes are reduced to the maximum, considering the cost of the house and buying capacity of the people. This leads to the cost effective compact housing, with compromise in natural ventilation, natural lighting, etc. We are going to analyze the various residential plot sizes available in current scenario and its ventilation pattern.
1.1. Aim
The aim is to study and analyze the transformation of ventilation pattern of low-rise individual residences and the relation between plot sizes.

1.2. Scope and Limitations
Our aim is basically to figure out the pattern of natural wind driven ventilation in villas or individual residential buildings. The analysis is done based on the design of building which is directly related to the plot size and setback.

For the study residences in puducherry are chosen which has good amount of residences with different time-line and design typology. No experiments are conducted to measure the rate of air exchange or air velocity, only method of natural ventilation is analyzed.

2. METHODOLOGY
Selection of residences with different plot sizes is done and further it is classified based on the time and type of construction techniques. Ventilation system in the specific building is analyzed based on the openings and setback spaces. Current scenario of residential plot layouts of newly developing areas are also analyzed with their building design and ventilation patterns. Based on the time and advancements in the construction industry the transformation of ventilation pattern has been mapped and concluded.

3. TRADITIONAL RESIDENCES
The traditional houses in general have no specific layout sizes. Mostly in the rural areas, the traditional houses are as scattered settlements which are compact settlements in urban areas. But every house has a central courtyard or a covered central court with clear story windows.

3.1. Courtyard ventilation
Courtyard type of houses plays a major role in traditional architectural style of south India. It has the central open to sky area, next comes the covered circulation area and habitable rooms in the outer periphery with sloped terracotta tiled roofs. These types of houses have minimal window openings on the outer side which allows ventilation through courtyard. Considering the safety and privacy they have the open space at the centre with outer walls which acts as fortification. The central courtyard is open to sky and gets heated by solar radiation. The warm air rises up and the lower portion is replaced by the cool air drawn through windows and doors as shown below.

![Figure 1 Ventilation pattern of a courtyard house with sloped roof in section.](http://www.iaeme.com/IJCIET/index.asp)
3.2. Clear story window ventilation
After the extensive use of flat roofs like madras terrace roofs and reinforced cement concrete roofs the courtyard portions are covered with slabs at a raised level. This is to protect the interior spaces from direct solar radiation and minimize the solar heat gain. The vertical walls of the raised courtyard slab have louvered windows to promote ventilation and lighting. At the ground level it has the same function as we had in the courtyard houses. Louvers are used to keep away the driving rain and air ventilation concurrently. This portion is like an atrium, as the hot air in it reaches the top and escapes through the clearstory window.

Figure 2 Clear story window ventilation pattern in section.

4. CURRENT TRENDS IN RESIDENTIAL LAYOUTS
Due to increasing number of nuclear families, the residential plot sizes are reducing based upon their needs. The setback spaces of a residential unit are also compromised along with the size of plots. Schematic layout of residences of various plot sizes with their setbacks is shown in the figure -3. This is arrived based on the case study of residences in developing areas of Pondicherry. We are going to study the transition of ventilation pattern of living rooms marked with yellow in the below figure.

Figure 3 Current trends of residential buildings and setback spaces.
4.1. Cross ventilation
In 222msq and 167msq plots the setback space is provided in all four sides of the building and promotes cross ventilation for the living space. The other rooms can have windows only on walls of the adjacent sides. Living area connects the front and the rear part of the residence. The rate of air exchange also depends on the type of setback in the adjacent plots. Cross ventilation pattern may vary by window positions and interior arrangements of the living room. It has maximum possibilities of cross ventilation by having windows in opposite walls as shown in the figure below.

Figure 4 (a) 167msq plot (b) cross ventilation in plan.

4.2. Single side ventilation
These types of residential buildings are mostly found in 111msq plots. It will have a common wall, shared with the neighboring plot which has no possibilities of setbacks and windows. It may have setback on the other three sides. Out of the four sides of a living room, only one side can have windows directly opening to the exterior. In this case instead of having one huge window we can have two or more small windows. That will promote more ventilation as shown in the figure below.

Figure 5 (a) 111msq plot (b) single side ventilation in plan.
4.3. Duct ventilation

This type of ventilation is also found in 111msq plots. This happens due to achieving maximum carpet area in the plot. Like the wall to wall construction, there is no setback space on the side boundaries. The exact site is extruded as the building and a small shaft or a duct like open to sky is provided for ventilation. The chimney shaft like duct, vents out the warm air, in the stack effect manner as shown in the figure 6 below. To maximize the ventilation and rate of air exchange, mechanical exhaust has to be used.

![Figure 6](a) 111msq plot (b) duct ventilation in plan.

5. CONCLUSION

In the traditional style houses, the open spaces are inscribed within the building as courtyards. In the contemporary style the open spaces are circumscribed about the building as setback spaces. The National building code also recommends minimum setback spaces for residential units to ensure ventilation. Due to the increase in the demand of residential plots and the affordability, the plot sizes have been reduced up to 50%. This results in the shift of living room’s ventilation pattern from cross ventilation to single side ventilation and duct ventilation as explained above. Poor ventilation may cause severe health illness and respiratory problems.

REFERENCE


