Impact of Shape of Block Arrangements

Four different block shapes of the HDB flats were selected for the study. They are Linear, Point Block, L-Shape, and U-Shape which represent the typical block arrangement of HDB flats. The 4 different shapes were tested in a typical HDB estate setting. The results show that the Linear shape was having the minimum mean ACH, whilst the L-shape has the maximum. However, the results also show that the obstructions surrounding the building block have serious impacts on the natural ventilation performance of the residential units, which in some cases supersede the effect of the block shape.

![ACH comparison between 4 different shapes](image.png)

**Figure 6.1 ACH comparison between 4 different shapes**

From Figure 6.32 it can be seen that the Linear shape was having the minimum mean ACH, whilst the L-shape has the maximum. This is not surprising, since the earlier comparison study in the 3 different locations have the same result.

The maximum mean ACH seems to occur mainly at the lower floors, i.e. 2nd and 5th levels. This means that the deflected wind plays an important part in affecting the ventilation performance for this particular site configuration. For the U-shape block, the high ACH was the result of the direct wind that was allowed to enter the indoor space, either perpendicularly or parallel to the building façade. Fortunately, the parallel wind didn’t create much of the tunneling effect for this building. The deflected wind helps the ventilation for those unit located at the Center of the building. The West corner location was the most ideal location for this building, since it was able to benefit from the 4 observed wind directions.
On the contrary, in terms of its ability to capture the direct prevailing wind, the 3 locations in the Linear shape block was not able to benefit from any of the 4 observed wind directions. Since it was obstructed at the Northern and Southern sides, obviously no direct wind was allowed to reach the fenestrations.

Compared to the Linear shape, the Point block has more compact building morphology. Being a favorite as it offers the best privacy for the occupants, it’s believed that the Point block shape would have good ventilation. However in this study, it is only happened when the Point block is positioned in the good location at the good site configuration. In this study, it showed that the mean ACH in this Point block shape was quite low, compared to the other 2 shapes. It was because the site configuration was not able to accommodate this type of compact design. The Point block shape would have had better ventilation if it was positioned together with other compact building shapes, such as U-shape or with other Point block shape. The 2 elongated blocks in the Northern and the Southern side of the block acted as wind obstructions. Thus, the point block was not able to enjoy direct wind direction from these 2 predominant wind directions. However, the West and East wind directions were able to penetrate the fenestration directly though they are not considered predominant wind directions.

Similar to L-shape, the U-shape building would benefit from the 4 wind directions. When the East wind blew, this building morphology managed to capture the prevailing wind so that the units facing the public enclosed space would enjoy positive cp values. In the same time, turbulence occurred when the wind hit the sharp corners of the 2 wings. The units located in between the 2 wings were only able to receive the prevailing wind when it blows perpendicularly, but not parallel. The 2 predominant wind directions (North and South) were those that blew parallel to the building façade. That’s why the mean ACH of this particular building shape was slightly lower than that found in the L-shape building.

From this study, we can conclude that the consideration of the prevailing wind directions and the fenestrations are crucial in the natural ventilation design. 2 of the 4 assumed wind directions were considered the predominant in Singapore, i.e. North and South wind directions. Thus, the design consideration should be based on this 2 wind predominant wind directions to provide a good natural ventilation performance.
Figure 6.2 Recommended site configuration for U shape for North wind direction

Figure 6.3 Recommended site configuration for L Shape for North wind direction