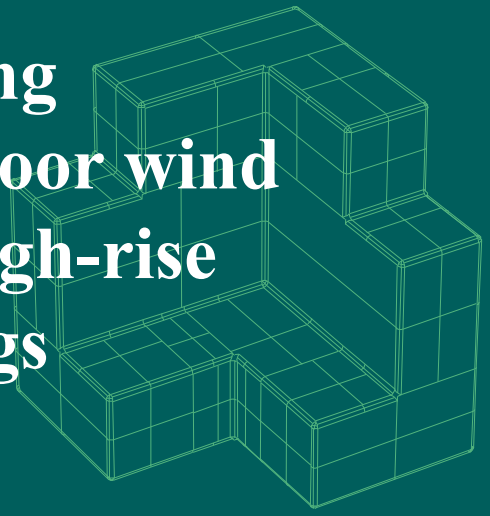
Journal of Zhejiang University-SCIENCE A

Developing planning indicators for outdoor wind environments of high-rise residential buildings



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Key words:
Outdoor wind environment, Planning indicators, Building cluster layout, High-rise building

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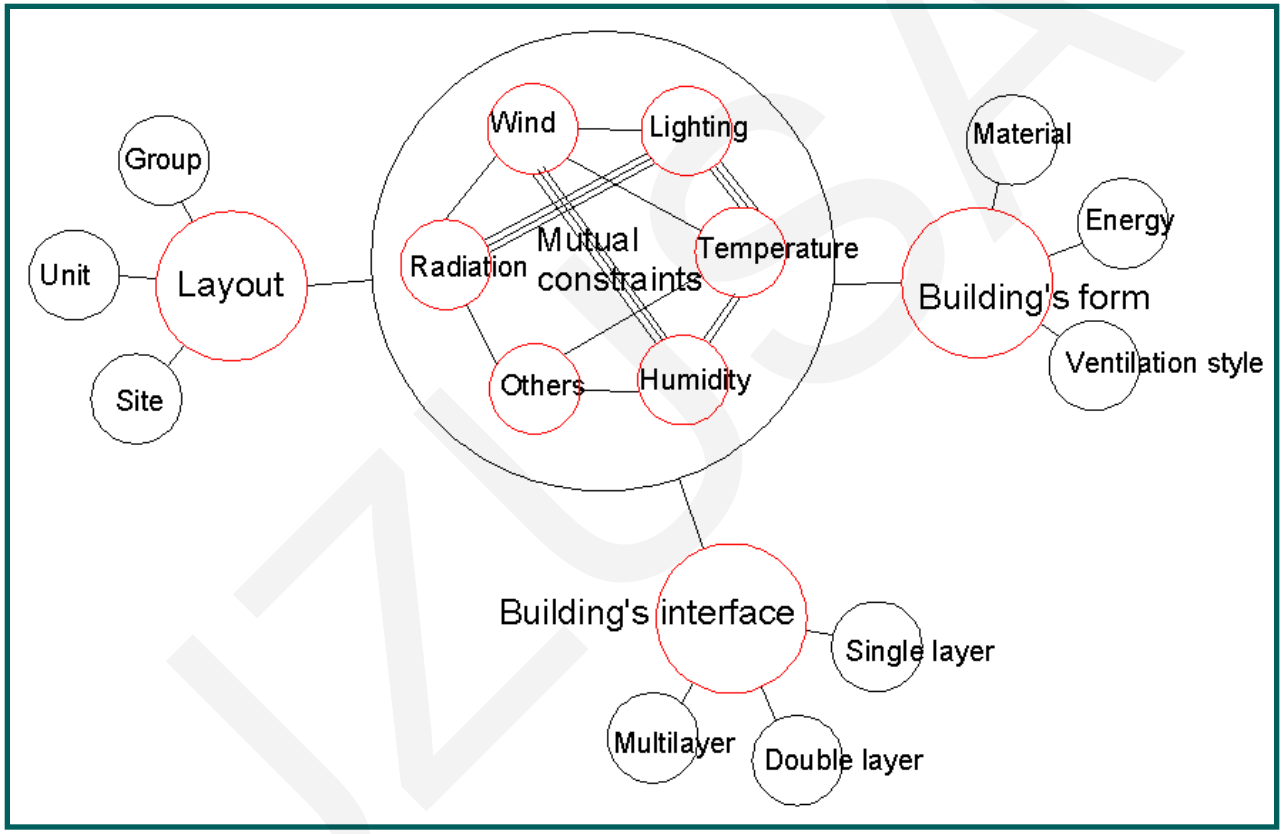
Wind can be easiest influenced by design work



Among five indicators of environment, the indicator “wind” has the most close relation with architectural spatial factor, especially in outdoor environment.

Wind can evaluate different scale of design work

Wind environment evaluation is a efficient way to evaluate different scale of design works,such as city planning, building group's layout or spacing of buildings.

Site :city planning

Group:building group's layout

Unit:spacing of building

Big scale

Middle scale

Small scale

- Ying, X.Y., Zhu, W., Hokao, K. et al., 2013. **Numerical research of layout effect on wind environment around high-rise buildings.** Architectural Science Review,56(4):272-278.
- Ying X.Y., Zhu, W., Hokao, K. et al.,2015. **Numerical research on building ventilation space in the layouts of residential area.** Lowland Technology International,16(2):117-124.

The meaning of this study：A bridge

Building density and layout are directly associated with urban canyon geometry and orientation, which have significant impacts on Urban Heat Island intensity.

On the other hand, building's layout is the most interesting topic to architects and urban designers and the study results could be readily apprehended and referenced in their practice.（Q. Chen，2003）

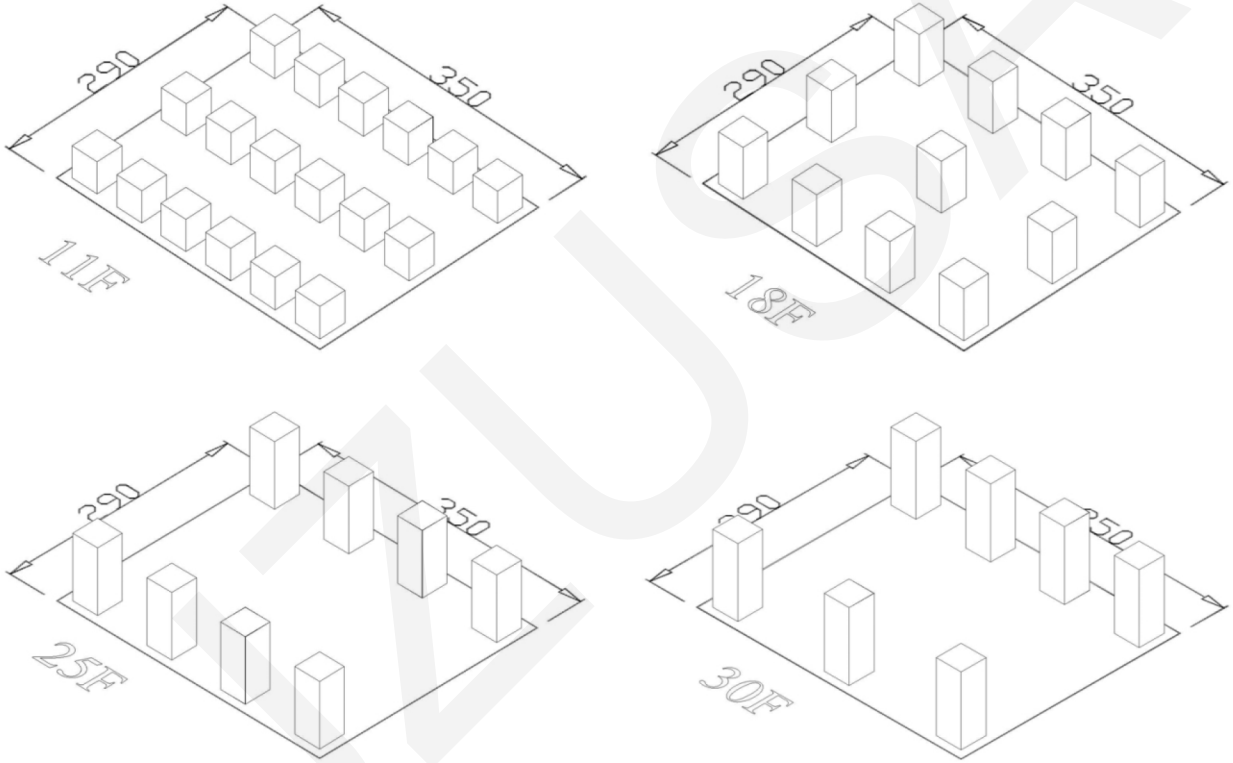
Studies on building's layout factors with the wind environment ecessitate joint efforts from architecture, engineering, meteorology and other disciplines.（C. Allocca，2006）

Environment engineering

Architecture design

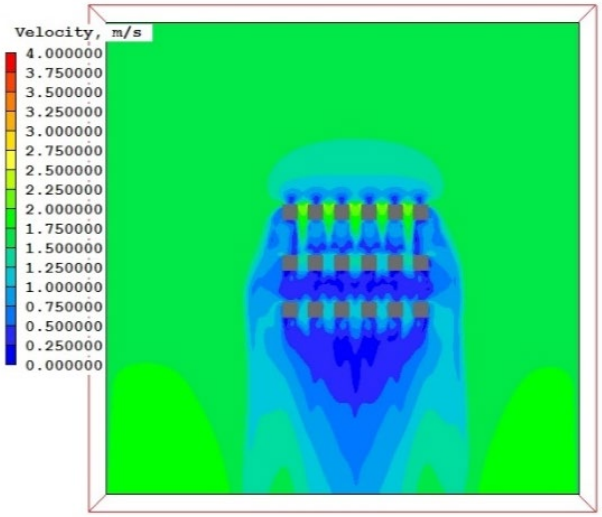
Take floor area ratio=2 as an example

When floor area ratio=2.0, four possible distribution of high-rise buildings.



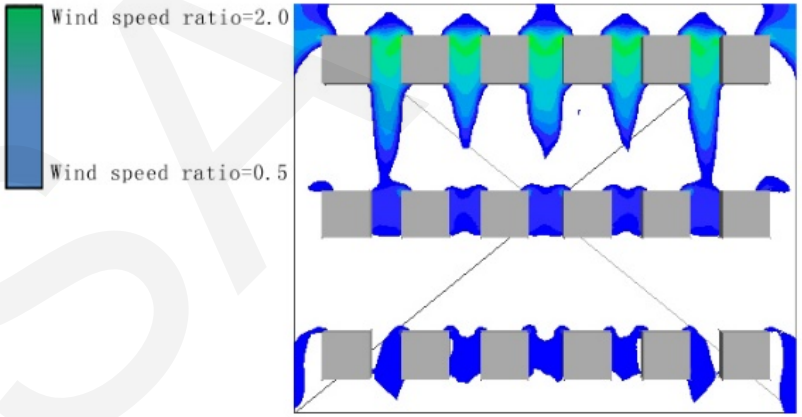
What is the relationship between the floor area ratio, the building density and the building height ?

Method



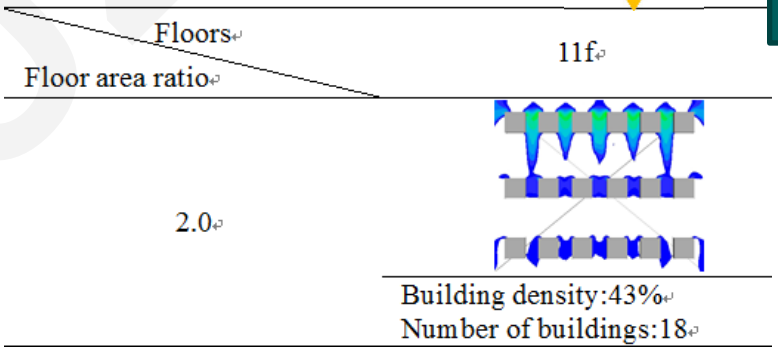
Wind velocity distribution in a simulation result (layout 2.0-11f)

By masking areas with uncomfortable wind speed ratios, we could clearly identify the comfort zones of different layouts and make comparisons

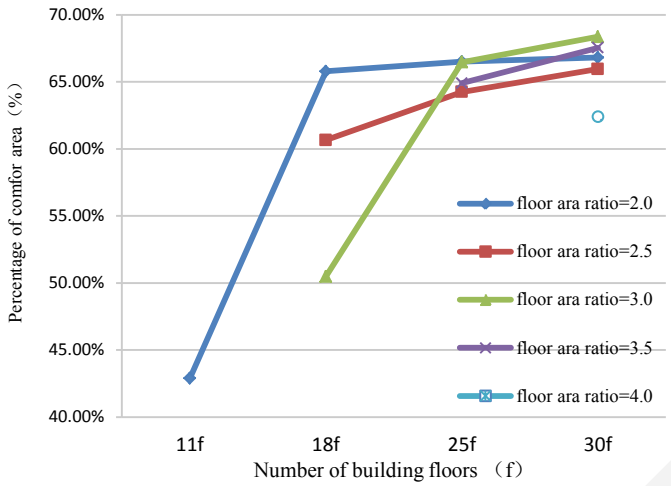


Areas with a comfortable wind speed ratio between 0.5 and 2.0 (layout 2.0-11f)

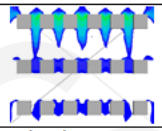
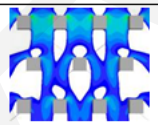
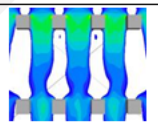
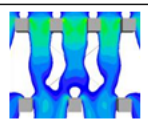
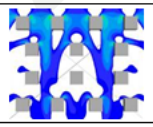
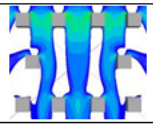
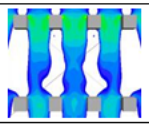
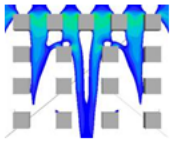
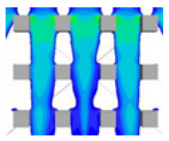
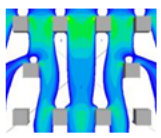
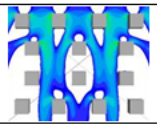
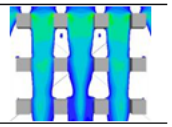
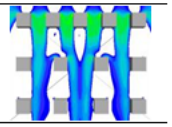
Using the histogram plot tool in Photoshop CS (a graphic software program), the percentage of the area in the comfort zone can be calculated



Percentage of comfort area in each layout



Proportion of comfort zone in thirteen possible layouts

Floor area ratio \ Floors	11f	18f	25f	30f
2.0				
	Building density:43% Number of buildings:18	66%, 11	67% 8	67% 7
2.5				
	Building density Number of buildings	61% 14	64% 10	66% 8
3.0				
	Building density Number of buildings	50% 17	66% 12	68% 10
3.5				
	Building density Number of buildings		65% 14	68% 12
4.0				
	Building density Number of buildings			62% 13

A cell with a diagonal strikethrough means this layout cannot meet the requirements of fire prevention or sunlight spacing.

Conclusions

Conclusion

The study disproves the common belief in the practice that:
a lower floor area ratio means fewer buildings and therefore greater external comfort.

In fact the higher the building, the greater is the outdoor comfort wind zone for pedestrians. However, the increment in comfort area is limited to buildings extending from 25 to 30 levels.

limitation

One limitation of this study is that the assessment did not take account of the buildings around the site which can greatly influence the wind environment and external comfort. In particular the number of storeys in these buildings may be a major factor affecting the external environment.

In addition, the plans of all the buildings were square in this study. However, in practice there are various plan forms.