













### 2.3 Wind velocity profile

Strong wind characteristics are important for wind load calculation in structural engineering, so we select strong wind data from all samples. Since the data of the two districts come from different sources, they are processed in different way. For Chaiwobao station, the 10min-average wind velocity equal to or above 10.8m/s (6 on the Beaufort scale) at 10m altitude is defined as strong wind; for Shatian station, the 1h-average wind velocity equal to or above 10.8m/s at 10m altitude is defined as strong wind (36 time levels were recorded during the observation period). Using the measured wind velocities at each altitude, the velocity profile index is calculated by least squares method for the two wind towers. The index is 0.09 during the strong wind period at Chaiwobao station and 0.121 at Shatian station. Based on conventional meteorological observations, the wind shear exponent is 0.116 at Chaiwobao station and 0.153 at Shatian station (Fig. 7).

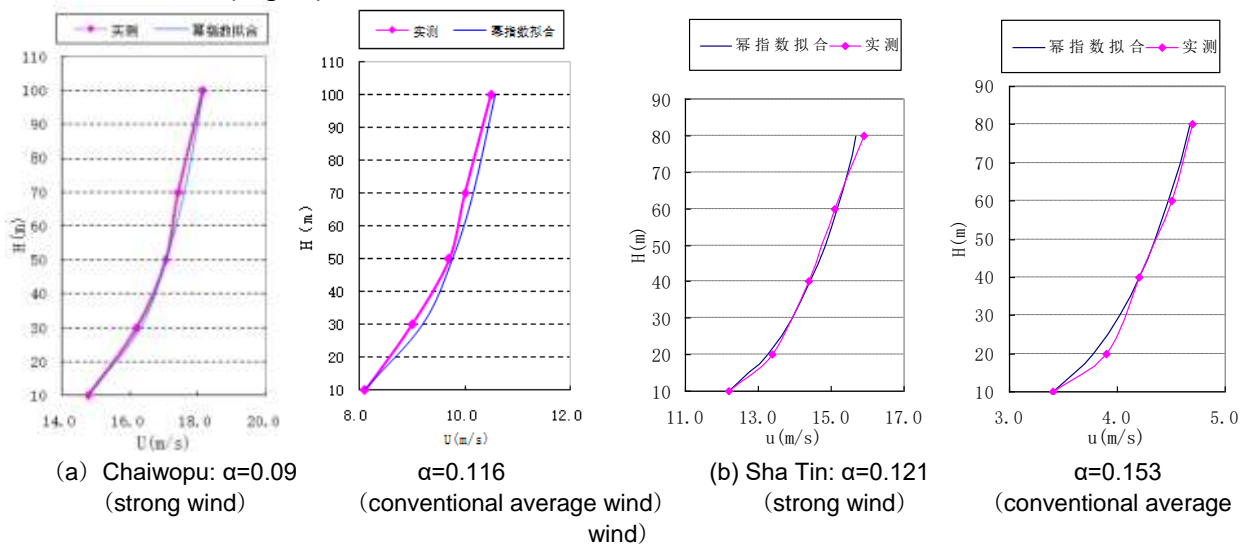


Fig.7 Wind velocity profile of every measuring point

According to velocity profile index, the land covers of the two districts basically belong to type A ( $\alpha=0.12$ ); according to average velocity profile index, the land cover of Chaiwobao station basically belong to type A, and that of Shatian station type B ( $\alpha=0.16$ ). The velocity profile index decreases with the increase of wind velocity.

### 2.4 Turbulence intensity

For turbulence intensity calculation, different data of strong winds are selected. At Chaiwobao station, the 10min-average wind velocity equal to or above 10.8m/s (6 on the Beaufort scale) at 10m altitude is defined as strong wind; for Shatian station, the 10min-average wind velocity equal to or above 8m/s at 10m altitude is defined as strong wind. Turbulence intensity is calculated as the ratio of standard deviation to mean of wind velocity for every 10min at each altitude. The vertical profiles of turbulence intensity during strong winds are plotted through averaging of the turbulence intensity at each altitude (Fig. 8).

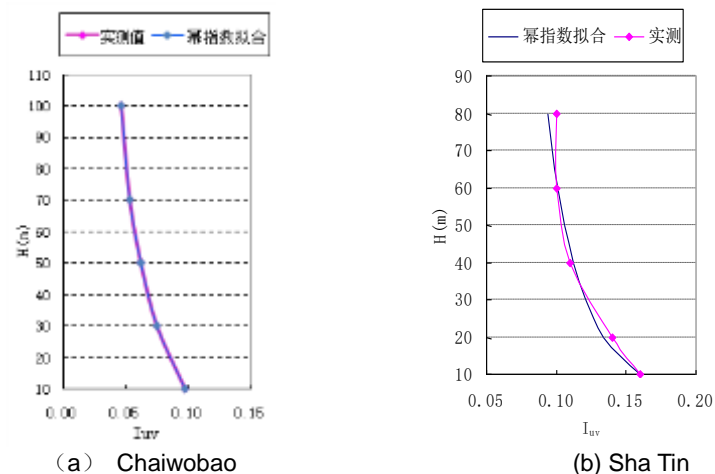


Fig.8 Turbulence intensity profile of every measuring point (a. Chaiwopu, b. Sha Tin)

As seen from Fig. 8, ① the turbulence intensity for Chaiwobao station at the altitude of 10m, 30m, 50m, 70m and 100m is 0.10, 0.07, 0.06, 0.05 and 0.05, respectively. The turbulence intensity ratio between the altitude of 10m and 70m is  $I_{10}:I_{70}=1:0.5$ . Turbulence intensity at the altitude of 70m decreases by 50% as compared with that at 10m; ② for Shatian station, the turbulence intensity at the altitude of 10m, 20m, 40m, 60m and 80m is 0.16, 0.14, 0.11, 0.10 and 0.10, respectively. The turbulence intensity ratio between the altitude of 10m and 80m is  $I_{10}:I_{80}=1:0.63$ . Turbulence intensity at the altitude of 80m decreases by 30% as compared with that at 10m; ③ turbulence intensity decreases with altitude, and the turbulence intensity at Chaiwobao station attenuates more rapidly than at Shatian station.

Exponential model is fit to the turbulence intensity using least squares method:

$I = I_{10} \left( \frac{z}{10} \right)^\alpha$ . The wind shear exponent is calculated as  $\alpha = -0.001$  for Chaiwobao station and  $\alpha = -0.255$  for Shatian station.

Comparison of turbulence intensity between the two districts indicates that ① the turbulence intensity at Shatian station is higher by about 0.05 (over 50%) than that at Chaiwobao station. This is related to wind velocity and the selection criteria for strong wind samples; ② the turbulence intensity at Chaiwobao station decreases more rapidly with altitude as compared with Shatian station; ③ the turbulence intensity fitted by using the exponential function is inconsistent with the fitted velocity profile index.

### 3 Conclusion

The field measured strong wind data at two wind towers in Xinjiang and coastal typhoon zone are compared and analyzed. The following conclusions on wind field characteristics are reached for these two districts:

(1) As to average wind velocity, ① it increases with altitude in the two districts; ② the extreme wind velocity at Chaiwobao station is 39.2 m/s, which is higher than that of the station in typhoon zone (32.9 m/s); ③ the occurrence time of maximum wind velocity is different. The maximum wind velocity occurs in winter and spring in Xinjiang and in summer and autumn in coastal typhoon zone. The wind velocity varies with season (monsoon climate).



(2) As to wind direction, ① the dominant wind direction is WNW in Xinjiang, and the second dominant wind direction is ESE. Consistency of wind direction throughout the year is primarily attributed to the orientation of mountains flanking the valley; ② in Shatian station, the dominant wind direction is SSE and NNE, and the wind direction varies seasonally.

(3) As to wind velocity profile and turbulence intensity, ① using the strong wind samples, the land covers of the two districts basically belong to type A. But based on the data of meteorological observations, the land cover in Chaiwobao distribution basically belongs to type A, and that in Shatian Town type B; ② the wind velocity profiles are greatly influenced by wind velocity. The higher the wind velocity, the smaller the velocity profile index is; ③ the turbulence intensity decreases with altitude, and it decreases by about one half at the altitude of 80m as compared with the land surface. The turbulence intensity fitted using the exponential function is inconsistent with the fitted velocity profile index; ④ turbulence intensity at Chaiwobao station attenuates more rapidly as compared with Shatian station, indicating that turbulence intensity decreases with the increase of wind velocity.

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## REFERENCES

- [1] Xiang Hai-fan. (1997), "State of the art and prospect in studies on structural wind engineering", *Journal of Vibration Engineering*, **10**(3), 258-263
- [2] Gao Liang. (2012), "Simulation and Field Measurement of the characters of Strong Wind in inner land of China", [D]. *Chang'an University*
- [3] A.G. Davenport. (1961), "The Spectrum of Horizontal Gustiness Near the Ground in High Winds", *Quarterly Journal of the Royal Meteorological Society*, **372** (87): 194–211
- [4] Duchene-Marullaz P. (1978), "Full-Scale Measurement of the Structure and Strong Winds", *CIRIA Report No. 76*.
- [5] Bao-Shi Shiau, Yuan-Bin Chen. (2001), "In situ measurement of strong wind velocity spectra and wind characteristics at Keelung coastal area of Taiwan", *Atmospheric Research*, **57** (3), 171-185
- [6] An Yi, Quan Yong, Gu Ming. (2013) , "Turbulence characteristic analysis of typhoon 'Muifa' near 500m above ground in Lujiazui district of Shanghai", *China Civil Engineering Journal*, **46**(7), 21-27.
- [7] WANG Hao, DENG Wen-ping, JIAO Chang-ke, et al. (2011), "Field measurements on typhoon Fung-Wong at the Sutong Bridge", *Journal of Vibration Engineering*, **24**(1), 36-40.
- [8] XIAO Yi-qing, LI Li-xiao, SONG Li-li. (2012), "Study on wind characteristics of typhoon Hagupit based on offshore sea surface measurements", *Acta Aerodynamica Sinica*, **30**(3), 380-387.

- [9] Hui M C H, Larsen A, Xiang H F. (2009), "Wind turbulence characteristics study at the Stonecutters Bridge site: Part I—Mean wind and turbulence intensities", *Journal of Wind Engineering and Industrial Aerodynamics*, **97**(1), 22-36.
- [10] PANG Jia-bin, GE Yao-jun, LU Ye. (2002), "Methods for Analysis of Turbulence Integral Length in Atmospheric Boundary-layer", *Journal of Tongji University*, **30**(5), 622-626
- [11] LI Yong-le, LIAO Hai-li, QIANG Shi-zhong. (2002), "Research on the Wind Characteristics of the Site of Nanjing Changjiang River Bridge on Beijing-Shanghai High-speed Railway", *Bridge Construction*, **4**(5), 5-7
- [12] CHEN Zheng-qing, LI Chun-guang, ZHANG Zhi-tian, et al. (2008), "Model test study of wind field characteristics of long-span bridge site in mountainous valley terrain", *Journal of Experiments in Fluid Mechanics*, **22**(3), 54-67
- [13] LIU Jian-xin , LI Jia-wu. (2005), "Study of wind project of bridge in western area of China", *Journal of Architecture and Civil Engineering*, **22**(4), 32-39
- [14] ZHANG Yue, HU Zhao-tong, LIU Jian-xin. (2011), "Wind characteristics observation and numerical simulation of cable-stayed bridge site in Chinese western valley areas", *Journal of Chang'an University(Natural Science Edition)*, **31**(5), 44-49
- [15] PANG Jia-bin, SONG Jin-zhong, LIN Zhi-xing. (2010), "Field Measurement Analysis of Wind Turbulence Characteristics of Sidu River Valley Bridge Site", *China Journal of Highway and Transport*, **23** (3), 42-47