Report on the Status of Codification on Wind Loading in Singapore

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INTRODUCTION

A draft wind loading code for Singapore has been developed by the WG on Wind Loading. In general, the code is given in the design pressure approach where the design pressure is calculated from the basic wind pressure and the three coefficients, the exposure factor, the dynamic factor and the shape factor, as given in the following equation:

$$p=0.5\rho_{air} V^2 C_{exp} C_{dyn} C_{fig}$$

In the drafting of the code, special considerations are given to the local climatic and geographic conditions of Singapore; adoptions to suit these conditions are being made. There are several features in the draft which the WG tried to put in to reflect the specific climatic and geographic situations of Singapore.

LOCAL CLIMATIC CONDITIONS

Singapore is situated in a mixed climate region. There are the two monsoon wind seasons (northeast and southwest) each year which generated relatively mild monsoon winds. On the other hand there are frequent thunderstorms occurring all over the year, with more during the inter-monsoon periods. Extreme wind studies indicated that while the monsoon wind (large scale wind) has higher wind speeds for the hourly mean wind, the thunderstorm wind (smaller scale wind) produces the higher gust speed. For the 10-minute mean wind speed, the higher extreme values also come from the small scale wind. These can be observed from the extreme wind distributions in Figures 1, 2 and 3.

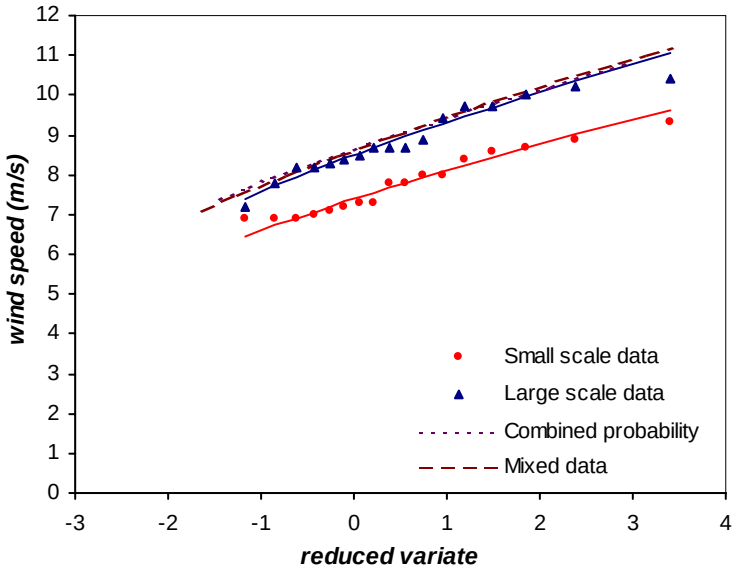

Figure 1 Extreme distributions of hourly mean wind speed at Changi

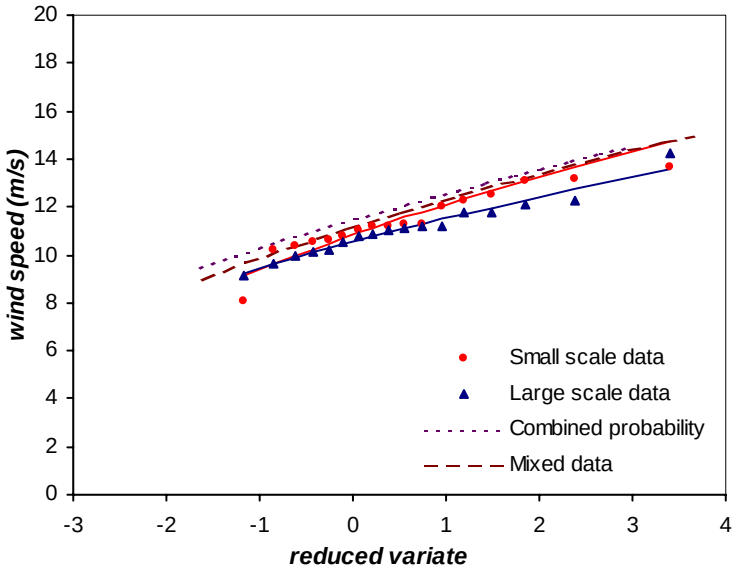

Figure 2 Extreme distributions of 10-minute mean wind speed at Changi

Averaging period for the mean wind speed:
As a result, to reflect the dominancy of the small scale wind, the 10-minute period is adopted for the calculation of the mean wind speed.

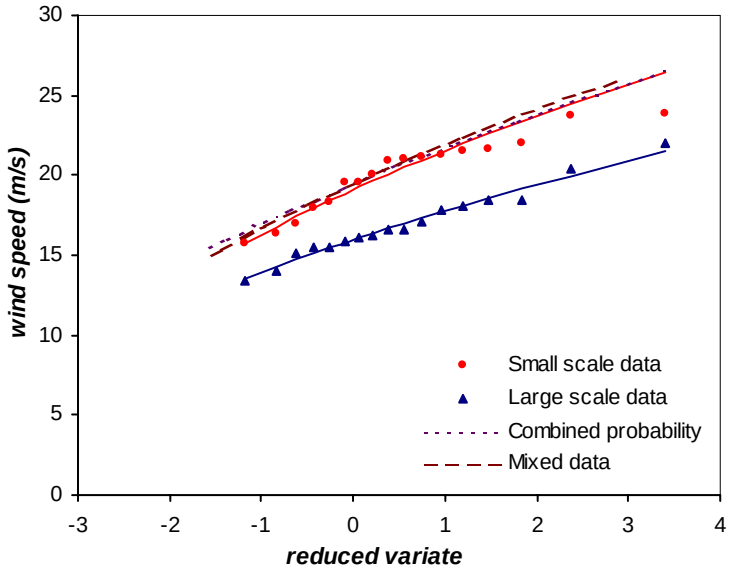

Figure 3 Extreme distributions of gust wind speed at Changi

Gust factor:
As the wind climate in Singapore is very much affected by thunderstorms, the winds are very turbulent and gusty producing high values of gust factor. On the other hand, many occasions of very high gust factor are the result of very low mean wind speed. To strike the balance, a gust factor (3-second gust on a 10-minute mean) of 1.7 is adopted for open terrain. This value is roughly the average gust factor for the extreme gusts.

LOCAL GEOGRAPHIC CONDITION

Terrain types:
Singapore is a small city country. The main island is less than 50km in extend. Substantial areas of the island are cover by buildings 20 over storeys in height. Thus to simplify the wind loading code, only two terrain types are adopted. They are the "open sea" type and the "other" type which cover all sub-urban and urban areas.

Guideline for the calculation for transitions between terrain types is included in the draft code.

DYNAMIC DESIGN:

The draft code covers both the static design and the dynamic design. A dynamic response factor method is adopted in the draft code. Both alongwind and crosswind responses are given. The design procedure and the design parameters are similar to the new AS/ZN 1170.