Power of the Wind

Talk on Wind Effects on Tall Buildings and Structures in Urban Environment and Complex Topography

by Ir. Chen Wai Peng

CIVIL & STRUCTURAL ENGINEERING TECHNICAL DIVISION

PROF. Kenny Kwok from University of Western Sydney delivered a talk titled Wind Effects on Tall Buildings and Structures in Urban Environment and Complex Topography to about 100 IEM members at Wisma IEM, Petaling Jaya on 28 March 2013. His lecture centered on three key areas:

- Overview of thunderstorm climates,
- Measurement of structural properties of tall buildings, and
- Perception of vibration in wind vibration and occupant comfort in wind excited tall buildings.

Prof. Kwok said thunderstorms are isolated acts of Nature, have a narrow path and so, are quite difficult to predict. Simulations similar to pulse jet would be required to conduct useful studies. Cases of thunderstorm modes on stationary, stationary with environmental winds and translating with environmental winds were discussed. The conclusions which he has drawn here are as follow:

- The environmental conditions do influence the wind field of a downburst.
- Thunderstorm winds are amplified above topographic features, but not to the extent of winds during synoptic storms.

He next spoke on the usefulness of measurement of dynamic behaviour in tall buildings. The dynamic response depends very much on many factors. Prof. Kwok concentrated on frequency and damping ratio. Measurements of tall masts, poles, lattice towers, lighting towers, control towers, and residential buildings were discussed.

Prof. Kwok also highlighted measurements taken of two tall buildings in Hong Kong – one was 38-storey and the other a 256m residential building. Excitations were carried out by students pushing up in a rhythmic sequence and with mechanical shakers. The measured frequencies in all the cases were generally higher than those predicted by simplified analysis such as f = 46/H or through finite element analysis. However, the figures generally err on the right side, i.e. conservative calculated outcome.

Then he highlighted the use of a motion simulator in a project with an amplitude of 30 mullig and 0.23hz and 1hz respectively. As the frequency increases, the accelerations of the participants head were increasing magnified. He concluded that there was a frequency dependence of motion perception and recommended that assessment of occupant comfort criteria should include frequency dependency of motion.

Prof. Kwok further discussed the results of a survey of 5,000 participants in Hong Kong on perceived wind induced motion in the home or office. 94% of respondents said they did not feel it and only 2.3% of the 6% who felt it wished to lodge a complaint. To a second question, 73% of respondents felt it was not acceptable for buildings to move in wind excitation and 75% in this group felt that safety was a concern. The 27% who accepted that buildings did move in excitation by wind had been given prior awareness education to understand the inherent safety aspects.

Prof. Kwok said the complaints of discomfort could be cultural dependence and may be subjected to public housing demand. Due to such subjective perceptions, he recommended that dampers should not be provided based on complaints received from a given percentage of population sampled, but only to investigate the need for such provision when amplitude of vibration exceeds a value of 25 mullig.

The talk ended on a very positive note, with a number of questions raised by members of the floor who mainly comprised practising engineers. Then a token of appreciation was presented to Prof. Kwok by the event organizer. ■

Ir. Chen Wai Peng is a Consultant attached with HSS Group. He is a member of the IEM Technical Committee on Earthquake.