ROYAL METEOROLOGICAL SOCIETY: AUSTRALIAN BRANCH MEETING

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Design Wind Speeds using Australian Meteorological Data

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Professor Melbourne, Monash University, introduced his talk by briefly describing the effect of wind upon structures by stress loading. He emphasised the importance of the natural wind fluctuations (through the spectrum of turbulent energy), the related pressure fluctuations, and how any one structure responds mechanically through its natural resonant frequency to these pressure variations. Thus designs should take into account, through appropriate modelling, expected mean winds, wind direction probabilities, and turbulence characteristics of the air flow. Unfortunately, present design codes are based mainly upon observations of mean winds only (where these exist) and the associated short-term (3 s) gusts. This essentially means the incorporation of large safety margins into the new structures.

The testing of wind tunnel models was an important step in the design of most structures (e.g. the new Victorian Arts Centre, Nauru House, the West Gate Bridge, and the VFL Park Grandstand had all been modelled in the Monash wind tunnel), as was the recognition of the dominant response characteristic of the structure. For example, the loading upon solid buildings depended mainly upon the longitudinal (horizontal) wind fluctuations and chimney stacks upon lateral fluctuations, while roofs and bridges responded mainly through their resonant frequencies. Models could also show how one large structure may interact with another, e.g. the Nauru House wake could double the load on downstream large buildings; an example was also given of the lack of foresight in siting a multistorey building in the United States, with the subsequent damage to downstream structures caused by the induced wake. Litigation may be one result of such design ignorance (or thoughtlessness). Fascinating graphs were also shown of predicted stresses upon the VFL Grandstand roof (manifest roof deformation for $V > 25$ m/s) and the West Gate Bridge. In the latter case, maximum expected wind speeds (wind directions are very important in the design orientation of the bridge) would give centre vertical deflections of 1 m, cable towers would sway at 45 m/s, and the bridge would bounce on its supports at 60 m/s!

The final part of the talk dealt with the estimation of design wind speeds as a function of geographical location. Given the annual maximum 3 s gust value for any location, 10, 20, 50, and 100 year return probabilities can be calculated based on certain statistical procedures, but in respect of the wind records, allowance had to be made for site changes over the years and extrapolation with height had also to be calculated.

It seemed that the concept of return periods based on these design speeds was somewhat 'ridiculous'; ideally 5 minute mean wind speeds and spectral distribution of fluctuations were required as a function of time (many years) at many locations. In addition, one had to allow for the different weather systems which prevailed across the continent, in terms of the related maximum probable wind speeds (namely whether high winds were produced by mid-latitude depressions, severe thunderstorms, or tropical cyclones).

The overall impression was that wind models gave good qualitative information, load calculations could be done reasonably well, but the ultimate design erred on the side of extreme safety (as indeed it must do in the circumstances, but at great cost) in the absence of relatively simple wind speed statistics.

Twenty-five members were present at a well presented and interesting lecture.

J.R.G.