TOWARDS AS1170.2-2000

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INTRODUCTION

At the time of this Seminar, it is less than two years since the latest version of the Australian Standard for Wind Loads, AS1170.2-1989 [1], was issued, and only a matter of months since the Commentary to the Standard [2] was published. It may, therefore, seem a bit premature to be looking ahead to new versions of the Standard at this time. However, it is in fact 3 to 4 years since the basic technical work was done for the 1989 edition and several "problems" and anomalies have arisen since, that unfortunately could not be addressed in time for the latest edition. In many cases this was because the technical work had not been completed or basic data was not available.

It is the purpose of this minor contribution to the Seminar to record several technical matters that have arisen in the last year or two that should be addressed by those responsible for future amendments and revisions of AS1170.2.

WIND SPEEDS AND MULTIPLIERS

The "basic wind speeds" on which calculations of dynamic pressures for all the Procedures in the Standard, are, of course, maximum gusts with an averaging period of "2 to 3 seconds". There are very good reasons for using a maximum gust speed that have been fully discussed previously [2, Chapter IV]. The problem arises with the 2 to 3 second averaging period. Again there is a very good reason for this period, as it relates to the response characteristics of the Dines anemometer which was the standard wind measuring instrument of the Bureau of Meteorology for many years. I believe these have been replaced by cup anemometers at many sites; their response characteristics are less-well known. However, the 2-3 second maximum gust is significantly (10-15%) lower than the maximum gust recorded by an instrument with an "ideal" frequency response. The Tables of Terrain/height Multipliers and turbulence intensities, in the Standard, have been derived without accounting for the 'filtering effect' of the meteorological instruments.

It is important to be clear about the appropriate reference wind velocity when translating wind-tunnel data for code use. An obvious solution would be to define the reference basic wind speed in the Standard as the true maximum speed at 10 metres height in Terrain Category 2. However, as the resulting 10-15% increase in wind speeds (20-30% increase in wind loads), would probably be unacceptable, an adjustment would have to be made elsewhere, say in the load factor for wind loads in Part 1 of AS1170.

The considerable differences in wind structure in thunderstorm downdrafts have been addressed in another paper in this Seminar [3]. Much more research is needed before acceptable Terrain/height and Topographic Multipliers can be specified. In the meantime, the present values, based on 'gale' and tropical-cyclone boundary-layer winds are probably conservative.

Some clarification of the basic wind speeds for serviceability design in AS1170.2 needs to be carried out, especially for dynamic response calculations in Section 4. The criteria for deflections, accelerations etc. themselves tend to be statistical and hence cannot be divorced from the specification of wind speed, which is also statistical. Thus a single basic wind speed for serviceability design is only meaningful if the serviceability criteria are defined at the same time.

Some problems in the current method of determination of Topographic Multipliers have also been covered in another contribution to the present Seminar[4].

PRESSURE AND FORCE COEFFICIENTS FOR STATIC ANALYSIS

Although some problems have already been resolved in the recent amendment to AS1170.2-1989 (e.g. free-standing walls and hoardings for oblique wind directions), a number of deficiencies are apparent for which data is currently being obtained or are not yet available:

a) Horizontal (drag) forces on pitched roofs on enclosed or free-standing low-rise structures are important design loads in many situations. The current approach used to determine separate pressures on upwind and downwind slopes is adequate for vertical (uplift) forces but may not be for peak horizontal forces which are produced by different instantaneous pressures. More wind-tunnel tests are required to investigate this. These tests should incorporate some measurements of 'coincident peak' pressures on upwind and downwind slopes and/or correlations of pressures on the two slopes.

b) The local pressure factors, K_l, currently specified for free-standing roofs are conservative values based on limited experimental data. Hopefully experiments currently being carried out at the University of Queensland will contribute useful data to both this problem and (a) above.

c) The effects of ancillaries (antennas, ladders, platforms etc.) on the drag coefficients of lattice towers used for communication, broadcasting etc. are not included in AS1170.2-1989, but have been addressed recently at CSIRO. However, the results of this work will probably appear in a separate Standard for the loading of lattice towers and masts, following the examples of other countries.

d) Recent wind-tunnel work at Concordia University in Canada (to be published shortly) has indicated that some revision to Appendix A1 for saw-tooth roofs may be required. The data for curved roofs in Section A2 was always considered suspect due its dubious origins. However, some numerical studies have recently been carried out at CSIRO (for Strarch International) which should allow this Section to be extensively revised.

DYNAMIC RESPONSE

Section 4, which allows the computation of response in both the along-wind and cross-wind directions for tall buildings, brought the dynamic response problem into the Standard proper for the first time. Section 4.4.2 allows the calculation of along-wind response for towers as well as tall buildings. However as indicated in another paper in this Seminar, [5], this Section should be used with caution when used with structures that have highly non-linear mode shapes. The main effect is on the background factor, B, and size factor, S, which are underestimated by the formulas in the Standard for structures with nonlinear mode shapes. A simple 'fix', that is currently being investigated at CSIRO, is the use of a reduced height in the formulas.

For consistency with the rest of the Standard and for the convenience of the user, it is desirable to provide equations for the cross-wind force spectrum coefficients in Figures 4.4.3(A) and (B). This work is in progress at Monash University.

REFERENCES

1. Standards Australia. Minimum design loads on structures. Part 2- Wind Loads, Australian Standard AS1170 Part 2, 1989.

2. J.D. Holmes, W.H. Melbourne and G.R. Walker. A Commentary on the Australian Standard for Wind Loads. Australian Wind Engineering Society, 1990.

3. R. Panneer Selvam and J.D. Holmes. Thunderstorm downdrafts from the point of view of building design. Seminar on "Wind Engineering in the 90's", Pokolbin N.S.W., February 7-8 1991.

4. D.A. Paterson and J.D. Holmes. Computation of topographic multipliers. Seminar on "Wind Engineering in the 90's", Pokolbin N.S.W., February 7-8 1991.

5. J.D. Holmes, B.L. Schafer and R.W. Banks. Wind-induced dynamic response of a large lattice tower. Seminar on "Wind Engineering in the 90's", Pokolbin N.S.W., February 7-8 1991.