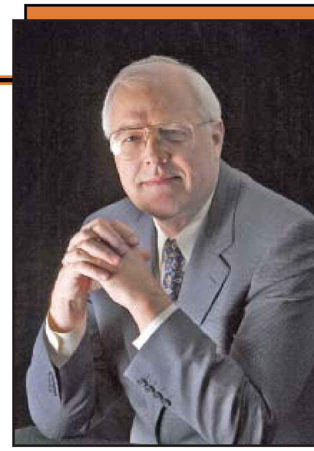
Editorial

Wind Tunnel Testing Moving Forward

By Larry Griffis, P.E.
Past-Chair, ASCE 7 Wind Load Task Committee



For decades, wind tunnels have provided the technical basis for the pressure coefficients used in standards throughout the world to calculate wind loads on buildings and other structures. As more sophisticated analysis and design procedures have developed, the use of a wind tunnel test to determine the loads on a specific building has grown in popularity and precision. Long viewed as the most accurate method permitted by ASCE 7, a structure-specific wind tunnel test has proven to be a reliable and cost-effective tool for structural engineers, answering the demands of today's marketplace for more accurate and lower loads to save on both cladding and frame costs. Indeed, the wind tunnel test has become one of the most powerful tools in the structural engineer's tool kit, and a significant milestone in structural design for the twentieth century. Engineering News Record (ENR), in its publication *Horizons*, called the evolution of wind tunnel testing one of the most significant innovations in 125 years of construction.

> "…the wind tunnel test has become one of the most powerful tools in the structural engineer's tool kit…"

The benefits of wind tunnel tests are acknowledged in the NIST report on their 3-year, $16-million investigation of the collapse of the WTC towers. A recommendation of that report calls for the development of a standard methodology for conducting wind tunnel tests. The SEI of ASCE has long recognized this need and has been developing a national consensus standard for wind tunnel testing since the late 1990's. This new standard is presently entering its final development phase and has an anticipated publication date of fall/winter of 2006, effectively fulfilling the recommendation by NIST.

> "…there have been a large number of projects tested by more than one wind tunnel laboratory where results were very close, typically within about 10%."

While this standard will certainly prove useful to the profession, it must be remembered that obtaining wind loads through the use of a building-specific wind tunnel test is a two-part process; the first part being the actual physical test done in the wind tunnel and the second part being a climatological study combining the local meteorological, wind speed and directional information with the raw wind tunnel data in order to determine the loads on the specific building. For part one, the physical wind tunnel test, the results between the different commercial laboratories commonly used in practice can generally be expected to agree within a few percent. The larger variation, where it occurs at all, is generally attributed to part two, the climatological study. Here, because of the quantity and quality of the data available, the need to correct it for site conditions and with the numerous sophisticated statistical approaches available to predict the final wind climate, the final loads recommended by the different laboratories may differ by 10% or more.

The situation is similar to that of geotechnical specialists who have to work with limited and imperfect soils information. It is well recognized that different geotechnical experts can sometimes arrive at different recommendations for the same site and provide different design values using the same soil data.

Although there isn't one standard method for combining the meteorological data with the wind tunnel data, the various methods in practice today generally yield reasonably close results for most buildings. Contrary to the NIST comparison of WTC Tower 2 where a 40% difference has been claimed, there have been a large number of projects tested by more than one wind tunnel laboratory where results were very close, typically within about 10%. In the Amoco tower litigation some years ago, the same two wind tunnel testing facilities as those involved on the WTC independently arrived at base moments that were within a few percent of each other. In similar recent comparisons for two super-tall buildings in Hong Kong, base moments were matched within 10%.The 40% difference reported by NIST for the WTC will require a detailed study to resolve.

Future editions of the wind tunnel standard will need to wrestle with the issue of combining the wind tunnel data with the local meteorological data, along with the inevitable calls for simplicity. We all would like transparency and simplicity in our codes and standards, yet history tells us that when a standard or code of practice strives for transparency and simplicity above all else, it can easily become very prescriptive, possibly stifling innovation and the future development of improved methodology.

As we move forward, it is hoped that the standard for wind tunnel testing will not be made as simplistic and prescriptive as to preclude the use of new and improved methods, or that a standard evolves that puts wind consultants into a straight jacket and prevents them from using the best available approach for each problem. There are a number of exciting new developments occurring in wind engineering, particularly in the areas of statistics, meteorological modeling and insights into the structure of different types of storm. The developers of the next edition of the standard should strive to ensure that the standard encourages and promotes progress without stifling creativity.▪