Preface

Special Issue on the high-frequency balance testing

Why is now the time for a complete volume on the subject of high-frequency balance testing, which was introduced to the wind engineering community more than 30 years ago? It is well known that this technique virtually revolutionized the use of wind tunnels in the role of tall building design, having changed the process from an expensive time-consuming affair, only rarely used for the most demanding of structures, to a cost-effective process capable of delivering useful design information to the structural engineer in a timely manner. Is the subject still worthy of such a treatment?

When I began development of balance testing for use at Colorado State University in 1980, it quickly found commercial use there and at CPP, Inc.—so much so that, when the Ph.D program finally ended 10 years later due to the real-world demands of complex mode shapes, meaningful load combinations, integration with site-specific wind climatology, and buildings much more irregular than idealized prismatic boxes, my dissertation bore only a passing resemblance to the initial outline.

Today many others have joined as users and developers of the technique, and so progress has continued in both practical application and technical sophistication. Yet demands continue to rise, in response to ever more complex architectural forms and engineers' needs. For this Special Issue I have invited a number of leaders in the field to join in presenting their current views, practices, and projections. The response was enthusiastic, yet the papers presented in this issue represent only a few of the advanced topics still under development for this most interesting of experimental methods.

The issue begins with my own introductory paper—an overview of the current state-of-the-art of this measurement-analysis technique, highlighting some of the major technical issues that had to be solved, and remain to be solved. The following paper by Ho *et al.* represents a technical viewpoint, especially regarding post-processing, as developed over many years at the University of Western Ontario, where the technique originated. Another technically advanced treatment of the technique is further presented by Xie and Garber, and includes application to a variety of modern buildings as encountered during the extensive consulting practice at Rowan Williams Davies and Irwin, and related validation studies. The paper by Chen *et al.* focuses on the non-ideal mode shape problem: nonlinear, coupled, and higher modes—one of the best-recognized but most-evasive issues with the technique. This is logically followed by the paper of Tse *et al.*, which discusses a novel approach to this problem known as the linear mode shape (LMS) technique, introduced some years ago at the Hong Kong University of Science and Technology. A change of pace is offered by Lim and Bienkiewicz, who describe the technique as a research tool—a means to an end rather than an end in itself—to investigate the joint aerodynamic loading of tall twin buildings in close proximity. Finally, the subject is wrapped up by Holmes and Tse who describe some results from a recent international benchmark comparison in which two generic buildings were studied by eight different wind tunnel laboratories.

I close this introductory note with a few comments regarding the name, simply stated as "this technique" above, by which it might be more specifically known. Most importantly, it is a "high-frequency" technique; and In the present context, "high" means *high enough to capture the aerodynamic loads incident on the test specimen, without truncation or artificial amplification of any part of the bandwidth of interest*. And so the balance may rightfully be described as an *aerodynamic* balance, as opposed to a setup possibly designed with a very different type of balance to study *aeroelastic* loads. Nevertheless, the method became known at an early stage as the "High Frequency Force Balance" (HFFB) technique, in spite of the fact that forces—as distinct from moments—needn't be measured (or at least are much less important than moments for tall structures), and "high" is in the eye of the beholder. Further recognizing that a very important aspect of the method is to measure the incident aerodynamic load resultants only at or near-ground level, it began to take on the name “High Frequency Base Balance” (HFBB). See Fig. 1 and the associated discussion in the introductory paper of this volume for one person’s view of how this technique fits within the broader family of methods used to study this subject in the wind tunnel. At CPP we have settled on “High Frequency Balance,” or HFB, as the preferred name for this technique. Unfortunately the industry has not uniformly adopted this or any other name, and so the same technique is referred to variously throughout the papers herein as HFFB, HFBB, or HFB. I have made no attempt to standardize this, except to exploit editor’s privilege and use “High Frequency Balance Testing” as the name of this Special Issue.

Whatever name is chosen to identify this technique, users should be aware that the variations as currently practiced in boundary layer wind tunnels for civil applications around the word have common roots, theory, and application techniques, largely as described in this volume. I am pleased that you as readers can join all of the authors in our enthusiasm and dedication for the technique.

Guest Editor:
Daryl Boggs
Fort Collins, Colorado, U.S.A.