A Tribute to

Robert H. Scanlan

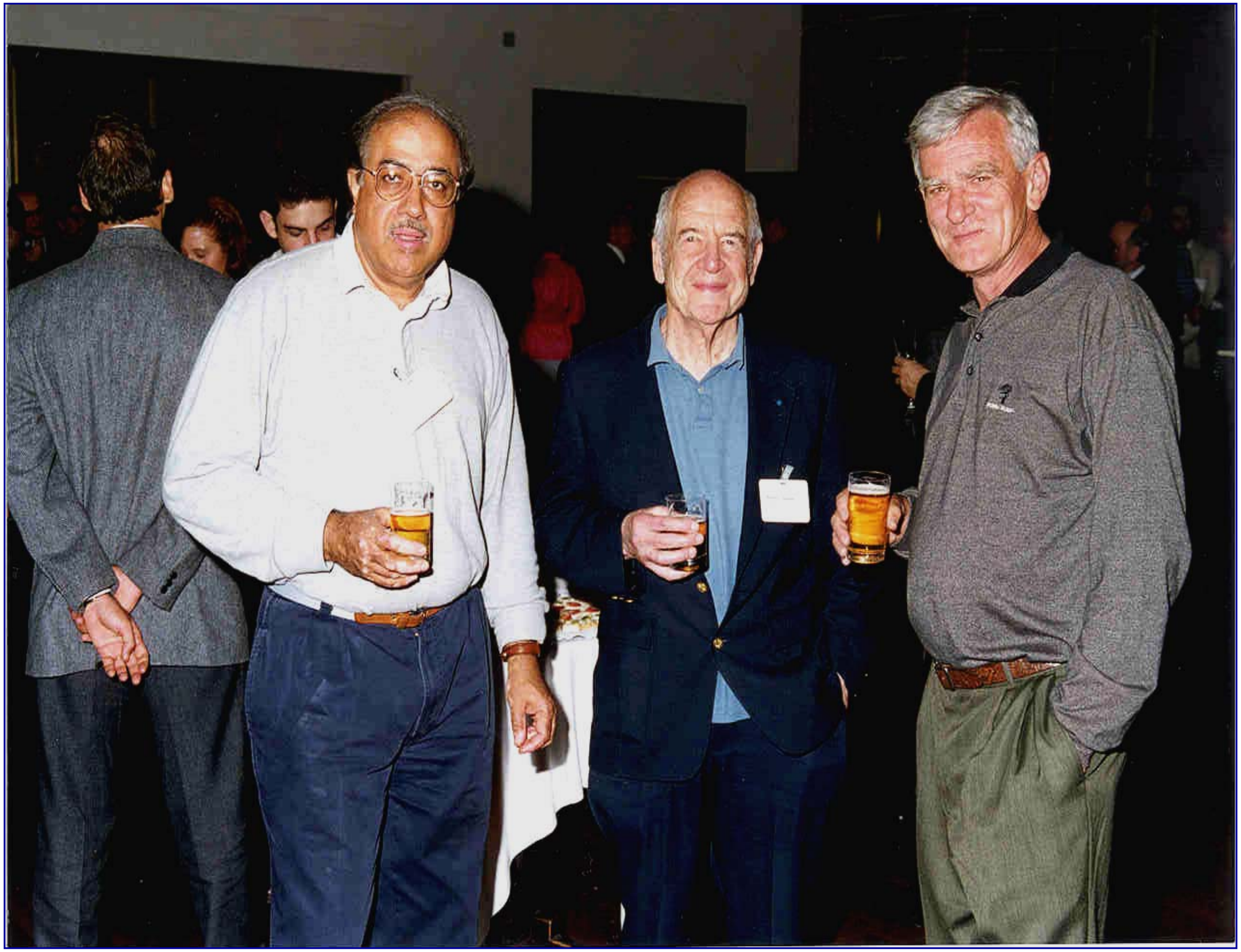
From colleagues at the
University of Notre Dame

In Memory of Robert H. Scanlan

Ahsan Kareem

- Bob was a mentor, an advisor and a friend to me, and I will cherish the memories of my interactions with him, both technical and social. I last met him in Bochum at the BBA where he was kind enough to climb four flights of stairs to listen to our presentation on the correlation of flutter forces and the influence of turbulence.
- I first met Bob during my student days at CSU as he was a frequent visitor there. Later, I spent an entire day with Bob and Beth sight seeing and climbing the towers of the Sydney Harbor Bridge before the International Conference on Wind at Gold Coast. This is where I really got to know them as we chatted all day on a variety of topics. I was always impressed by the joy he expressed when he noticed foreign students doing well in their professional career in the USA.
- I searched through my pictures from the Australian trip, but could not find a print of pictures we took that day. I found a more recent picture taken at the reception of the Symposium to honor Professor Blessman in Brazil in May of 1998 (in picture from left to right:Ahsan Kareem, Bob Scanlan and Barry Vickery)
- I am sure that the light of inquisitiveness and scholarship which Bob has kindled in our minds will linger long in promoting theory, analysis and experiments in bridge aerodynamics.

In Memory of Bob Scanlan



Robert H. Scanlan

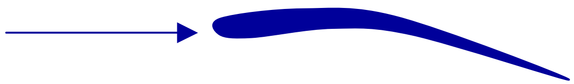
A Pioneering Vision and an Articulate Voice

General Thoughts on His Contributions to Bridge Aerodynamics

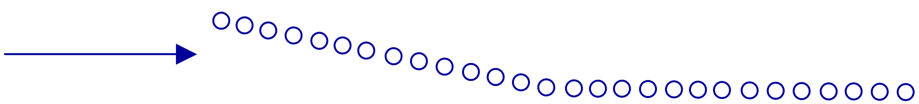
Fred L. Haan, Jr.

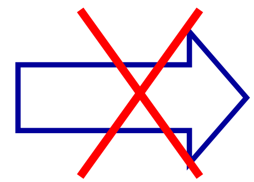
June 1, 2001

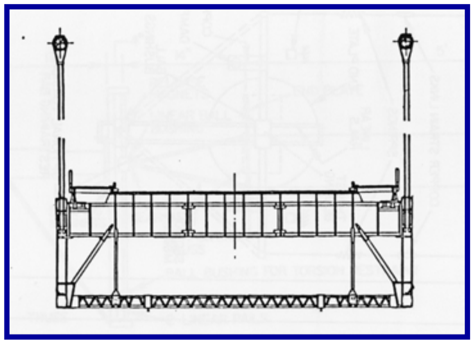
Primary Contribution



Thin airfoil approximation

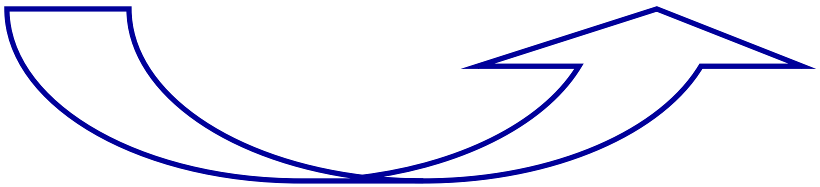






$$L = f\left(C(k), h, \dot{h}, \ddot{h}, \alpha, \dot{\alpha}, \ddot{\alpha}\right)$$

Analytically Determined



$$L = f\left(\cancel{C(k)}, h, \dot{h}, \ddot{h}, \alpha, \dot{\alpha}, \ddot{\alpha}\right)$$

Experimentally Determined
(Scanlan's "flutter derivatives")

$$L = C_1 h + C_2 \dot{h} + C_3 \ddot{h} + C_4 \alpha + C_5 \dot{\alpha} + C_6 \ddot{\alpha}$$

Good Writing

- In research writing, quality varies widely

- Scanlan's writing stands out clearly above the rest for clarity of presentation and transparency of method

- It is often so clear and so helpful, that it looks easy

- Feynman quote

Good Writing - Examples

Although the earliest section model tests of bridge decks were considered as directly representative of prototype bridge action . . . it is now generally recognized that the section model best serves only as an analog source of aerodynamic data rather than as a completely similar dynamic model.

from "The Action of Flexible Bridges Under Wind, I: Flutter Theory" in *Journal of Sound and Vibration*, v. 60, n. 2, 1978.

The section model, in effect, is an analog simulator that reveals aerodynamic mechanisms affecting bridge stability and general response. The "reading" of this simulator is done by examining the flutter derivatives. After the final design of the deck is fixed, the section model further serves as a means to investigate the static and dynamic forces expected on the prototype deck. It is in principle intended to represent the prototype *aerodynamically*, not simply geometrically.

from "The effect of section model details on aeroelastic parameters" in *Journal of Wind Engineering and Industrial Aerodynamics*, v. 54/55, 1995.

Good Writing - Examples

On the other hand, it is a matter of observation—mainly of models, though the famous Tacoma Narrows film record also lends some insight—that flutter, when it does occur, usually involves strong action of one mode in particular, especially one with a strong torsional component. Bridge flutter is most commonly a bluff-body, separated-flow phenomenon in which a single torsion mode becomes unstable and "drives" the system. One seeks out such "worst cases," however unlikely, as depicting the most critical circumstances of flutter for a given bridge design. Thus, there is some incentive to seek simplified versions of Eq. 12.

from "Interpreting Aeroelastic Models of Cable-Stayed Bridges"
in *Journal of Engineering Mechanics*, v. 113, n. 4, 1987.

A small connection with me . . .

Gust coherence decay form: $\exp^{-c\frac{|x_A - x_B|}{L}}$

"It is of some interest to compare the *c* values found appropriate to define flutter derivative coherence with those conventionally used to define lateral gust coherence."

It was very gratifying to see this because this was my suggestion as a reviewer of the paper. As a young researcher it was very encouraging to see Dr. Scanlan making use of one of my suggestions.

In the acknowledgments:

"The writer is grateful to the reviewers of the original manuscript for their insightful and helpful criticisms, not all of which could be responded to without additional investigation beyond the scope of the present effort."

This too was exciting to see—again because I had reviewed the paper—and exemplified to me what a gracious man he was despite his extraordinarily productive career and his globally-recognized reputation.

The paper related to this slide is "Amplitude and Turbulence Effects on Bridge Flutter Derivatives" in the Journal of Structural Engineering, v. 123, n. 2 (1997) p. 232-236.

His comments were always well-articulated and insightful. A lot of other people ramble and/or pat themselves on the back when making comments after someone's talk—personally I never heard him do this. He always had something good to say—you wanted to be taking notes during the Q&A time just to get what he had to say.

He always had something positive to say about people's work—like at conferences. Even when Other people were tearing someone up, he recognized the good aspects of someone's work. It also never seemed to be just some wimpy "being polite" type comment, but rather something that made you think "Well, yes, that is a good point."

He always showed class. The two times I talked to him, he treated me with respect and gave me little tidbits of encouragement and advice on my work. Big name people do not always do this with lowly grad students. It was a thrill for me to meet him, given his reputation, and I was pleasantly surprised to experience how cordial and helpful he was. I was inspired to strive for the same demeanor in my own career.

Good Writing

I always feel like I'm learning something when I read his papers—not just reading about the accomplishments of someone.

His papers are so clearly written that the work looks easy. That is one of the dangers of good presentation—if people readily comprehend what you've done, then it looks like it was too easy and not too big of a deal.

There is a Richard Feynman quote about being clear about everything that went into your work—all the assumptions, all the limitations, all the compromises. You're basically helping people shoot holes in it if that's at all possible. You do this because in science you're trying to figure out what works and how things work—not just what makes you look good. Bob Scanlan's papers obviously showed this kind of candor and clarity.

Prof. Robert H. Scanlan's Significant Contributions to Bridge Aerodynamics

Xinzhong Chen

Prof. Robert H. Scanlan's Significant Contributions to Bridge Aerodynamics

- Introduced flutter derivatives to model self-excited forces, which makes it possible to take into account the aeroelastic effects in analyses of the dynamic response of bridges to wind loads.
- Developed techniques for flutter derivative identification, and in particular particular, the free vibration techniques based on 2D section model tests. Flutter derivatives have been widely accepted for describing motion-induced forces on bridges and as one of the important aerodynamic parameters, along with the static forces coefficients for modeling static forces and admittance functions for modeling buffeting forces, for aerodynamic design of bridge sections and the evaluation of performance of overall bridges to wind.

Prof. Robert H. Scanlan's Significant Contributions to Bridge Aerodynamics

- Pioneering work on aerodynamic indicial functions for bridge deck sections with emphasis on time domain modeling of aerodynamic forces.
- Established analysis theory for multimode coupled flutter analysis of bridges.
- Established framework for buffeting analysis of bridges taking into account aeroelastic effects.
- Proposed simplified mode-by-mode approach for single mode flutter and uncoupled buffeting analyses.
- Pioneer work on turbulence effects on flutter derivatives, spanwise correlation, and flutter instability of overall bridges.

Prof. Robert H. Scanlan's Significant Contributions to Bridge Aerodynamics

- Provided comprehensive insight into the modeling of aerodynamic forces on bridges by discussions of relationship and interrelationship of aerodynamic force parameters.
- Pioneering work on the modeling of vortex-induced vibration of bridges.
- Pioneering work on the buffeting response of bridges under construction due to yawed wind.

Prof. Scanlan's pioneering work shaped the state-of-the-art of aeroelastic analysis, advanced wind-resistant design, and significantly enhanced our ability to build longer, stronger and more economical long-span bridges.