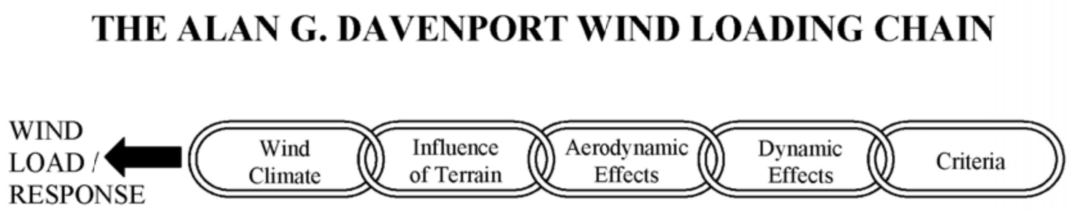
Announcement of the Alan G. Davenport Wind Loading Chain

Professor Alan Garnett Davenport (1932 – 2009)

On July 12, 2011 during ICWE-13 in Amsterdam, the General Assembly of the International Association of Wind Engineering (IAWE) unanimously approved the use of the term the “Alan G. Davenport Wind Loading Chain” for describing Alan Davenport’s approach for evaluating wind loads and wind-induced responses for buildings and structures. Many of us remember Alan G. Davenport’s name in connection with a number of specific technical aspects of wind engineering. These include his power law wind profiles; his spectrum of turbulence; his admittance and joint acceptance functions, which describe the spatial and temporal properties of turbulence as required in the evaluation of dynamic wind action; his gust effect factor; his pioneering use of wind tunnel model studies to chart the dynamic properties of buildings and structures; his statistical methods for predicting maximum values of extreme winds and their effects of wind on buildings and structures; and his criteria for judging the effects of wind on building occupants and pedestrians. Notwithstanding his influence on these and many other specific aspects of wind engineering, his greatest legacy is his rational approach or “chain of thought”, which ties together these various concepts in the development of the methodology for evaluating the action of wind particular buildings and structures.

Professor Davenport's approach or chain of thought is described as follows:



Alan's approach recognizes that the wind loading on a particular building or structure is determined by the combined effects of the local wind climate, which must be described in statistical terms; the local wind exposure, which is determined by the terrain roughness and topography; the aerodynamic characteristics of the building shape; and the potential for load increases due to possible wind-induced resonant vibrations. He also recognized that clear criteria must be in place for judging the acceptability of the predicted loads and responses. These include the effects of wind on the integrity of the structural system and the exterior envelope and various serviceability considerations which influence performance and which determine habitability. The latter include the wind-induced drift, the effects of wind-induced motion on occupants and the usability of outdoor areas of the project, as well as its immediate surroundings.

In his papers Alan referred to this process for evaluating wind action as the wind loading chain. This was in recognition that the evaluation of wind loading and its effects relies on several interconnected considerations, each of which requires scrutiny and careful assessment. With analogy to a physical chain, the weakest link or component of the process determines the final outcome. Little is gained by embellishing strong links but much is lost by not paying attention to the weak ones.

Alan and others have written about this wind loading chain and have used this chain concept to describe and solve specific wind engineering problems. Perhaps the most lucid raison d'être for this "chain" was articulated by Alan himself in his Chapter 12 of the book entitled "Engineering Meteorology", edited by Eric Plate and published by Elsevier Scientific Publishing Company in 1982. This chain or multiplicative process for arriving at wind loads has been adopted in many building codes and standards. Not only is it effective for formulating the loads and responses to wind action, it is also a powerful model for evaluating the reliability of the final outcome. For example, the coefficient of variation of the predicted wind action to a good degree of approximation is equal to the square root of the sums of the squares of the coefficients of variation of each of the individual links. In the case of wind loads, the coefficient of variation (CV) can be approximated as follows

$$CV_{wind\ load} \approx (CV^2_{reference\ wind\ pressure} + CV^2_{wind\ exposure} + CV^2_{aerodynamic\ shape} + CV^2_{dynamic\ action})^{1/2}$$

It is most fitting that the IAWE has decided to posthumously honor the late Alan G. Davenport by adding the “Alan G. Davenport Wind Loading Chain” to the wind engineering terminology. This is done in recognition of Alan’s many contributions to the development of wind engineering. It is hoped that the usage of the term “Alan G. Davenport Wind Loading Chain” to describe the wind loading process, as Alan developed it, will keep both the man and his work in our memory.

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