PART I: Wind and Structural Engineering

INTRODUCTORY REMARKS

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This conference provides a unique opportunity for an exchange of ideas between two groups—namely, meteorologists and structural engineers, who have radically different backgrounds and points of view but at least one important interest in common. Both are interested in the nature of the wind, although the interest is for completely different reasons. Perhaps a few introductory remarks by a structural engineer will help the meteorologists to understand the problems and needs of the engineer.

The structural engineer is interested in the wind because it is an important cause of loading on many structures. Some of the most notable structural failures have been due to wind. The wind problem with regard to structures may be separated into two parts: the static problem, and the dynamic problem.

As far as static loads are concerned (these are important on tall buildings, radio and television towers, long-span bridges, *etc.*), the structural designer needs to know the maximum wind velocity and wind directions to be expected at a given site. This involves not only the basic wind velocity for the area but also such things as probability of occurrence, variation with height, the spatial distribution of gust velocities, and the local effects of topography. Once the wind characteristics are known, the engineer can determine the loading with reasonable accuracy. There is available a considerable quantity of wind-tunnel data which, in the aggregate, provide a basis for the determination of loads on a particular structure. However, these data are useless unless the wind velocity and direction are known.

The dynamic problem is structurally more complicated. However, given the dynamic characteristics of the wind load, it is possible to determine the dynamic response of the structure. There are two

aspects of the dynamic problem: self-induced vibration, and the dynamic effect of gusts. The former, which may occur in tall stacks, transmission lines, suspension bridges, *etc.*, results from vortex formations around the structure and is most serious in a perfectly steady wind. Since each structure has one or more critical wind velocities at which self-induced vibration may be severe, the important meteorological data required are the probabilities of occurrence of such velocities.

The dynamic effect of gusts is probably not important for most structures, but our knowledge in this area is extremely limited. If the duration of the gust is small compared to the natural period of the structure, the latter may not feel the full loading associated with the maximum gust velocity. The same may be true if the depth of the structure is less than the length of the gust. On the other hand, if the time required for the gust to reach its maximum velocity is small compared to the natural period, the stresses in the structure may be even greater than those due to the maximum velocity considered statically. For these reasons, the time variation of the velocity is important but the engineer has very little information on this subject.

The engineers certainly do not expect the meteorologists to provide immediate answers to all of their questions. However, it is probable that in many cases the information is available but the engineer does not know where it may be located. In other cases, perhaps the required data could be easily obtained by meteorologists, but they do not know that it is needed by the engineer. It is for these reasons that this conference provides an unusual opportunity for both meteorologists and structural engineers. The papers to be presented will help to bridge the gap between the two groups.