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Preface

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The aim of this Theme Issue is to give an account of some aspects of atmospheric icing on structures. Major effects of ice accretion on a structure are the iceload and accompanying wind-on-iceload which often incur structural damage. Consequently, the theoretical and experimental study of icing has now become paramount to the design of structures located in cold regions.

The physical forms of atmospheric icing depend on the presence of icing particles and meteorological conditions that allow such particles to adhere to the surface of the structure. Freezing fog, drizzle and rain are a source of supercooled droplets, which on impaction with the surface cause both rime and glaze accretion. Likewise supercooled sea spray accretes on the superstructure of a ship as rime and glaze, except that these may contain pockets of brine due to the rejection of salt on freezing. Snowflakes of high water content and at air temperatures just above freezing produce in strong winds what is commonly known as wet-snow accretion. There are other forms of accretion such as frost, due to the sublimation of water vapour held in the air onto a surface below freezing, but this does not usually affect the overall function of a structure. Many of the above physical processes, governed by aerodynamic flow and heat and mass transfer as dictated by meteorological conditions, are well understood and capable of mathematical treatment. Developments in this approach are, of course, dependent on the availability of results gained from controlled experiments using an icing wind tunnel and field observations made at suitably chosen icing stations which possess the essential facilities to measure meteorological conditions.

A general introduction to the field of icing research, its background and scope, is given and is followed by the invited papers for the Theme Issue. The first paper is on marine icing, as historically this form of accretion has been studied much earlier than any other. This paper focuses on theoretical and engineering aspects of the problem and surveys procedures for the simulation of accretion by sea spray on the superstructure of a ship. These research developments are then complemented by the next paper, which discusses and assesses observations on the complex crystalline structure and physical properties of ship superstructure ice as a function of spray frequency and its liquid water content, droplet size, wind conditions and superstructure shape. The third paper deals with continuing advances in the research area relevant to the design of aircraft operating in an icing environment. This paper reviews recent numerical and experimental techniques for the study of aircraft accretion, protection and degradation. Prior to the inclusion of papers on ice and wet-snow accretion occurring on electricity overhead transmission lines, the fourth paper presents a review of physical and theoretical models developed, over the past 20 years, by icing engineers working for cold region electrical utilities. Although such models have appeared almost in parallel with similar research on aircraft icing, they apply in particular to icing at lower wind speeds, bearing in mind the meteorological conditions existing for localized terrains. Wet-snow accretion on transmission lines can cause serious structural damage due to wet-snow load and the associated wind load, and such phenomena are discussed in the fifth paper; included is a critical account of current experimental and theoretical research, together with allied field observations. Atmospheric icing due to freezing rain, drizzle, in-cloud icing and icing fog are instrumental in causing serious damage to transmission lines and their substations. Moreover, this form of icing may also weaken the insulation strength of insulators, resulting in power outages. The sixth paper examines these topics and in the light of theoretical and experimental work proposes a solution to achieve the increased liability of insulators. Finally, in the seventh paper an objective approach is described for the prediction of ice/wet-snow loads on transmission lines based on limited data for historical iceloads and snow precipitation rates at locations fully specified in terms of terrain and location.

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