10.5 WIND ON ICE-COVERED STRUCTURES

Ice accreted on structural members, components, and appurtenances increases the projected area of the structure exposed to wind. The projected area shall be increased by adding t_d to all free edges of the projected area. Wind loads on this increased projected area shall be used in the design of ice-sensitive structures. Figs. 10-2 to 10-6 include 3-s gust wind speeds at 33 ft (10 m) above grade that are concurrent with the ice loads due to freezing rain. Wind loads shall be calculated in accordance with Chapters 26 through 31 as modified by Sections 10.5.1 through 10.5.5.

10.5.1 Wind on Ice-Covered Chimneys, Tanks, and Similar Structures

Force coefficients C_f for structures with square, hexagonal, and octagonal cross-sections shall be as given in Fig. 29.5-1. Force coefficients C_f for structures with round cross-sections shall be as given in Fig. 29.5-1 for round cross-sections with $D\sqrt{q_z} \leq 2.5$ for all ice thicknesses, wind speeds, and structure diameters.

10.5.2 Wind on Ice-Covered Solid Freestanding Walls and Solid Signs

Force coefficients C_f shall be as given in Fig. 29.4 based on the dimensions of the wall or sign including ice.

10.5.3 Wind on Ice-Covered Open Signs and Lattice Frameworks

The solidity ratio $\in$ shall be based on the projected area including ice. The force coefficient C_f for the projected area of flat members shall be as given in Fig. 29.5-2. The force coefficient C_f for rounded members and for the additional projected area due to ice on both flat and rounded members shall be as given in Fig. 29.5-2 for rounded members with $D\sqrt{q_z} \leq 2.5$ for all ice thicknesses, wind speeds, and member diameters.

10.5.4 Wind on Ice-Covered Trussed Towers

The solidity ratio $\in$ shall be based on the projected area including ice. The force coefficients C_f shall be as given in Fig. 29.5-3. It is acceptable to reduce the force coefficients C_f for the additional projected area due to ice on both round and flat members by the factor for rounded members in Note 3 of Fig. 29.5-3.

10.5.5 Wind on Ice-Covered Guys and Cables

The force coefficient C_f (as defined in Chapter 29) for ice-covered guys and cables shall be 1.2.

10.6 Design Temperatures for Freezing Rain

The design temperatures for ice and wind-on-ice due to freezing rain shall be either the temperature for the site shown in Figs. 10-7 and 10-8 or 32°F (0°C), whichever gives the maximum load effect. The temperature for Hawaii shall be 32°F (0°C). For temperature sensitive structures, the load shall include the effect of temperature change from everyday conditions to the design temperature for ice and wind-on-ice. These temperatures are to be used with ice thicknesses for all mean recurrence intervals. The design temperatures are considered to be concurrent with the design ice load and the concurrent wind load.

10.7 PARTIAL LOADING

The effects of a partial ice load shall be considered when this condition is critical for the type of structure under consideration. It is permitted to consider this to be a static load.

10.8 DESIGN PROCEDURE

1. The nominal ice thickness, t, the concurrent wind speed, V_c, and the concurrent temperature for the site shall be determined from Figs. 10-2 to 10-8 or a site-specific study.
2. The topographic factor for the site, K_{zt}, shall be determined in accordance with Section 10.4.5.
3. The importance factor for ice thickness, I_i, shall be determined in accordance with Section 10.4.4.
4. The height factor, f_z, shall be determined in accordance with Section 10.4.3 for each design segment of the structure.
5. The design ice thickness, t_d, shall be determined in accordance with Section 10.4.6, Eq. 10.4-5.
6. The weight of ice shall be calculated for the design ice thickness, t_d, in accordance with Section 10.4.1.
7. The velocity pressure q_z for wind speed V_c shall be determined in accordance with Section 29.3 using the importance factor for concurrent wind pressure I_w determined in accordance with Section 10.4.4.
8. The wind force coefficients C_f shall be determined in accordance with Section 10.5.
9. The gust effect factor shall be determined in accordance with Section 26.9.