one within the detailed proximity model that protrudes well above its surroundings, or is unusually close to the subject building, or may otherwise cause substantial sheltering effect or magnification of the wind loads. When these supplemental test results are included with the original results, the acceptable results are then considered to be the higher of both conditions.

However, the absolute minimum reduction permitted is 65 percent of the baseline result for components and cladding, and 50 percent for the main wind force resisting system. A higher reduction is permitted for MWFRS, because components and cladding loads are more subject to changes due to local channeling effects when surroundings change and can easily be dramatically increased when a new adjacent building is constructed. It is also recognized that cladding failures are much more common than failures of the MWFRS. In addition, for the case of MWFRS it is easily demonstrated that the overall drag coefficient for certain common building shapes, such as circular cylinders especially with rounded or domed tops, is one-half or less of the drag coefficient for the rectangular prisms that form the basis of Chapters 27, 28, and 30.

For components and cladding, the 80-percent limit is defined by the interior zones 1 and 4 in Figs. 30.4-1, 30.4-2A, 30.4-2B, 30.4-2C, 30.4-3, 30.4-4, 30.4-5A, 30.4-5B, 30.4-6, 30.4-7, and 30.5-1. This limitation recognizes that pressures in the edge zones are the ones most likely to be reduced by the specific geometry of real buildings compared to the rectangular prismatic buildings assumed in Chapter 30. Therefore, pressures in edge and corner zones are permitted to be as low as 80 percent of the interior pressures from Chapter 30 without the supplemental tests. The 80-percent limit based on zone 1 is directly applicable to all roof areas, and the 80-percent limit based on zone 4 is directly applicable to all wall areas.

The limitation on MWFRS loads is more complex because the load effects (e.g., member stresses or forces, deflections) at any point are the combined effect of a vector of applied loads instead of a simple scalar value. In general the ratio of forces or moments or torques (force eccentricity) at various floors throughout the building using a wind tunnel study will not be the same as those ratios determined from Chapters 27 and 28, and therefore comparison between the two methods is not well defined. Requiring each load effect from a wind tunnel test to be no less than 80 percent of the same effect resulting from Chapter 27 and 28 is impractical and unnecessarily complex and detailed, given the approximate nature of the 80-percent value. Instead, the intent of the limitation is effectively implemented by applying it only to a simple index that characterizes the overall loading. For flexible (tall) buildings, the most descriptive index of overall loading is the base overturning moment. For other buildings, the overturning moment can be a poor characterization of the overall loading, and the base shear is recommended instead.

C31.4.1 Mean Recurrence Intervals of Load Effects

Examples of analysis methods for combining directional wind tunnel data with the directional meteorological data or probabilistic models based thereon are described in Lepage and Irwin (1985), Rigato et al. (2001), Isyumov et al. (2003), Irwin et al. (2005), Simiu and Filliben (2005), and Simiu and Miyata (2006).

C31.4.2 Limitations

Section 31.4.2 specifies that the statistical methods used to analyze historical wind speed and direction data for wind tunnel studies shall be subject to the same limitations specified in Section 31.4.2 that apply to the Analytical Method.

Database-Assisted Design. Wind-tunnel aerodynamics databases that contain records of pressures measured synchronously at large numbers of locations on the exterior surface of building models have been developed by wind researchers, e.g., Simiu et al. (2003) and Main and Fritz (2006). Such databases include data that permit a designer to determine, without specific wind tunnel tests, wind-induced forces and moments in Main Wind Force Resisting Systems and Components and Cladding of selected shapes and sizes of buildings. A public domain set of such databases, recorded in tests conducted at the University of Western Ontario (Ho et al. 2005 and St. Pierre et al. 2005) for buildings with gable roofs is available on the National Institute of Standards and Technology (NIST) site www.nist.gov/wind. Interpolation software for buildings with similar shape and with dimensions close to and intermediate between those included in the set of databases is also available on that site. Because the database results are for generic surroundings as permitted in item 3 of Section 31.2, interpolation or extrapolation from these databases should be used only if condition 2 of Section 27.1.2 is true. Extrapolations from available building shapes and sizes are not permitted, and interpolations in some instances may not be advisable. For these reasons, the guidance of an engineer