In this expression ΔK is calculated using

$$\Delta K = (K_{33,u} - K_{33,d})\frac{K_{zd}}{K_{33,d}} F_{\Delta K}(x) \quad \text{(C27.3-6)}$$

$$|\Delta K| \le |K_{zu} - K_{zd}|$$

where $K_{33,d}$ and $K_{33,u}$ are respectively the downwind and upwind equilibrium values of exposure coefficient at 33 ft (10 m) height, and the function $F_{\Delta K}(x)$ is given by

$$F_{\Delta K}(x) = \log_{10}\left(\frac{x_1}{x}\right) / \log_{10}\left(\frac{x_1}{x_0}\right) \quad \text{(C27.3-7)}$$

for $x_0 < x < x_1$

$F_{\Delta k}(x) = 1$ for $x < x_0$
$F_{\Delta k}(x) = 0$ for $x > x_1$

In the preceding relationships

$$x_0 = c_3 \times 10^{-(K_{33,d} - K_{33,u})^2 - 2.3} \quad \text{(C27.3-8)}$$

The constant c_3 = 0.621 mi (1.0 km). The length x_1 = 6.21 mi (10 km) for $K_{33,d} < K_{33,u}$ (wind going from smoother terrain upwind to rougher terrain downwind) or x_1 = 62.1 mi (100 km) for $K_{33,d} > K_{33,u}$ (wind going from rougher terrain upwind to smoother terrain downwind).

The above description is in terms of a single roughness change. The method can be extended to multiple roughness changes. The extension of the method is best described by an example. Figure C27.3-1 shows wind with an initial profile characteristic of Exposure D encountering an expanse of B roughness, followed by a further expanse of D roughness and then some more B roughness again before it arrives at the building site. This situation is representative of wind from the sea flowing over an outer strip of land, then a coastal waterway, and then some suburban roughness before arriving at the building site. The above method for a single roughness change is first used to compute the profile of K_z at station 1 in Fig. C27.3-1. Call this profile $K_z^{(1)}$. The value of ΔK for the transition between stations 1 and 2 is then determined using the equilibrium value of $K_{33,u}$ for the roughness immediately upwind of station 1, i.e., as though the roughness upwind of station 1 extended to infinity. This value of ΔK is then added to the equilibrium value $K_{zd}^{(2)}$ of the exposure coefficient for the roughness between stations 1 and 2 to obtain the profile of K_z at station 2, which we will call $K_z^{(2)}$. Note however, that the value of $K_z^{(2)}$ in this way cannot be any lower than $K_z^{(1)}$. The process is then repeated for the transition between stations 2 and 3. Thus, ΔK for the transition from station 2 to station 3 is calculated using the value of $K_{33,u}$ for the equilibrium profile of the roughness immediately upwind of station 2, and the value of $K_{33,d}$ for the equilibrium profile of the roughness downwind of station 2. This value of ΔK is then added to $K_{zd}^{(2)}$ to obtain the profile $K_z^{(3)}$ at station 3, with the limitation that the value of $K_z^{(3)}$ cannot be any higher than $K_z^{(2)}$.

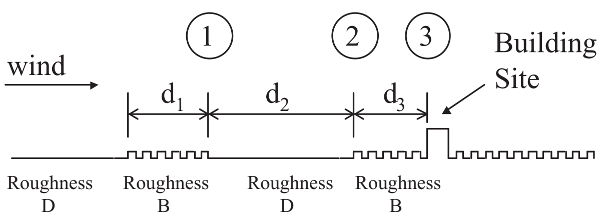

FIGURE C27.3-1 Multiple Roughness Changes Due to Coastal Waterway

Example 1, single roughness change: Suppose the building is 66 ft (20 m) high and its local surroundings are suburban with a roughness length z_0 = 1 ft (0.3 m). However, the site is 0.37 mi (0.6 km) downwind of the edge of the suburbs, beyond which the open terrain is characteristic of open country with z_0 = 0.066 ft (0.02 m). From Eqs. C27.3-1, C27.3-3, and C27.3-4, for the open terrain

$$\alpha = c_1 z_0^{-0.133} = 6.62 \times 0.066^{-0.133} = 9.5$$

$$z_g = c_2 z_0^{0.125} = 1{,}273 \times 0.066^{0.125} = 906 \text{ ft (276 m)}$$

Therefore, applying Eq. C27.3-1 at 66 ft (20 m) and 33 ft (10 m) heights,

$$K_{zu} = 2.01\left(\frac{66}{906}\right)^{2/9.5} = 1.16 \text{ and}$$

$$K_{33,u} = 2.01\left(\frac{33}{906}\right)^{2/9.5} = 1.00$$

Similarly, for the suburban terrain

$$\alpha = c_1 z_0^{-0.133} = 6.62 \times 1.0^{-0.133} = 6.62$$

$$z_g = c_2 z_0^{0.125} = 1{,}273 \times 1.0^{0.125} = 1{,}273 \text{ ft (388 m)}$$

Therefore

$$K_{zd} = 2.01\left(\frac{66}{1{,}273}\right)^{2/6.19} = 0.77 \text{ and}$$

$$K_{33,d} = 2.01\left(\frac{33}{1{,}273}\right)^{2/6.62} = 0.67$$

From Eq. C27.3-8

$$x_0 = c_3 \times 10^{-(K_{33,d} - K_{33,u})^2 - 2.3} = 0.621 \times 10^{-(0.62-1.00)^2 - 2.3}$$
$$= 0.00241 \text{ mi}$$