

Ground effects (reflecting vs. absorbing ground):



To do:

- (a) What stability class is this?
- (b) What value of constant *d* should we use at x = 2.0 km to determine the dispersion coefficient?

Solution:

(a) Use Table 20.1 to determine the stability class (see next page for table).

(b) Use Table 20.2 to determine constant d at x = 2.0 km (see table below).

| Stability | а | b | <i>x</i> < 1 km | | | <i>x</i> > 1 km | | |
|-----------|------|-------|-----------------|-------|-------|-----------------|-------|-------|
| | | | С | ď | f | С | d | f |
| А | 213 | 0.894 | 440.8 | 1.941 | 9.27 | 459.7 | 2.094 | -9.6 |
| В | 156 | 0.894 | 106.6 | 1.149 | 3.3 | 108.2 | 1.098 | 2.0 |
| С | 104 | 0.894 | 61.0 | 0.911 | 0 | 61.0 | 0.911 | 0 |
| D | 68 | 0.894 | 33.2 | 0.725 | -1.7 | 44.5 | 0.516 | -13.0 |
| Е | 50.5 | 0.894 | 22.8 | 0.678 | -1.3 | 55.4 | 0.305 | -34.0 |
| F | 34 | 0.894 | 14.35 | 0.740 | -0.35 | 62.6 | 0.180 | -48.6 |

Table 20.2 Values of Curve-Fit Constants for Calculating Dispersion

 Coefficients as a Function of Downwind Distance and Atmospheric Stability

Adapted from Martin, 1976.

Dispersion coefficients: Tables scanned from Cooper, C. D. and Alley, F. C. *Air Pollution Control: A Design Approach*, Edition 4, Waveland Press, Inc., Long Grove, IL, 2011, pp. 662-663.

| Surface | Incor | Night Cloudiness ^e | | | | |
|--------------------------------|---------------------|----------------------------------|---------------------|------------------|-----------------|--|
| Wind Speed ^a m/s | Strong ^b | Moderate ^c | Slight ^d | Cloudy (≥4/8) | Clear (≤3/8) | |
| <2 | A | A–B ^f | В | E | F | |
| 2–3 | A–B | B | С | Ε. | F | |
| 3–5 | В | B–C | С | D | E | |
| 5-6 | С | C-D | D | D | D | |
| >6 | С | D | D | D | D | |

| Table 20. | 1 | Stability | Classifications* |
|-----------|---|-----------|------------------|
| ladie zu. | | Stability | Classifications |

^a Surface wind speed is measured at 10 m above the ground.

^b Corresponds to clear summer day with sun higher than 60° above the horizon.

^c Corresponds to a summer day with a few broken clouds, or a clear day with sun 35-60° above the horizon.

^d Corresponds to a fall afternoon, or a cloudy summer day, or clear summer day with the sun 15–35°.

^e Cloudiness is defined as the fraction of sky covered by clouds.

^f For A–B, B–C, or C–D conditions, average the values obtained for each.

- * A = Very unstable D = Neutral
 - B = Moderately unstable E = Slightly stable

C = Slightly unstable F = Stable

Regardless of wind speed, Class D should be assumed for overcast conditions, day or night.

| | а | b | <i>x</i> < 1 km | | | x > 1 km | | |
|-----------|------|-------|-----------------|-------|-------|----------|-------|-------|
| Stability | | | С | ď | f | С | d | f |
| А | 213 | 0.894 | 440.8 | 1.941 | 9.27 | 459.7 | 2.094 | -9.6 |
| В | 156 | 0.894 | 106.6 | 1.149 | 3.3 | 108.2 | 1.098 | 2.0 |
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$$c_{j} = \frac{\dot{m}_{j,s}}{2\pi U \sigma_{y} \sigma_{z}} \left[\exp\left\{-\frac{1}{2} \left[\left(\frac{y}{\sigma_{y}}\right)^{2} + \left(\frac{z-H}{\sigma_{z}}\right)^{2}\right]\right\} + \exp\left\{-\frac{1}{2} \left[\left(\frac{y}{\sigma_{y}}\right)^{2} + \left(\frac{z+H}{\sigma_{z}}\right)^{2}\right]\right\}\right]$$