**Table 1. 2004 *Green Book* minimum acceleration lane length values and corresponding acceleration rates (adapted from AASHTO, 2004).**

| Design speed (mi/h) | Speed reached (mi/h) | Acceleration length, L (ft) for entrance curve design speed (mi/h) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Stop | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| | | Initial speed (mi/h) | | | | | | | | |
| | | 0 | 14 | 18 | 22 | 26 | 30 | 36 | 40 | 44 |
| 2004 *Green Book* | | | | | | | | | | |
| 30 | 23 | 180 | 140 | – | – | – | – | – | – | – |
| 35 | 27 | 280 | 220 | 160 | – | – | – | – | – | – |
| 40 | 31 | 360 | 300 | 270 | 210 | 120 | – | – | – | – |
| 45 | 35 | 560 | 490 | 440 | 380 | 280 | 160 | – | – | – |
| 50 | 39 | 720 | 660 | 610 | 550 | 450 | 350 | 130 | – | – |
| 55 | 43 | 960 | 900 | 810 | 780 | 670 | 550 | 320 | 150 | – |
| 60 | 47 | 1,200 | 1,140 | 1,100 | 1,020 | 910 | 800 | 550 | 420 | 180 |
| 65 | 50 | 1,410 | 1,350 | 1,310 | 1,220 | 1,120 | 1000 | 770 | 600 | 370 |
| 70 | 53 | 1,620 | 1,560 | 1,520 | 1,420 | 1,350 | 1230 | 1,000 | 820 | 580 |
| 75 | 55 | 1,790 | 1,730 | 1,630 | 1,580 | 1,510 | 1,420 | 1,160 | 1,040 | 780 |
| Acceleration Rates (ft/s$^2$) Used to Reproduce Acceleration Lengths | | | | | | | | | | |
| 30 | 23 | 3.18 | 2.57 | – | – | – | – | – | – | – |
| 35 | 27 | 2.81 | 2.62 | 2.73 | – | – | – | – | – | – |
| 40 | 31 | 2.88 | 2.76 | 2.55 | 2.45 | 2.57 | – | – | – | – |
| 45 | 35 | 2.36 | 2.27 | 2.21 | 2.11 | 2.12 | 2.19 | – | – | – |
| 50 | 39 | 2.28 | 2.17 | 2.12 | 2.04 | 2.03 | 1.92 | 1.87 | – | – |
| 55 | 43 | 2.08 | 1.98 | 2.03 | 1.89 | 1.89 | 1.86 | 1.87 | 1.79 | – |
| 60 | 47 | 1.99 | 1.91 | 1.85 | 1.83 | 1.82 | 1.77 | 1.79 | 1.57 | 1.64 |
| 65 | 50 | 1.92 | 1.84 | 1.79 | 1.79 | 1.76 | 1.73 | 1.69 | 1.62 | 1.65 |
| 70 | 53 | 1.87 | 1.81 | 1.77 | 1.77 | 1.71 | 1.68 | 1.63 | 1.59 | 1.63 |
| 75 | 55 | 1.83 | 1.77 | 1.79 | 1.74 | 1.68 | 1.62 | 1.61 | 1.48 | 1.51 |

tion rates used to generate those values, based on Equation 1. Overall, the pattern is a decreasing acceleration rate as the initial speed increases, but there are situations when this overall pattern is not followed.

Exhibit 10-71 in the 2004 *Green Book* includes adjustment factors for when the acceleration lane occurs on a grade of 3 to 4 percent or 5 to 6 percent (see Table 2). Similar values were included in the 1954 AASHO *Policies on Geometric Highway Design* (an earlier version of the AASHO *Blue Book*). Given the similarities between the values in the 2004 and 1954 editions, it appears that the source of the adjustment factors in the 2004 *Green Book* could be the values in the 1954 *Blue Book*. The source of the adjustment factors per the 1954 *Blue Book* was to apply principles of mechanics to rates of speed change for level grades. The direct quote from the 1954 *Blue Book* follows:

> Deceleration distances are longer on downgrades and shorter on upgrades, while acceleration distances are longer on upgrades and shorter on downgrades. Data on driver behavior while decelerating or accelerating on grades are not available, but they may be approximated by applying principles of mechanics to rates of speed change for level grades, recognizing that drivers accelerating on upgrades open throttles more than the equivalent for normal acceleration on level grades. Calculations result in lengths of acceleration and deceleration lanes on grades as compared with those on the level . . . The ratio . . . multiplied by the length (on level) . . . gives the length of speed-change lane on grade.

## 3.2 Freeway Mainline Exit Terminals

At least since the 1965 *Blue Book,* and still in the 2004 *Green Book,* AASHO/AASHTO policies have used a basic two-step process for establishing design criteria for exit ramps. Deceleration is accomplished first as the driver removes his or her foot from the accelerator pedal and the vehicle slows in gear for a period of time (assumed to be 3 s) without the use of brakes, and then as the driver applies the brakes and decelerates at a comfortable rate. Equations 2 and 3 are used to represent this dual process. The minimum deceleration lane length is based on the combination of the following inputs:

A. The speed at which drivers maneuver onto the auxiliary lane.
B. The speed at which drivers turn after traversing the deceleration lane.
C. The manner of deceleration.

$$L_{Decel} = 1.47V_h t_n - 0.5d_n\left(t_n\right)^2 + \frac{\left(1.47V_r\right)^2 - \left(1.47V_a\right)^2}{2d_{wb}} \quad (2)$$

$$V_a = \frac{1.47V_h + d_n t_n}{1.47} \quad (3)$$

where: $L_{Decel}$ = Deceleration lane length, ft
$V_h$ = Highway speed, mi/h