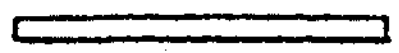
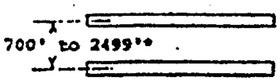
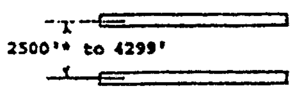
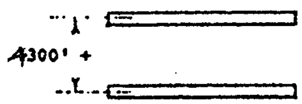
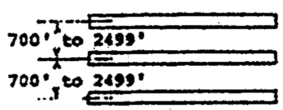
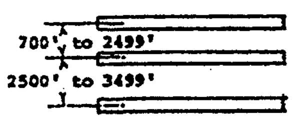
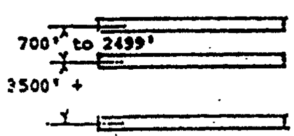
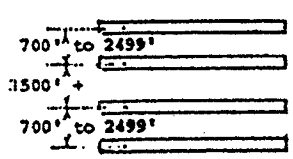
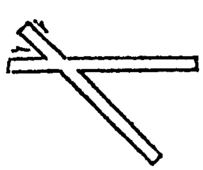
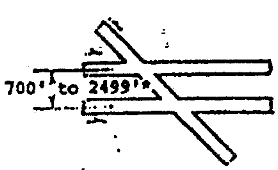
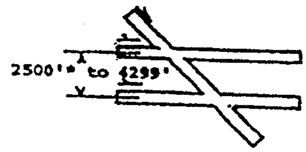
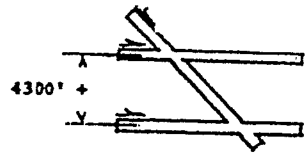
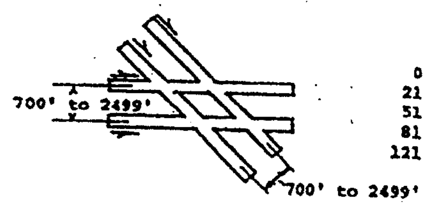
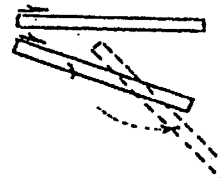
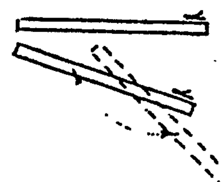
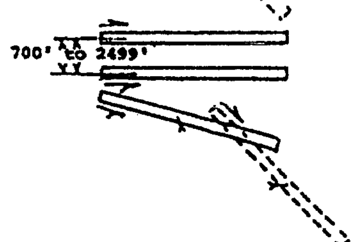
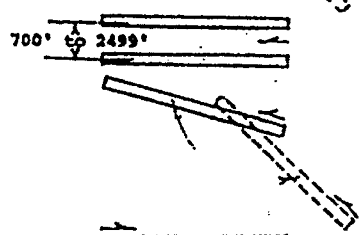
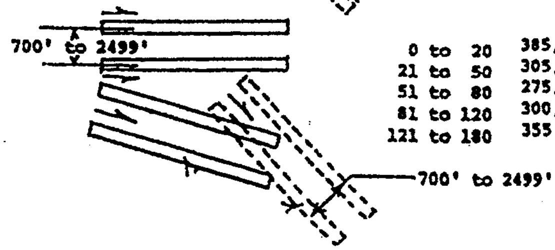
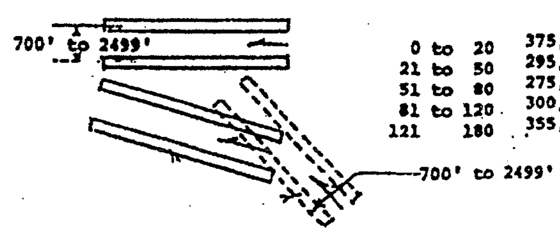
No.	Runway-use Configuration	Mix Index %(C+3D)	Annual Service Volume Ops/Yr
1.		0 to 20	230,000
		21 to 50	195,000
		51 to 80	205,000
		81 to 120	210,000
		121 to 180	240,000
2.		0 to 20	355,000
		21 to 50	275,000
		51 to 80	260,000
		81 to 120	285,000
		121 to 180	340,000
3.		0 to 20	355,000
		21 to 50	285,000
		51 to 80	275,000
		81 to 120	300,000
		121 to 180	365,000
4.		0 to 20	370,000
		21 to 50	320,000
		51 to 80	305,000
		81 to 120	315,000
		121 to 180	370,000
5.		0 to 20	385,000
		21 to 50	305,000
		51 to 80	285,000
		81 to 120	310,000
		121 to 180	375,000
6.		0 to 20	385,000
		21 to 50	310,000
		51 to 80	290,000
		81 to 120	315,000
		121 to 180	385,000
7.		0 to 20	625,000
		21 to 50	475,000
		51 to 80	455,000
		81 to 120	510,000
		121 to 180	645,000
8.		0 to 20	715,000
		21 to 50	550,000
		51 to 80	515,000
		81 to 120	565,000
		121 to 180	675,000
9.		0 to 20	230,000
		21 to 50	200,000
		51 to 80	215,000
		81 to 120	225,000
		121 to 180	265,000
10.		0 to 20	355,000
		21 to 50	275,000
		51 to 80	260,000
		81 to 120	285,000
		121 to 180	340,000
11.		0 to 20	355,000
		21 to 50	285,000
		51 to 80	275,000
		81 to 120	300,000
		121 to 180	365,000
12.		0 to 20	370,000
		21 to 50	320,000
		51 to 80	305,000
		81 to 120	315,000
		121 to 180	370,000
13.		0 to 20	355,000
		21 to 50	275,000
		51 to 80	270,000
		81 to 120	295,000
		121 to 180	350,000
14.		0 to 20	270,000
		21 to 50	225,000
		51 to 80	220,000
		81 to 120	225,000
		121 to 180	265,000
15.		0 to 20	260,000
		21 to 50	220,000
		51 to 80	215,000
		81 to 120	225,000
		121 to 180	265,000
16.		0 to 20	385,000
		21 to 50	305,000
		51 to 80	275,000
		81 to 120	300,000
		121 to 180	355,000
17.		0 to 20	355,000
		21 to 50	275,000
		51 to 80	260,000
		81 to 120	285,000
		121 to 180	340,000
18.		0 to 20	385,000
		21 to 50	305,000
		51 to 80	275,000
		81 to 120	300,000
		121 to 180	355,000
19.		0 to 20	375,000
		21 to 50	295,000
		51 to 80	275,000
		81 to 120	300,000
		121 180	355,000

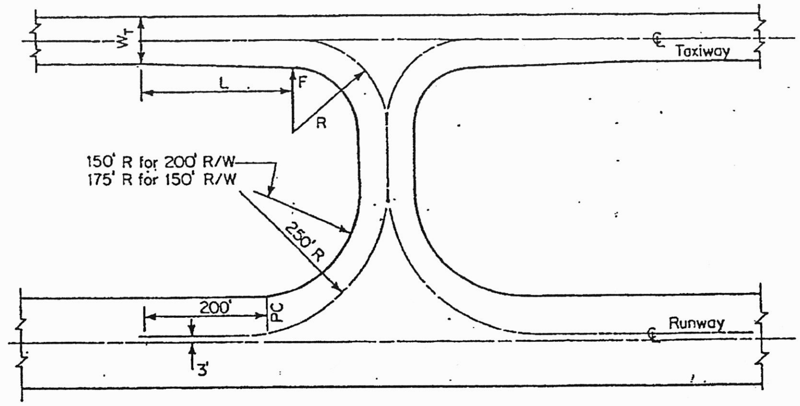


Figure 9-17 A 90° taxiway exit (see Table 9-27 for dimensions) (*Federal Aviation Administration [6]*).

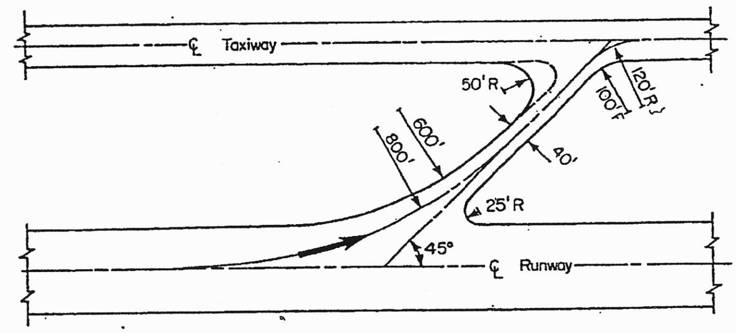


Figure 9-15 A 45° high-speed taxiway exit for aircraft in categories A and B (see Table 9-27 for dimensions) (*Federal Aviation Administration [6]*).

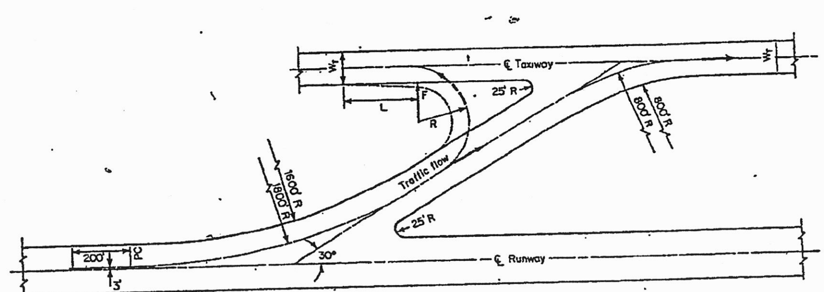


Figure 9-16 A 30° high-speed exit taxiway for aircraft in categories C, D, and E (see Table 9-27 for dimensions) (*Federal Aviation Administration [6]*).

Horonjeff, Robert.
Planning and design of airports / Robert Horonjeff and Francis X. McKelvey.—4th ed.

[6] *Airport Design*, Advisory Circular AC 150/5300-13, Federal Aviation Administration, Washington, 1989.

ALWAYS CHECK FOR UPDATES

EQUATION (1)

$$1\ \text{m} = 3.28\ \text{ft}$$

EQUATION (2)

[Converting temperature in °F to °C]

$$°C = \frac{5}{9}(°F - 32)$$

TABLE 9-23 Approximate Taxiway Exit Location from Threshold, ft

Type of aircraft	Touchdown speed, kn	Exit speed, mi/h 60	Exit speed, mi/h 15
Small propeller			
General aviation single-engine	60	1800	2400
General aviation twin-engine	95	2800	3500
Large turbojet			
Two-engine narrow-body	130	4800	5600
Three-engine narrow-body			
Heavy turbojet			
Four-engine narrow-body	140	6400	7100
Three-engine wide-body			
Four-engine wide-body			

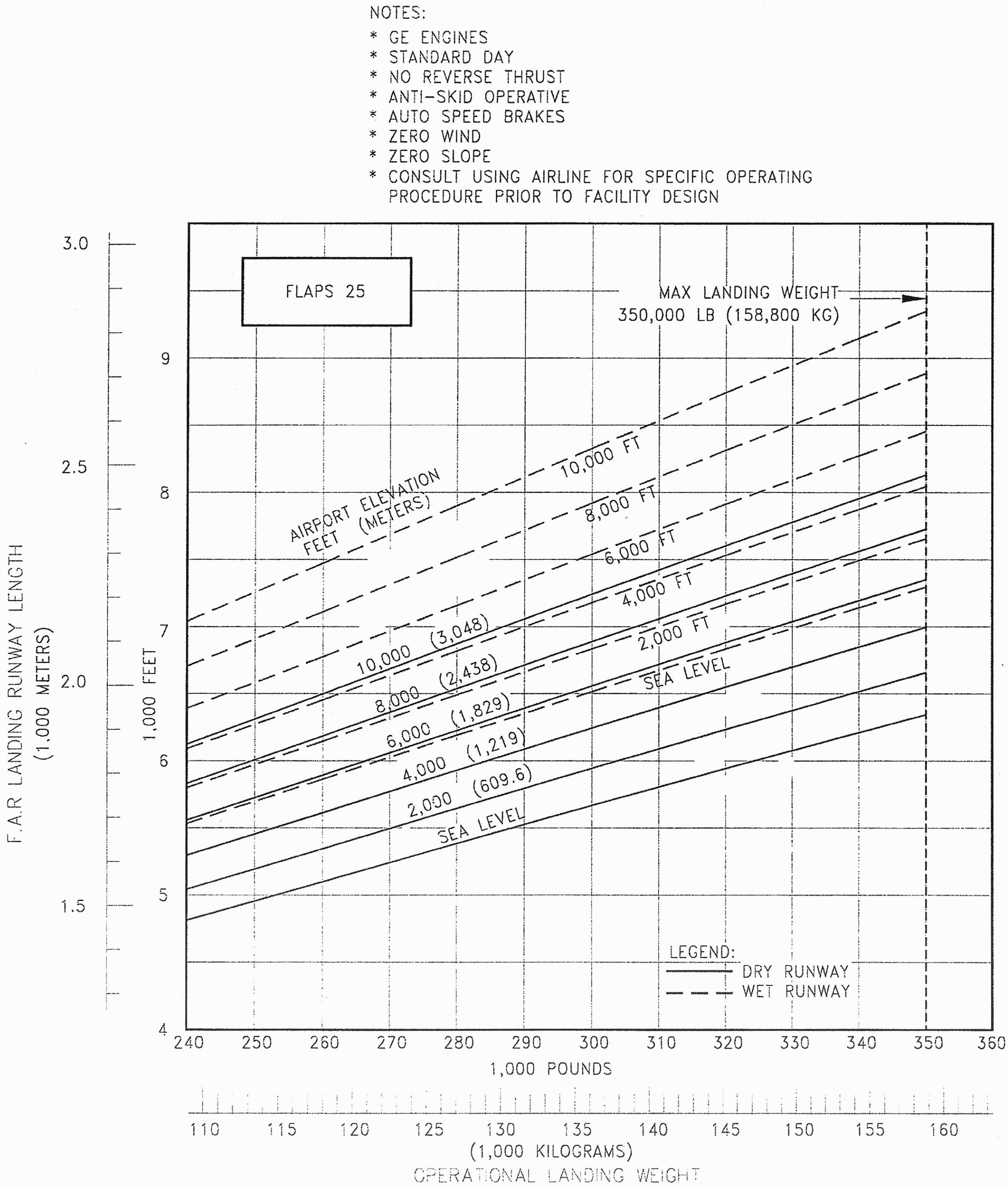
These locations are derived by using standard sea-level conditions. Altitude and temperature can affect the location of exit taxiways. Altitude increases the distance on the order of 3 percent for each 1000 ft above sea level, and temperature increases the distance 1.5 percent for each 10°F above 59°F.

CHARACTERISTICS	UNITS	BASELINE AIRPLANE
MAX DESIGN TAXI WEIGHT	POUNDS	451,000
	KILOGRAMS	204,630
MAX DESIGN TAKEOFF WEIGHT	POUNDS	450,000
	KILOGRAMS	204,170
MAX DESIGN LANDING WEIGHT	POUNDS	350,000
	KILOGRAMS	158,800
MAX DESIGN ZERO FUEL WEIGHT	POUNDS	330,000
	KILOGRAMS	149,730
SPEC OPERATING EMPTY WEIGHT (1)	POUNDS	227,400
	KILOGRAMS	103,150
MAX STRUCTURAL PAYLOAD	POUNDS	102,600
	KILOGRAMS	46,540
SEATING CAPACITY (1)	ONE-CLASS	409 ALL ECONOMY
	TWO-CLASS	296 - 24 FIRST + 272 ECONOMY
	THREE-CLASS	243 - 16 FIRST + 36 BUSINESS + 189 ECONOMY
MAX CARGO - LOWER DECK (2)	CUBIC FEET	4,905
	CUBIC METERS	139
USABLE FUEL	US GALLONS	24,140
	LITERS	91,380
	POUNDS	161,740
	KILOGRAMS	73,360

NOTES: (1) SPEC WEIGHT FOR BASELINE CONFIGURATION OF 296 PASSENGERS. CONSULT WITH AIRLINE FOR SPECIFIC WEIGHTS AND CONFIGURATIONS.

(2) FWD CARGO = 20 LD-2 CONTAINERS AT 120 CU FT EACH
AFT CARGO = 18 LD-2 CONTAINERS AT 120 CU FT EACH
BULK CARGO = 345 CU FT

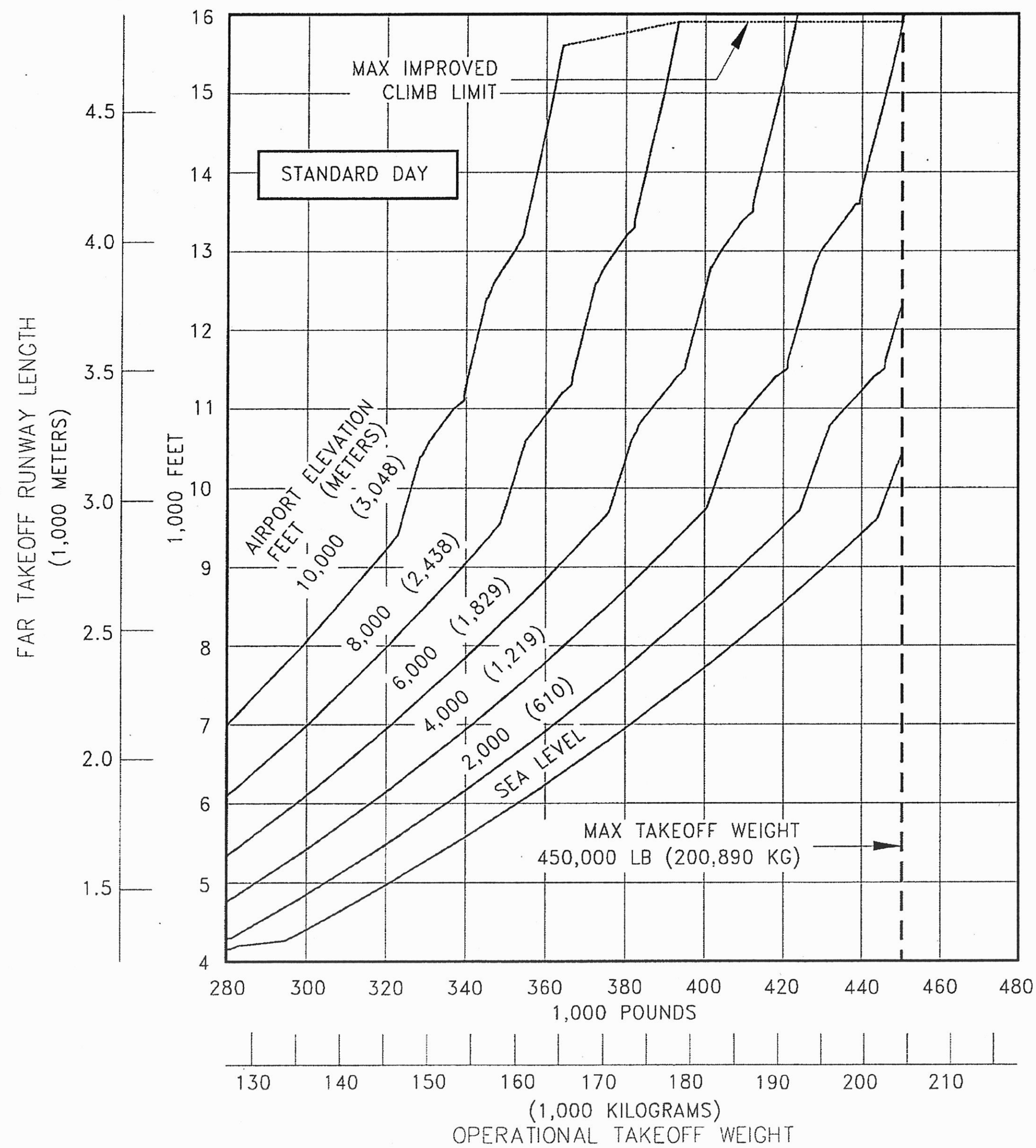
2.1.1 GENERAL CHARACTERISTICS
MODEL 767-400ER



3.4.2 FAA LANDING RUNWAY LENGTH REQUIREMENTS - FLAPS 25
MODEL 767-400ER

NOTES:

* CF6-80C2B8F ENGINES
* NO ENGINE AIRBLEED FOR AIR CONDITIONING
* ZERO WIND, ZERO RUNWAY GRADIENT
* WET SMOOTH RUNWAY SURFACE
* CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN
* LINEAR INTERPOLATION BETWEEN ALTITUDES INVALID
* LINEAR INTERPOLATION BETWEEN TEMPERATURES INVALID



3.3.3 FAA TAKEOFF RUNWAY LENGTH REQUIREMENTS - STANDARD DAY - WET RUNWAY

MODEL 767-400ER

Table 1. Coefficient of side friction.		
Speed (mph)	**Dry Surface**	**Wet Surface**
10	0.45	.38
20	0.40	0.27
30	0.35	0.20
40	0.30	0.16
50	0.26	0.14
55	0.22	0.13
60	0.19	0.12
65	0.18	0.11
70	0.17	0.10
75	0.16	0.09
80	0.15	0.08
85	0.14	0.07

Table 2: Coefficient of forward skidding friction.		
Speed (mph)	**Dry Surface**	**Wet Surface**
10	0.78	0.600
20	0.76	0.400
30	0.74	0.350
40	0.72	0.320
50	0.70	0.305
55	0.67	0.300
60	0.65	0.295
65	0.64	0.290
70	0.63	0.285
75	0.62	0.280
80	0.61	0.275
85	0.60	0.270

5 **Signal timing.** Timing calculations are based on traffic requirements. Cycle lengths during off-peak periods should be as short as possible (from 40 to 60 s for two-phase signals) and still allow necessary vehicular and pedestrian movements. Longer cycles are used during peak periods to provide more green time for the major street, to permit larger platoons in the peak direction, and/or to reduce the number of starting delays. Although many factors related to specific locations must be considered, a generalized procedure for timing a signal is presented below.

a. *Calculate yellow change plus red clearance intervals* based on approach speeds, using equation 15.1 (Ref. 4):

$$CP = t + \cancel{\frac{V}{2a} \quad \frac{V}{20g}} + \frac{W+L}{V} + \frac{V}{(2a \pm 2*9.81*g)} \qquad [15.1]$$

REPLACE WITH

$(2a \pm 2*32.2*g)$

FOR ENGLISH UNITS

where:
- CP = non-dilemma change period (change + clearance interval), s
- t = perception-reaction time, s; (nominally 1 s)
- V = approach speed, m/s
- g = grade/100 (>0 for upgrade <0 for downgrade)
- a = deceleration rate, m/s^2; typically 3.1 m/s^2
- W = width of intersection, curb to curb, m
- L = length of vehicle, m (typically 6 m).

b. *Determine need for red clearance.* Many jurisdictions limit the duration of the yellow change interval to 4 or 5 seconds. If the calculation from Eq. 15.1 indicates the need for a change plus clearance interval greater than the maximum yellow, a red clearance interval is used. The combination of yellow plus red clearance equal to the result from Eq. 15.1 will ensure that drivers will not be trapped in a "dilemma zone" as they approach the intersection.

13TH EDITION CHAPTER 17

Select yellow change intervals based on approach speeds; see Table 17-1.

Table 17-1—Yellow Change Intervals

Approach Speed	Yellow
≤35 mph	3.0 sec
40 mph	3.5 sec
45 mph	4.0 sec
50 mph	4.5 sec
>50 mph	5.0 sec

c. *Determine pedestrian clearance times* for all approaches based on an assumed pedestrian walking speed of 0.9 m/s (Ref. 3, p. 4D-5). Prior to the Americans with Disabilities Act, an assumed pedestrian walking speed of 1.2 m/s was typically used. (See also Chap. 20, part D.1.) The first portion of this clearance time is signalled with a flashing Upraised Hand/Don't Walk (FDW) indication; the last part, coinciding with the yellow interval, is shown as a steady Upraised Hand/Don't Walk (DW).

d. *Compute minimum green times.* Minimum green time is equal to the pedestrian clearance time minus the yellow interval plus an initial interval when pedestrians may start to cross. In any case, minimum green for through traffic should be not less than 15 s.

(1) With pedestrian signals, the initial interval is the Walk period, normally not less than 7 s. However, it can be reduced to 4 s under special circumstances (Ref. 3, p. 4E-7).

~~*(2)* Without pedestrian signals, a minimum of 5 s is used for the initial interval.~~

$1\,\text{mph} = 1.47\ \text{ft/sec}$ (1)

$D_s = D_p + D_b$ (2)

$D_p = v_0\, t$ (3)

1 foot = 0.3048 meter (4)

1 inch = 0.0254 meter (5)

1 meter = 100 cm (6)

1 knot = 1.15 miles per hour (7)

$$v = \frac{dx}{dt} \qquad (2.2.1)$$

$$\left.\begin{aligned} a &= \frac{dv}{dt} \\ a &= \frac{dv}{dx}\left(\frac{dx}{dt}\right) \\ a &= \left(\frac{dv}{dx}\right)v \end{aligned}\right\} \qquad (2.2.2)$$

$$v\,dv = a\,dx \qquad (2.2.3)$$

$$\int_{v_0}^{v} dv = \int_0^t a\,dt$$

$$v = at + v_0 \qquad (2.2.4)$$

$$\tfrac{1}{2}(v^2 - v_0^2) = a(x - x_0) \qquad (2.2.5)$$

$$x - x_0 = \frac{v^2 - v_0^2}{2a} \qquad (2.2.6)$$

$$x = \tfrac{1}{2}at^2 + v_0 t + x_0 \qquad (2.2.7)$$

$$D_b = \frac{v_0^2 - v^2}{2g(f \pm G)} \qquad (2.2.14)$$

where $G = \tan\alpha$, or the *percent grade* divided by 100.

$$a_t = \frac{dv}{dt} \tag{2.2.15}$$

$$a_n = \frac{v^2}{\rho} \tag{2.2.16}$$

$$\sum F_t = m\left(\frac{dv}{dt}\right) \tag{2.2.17}$$

$$\sum F_n = \frac{mv^2}{\rho}. \tag{2.2.18}$$

$$x - v_0\delta_2 \geqslant \frac{v_0^2}{2a_2} \tag{2.3.1}$$

$$a_2 = \frac{v_0^2}{2(x - v_0\delta_2)} \tag{2.3.2}$$

$$x_c = v_0\delta_2 + \frac{v_0^2}{2a_2^*} \tag{2.3.3}$$

$$x + w + L - v_0\delta_1 \leqslant v_0(\tau - \delta_1) + \tfrac{1}{2}a_1(\tau - \delta_1)^2 \tag{2.3.4}$$

$$x_o = v_0\tau - (w + L) \tag{2.3.6}$$

$$F_c = m\frac{v^2}{R} \tag{A}$$

$$W = mg \tag{B}$$

$$F = f_s N \tag{C}$$

$$\tau_{min} = \delta_2 + \frac{v_0}{2a_2^*} + \frac{w + L}{v_0} \qquad (2.3.7)$$

$$L = 2\pi R\left(\frac{\Delta}{360}\right) \qquad (2.4.1)$$

$$\left.\begin{aligned} \frac{100}{2\pi R} &= \frac{D}{360} \\ D &= \left(\frac{5729.58}{R}\right)^{\circ} \end{aligned}\right\} \qquad (2.4.2)$$

$$L = \frac{100\Delta}{D} \qquad (2.4.4)$$

E: External distance $= R\left(\sec\frac{\Delta}{2} - 1\right)$ (8)

M: Middle ordinate distance $= R\left(1 - \cos\frac{\Delta}{2}\right)$ (9)

T: Length of tangent $= R\tan\frac{\Delta}{2}$ (10)

L: Length of curvé $= 100\frac{\Delta}{D}$ (11)

LC: Long chord $= 2R\sin\frac{\Delta}{2}$ (12)

$$e = \tan\beta$$

$$e + f_s = \frac{v^2}{gR} \qquad (2.4.5)$$

$$e + f_s = \frac{v^2}{15R} \qquad (2.4.6)$$

$$R_{min} = \frac{v^2}{g(e_{max} + f_{max})} \qquad (2.4.7)$$

$$e_{des} = \frac{v^2}{gR} - f_s \quad \text{for } R > R_{min} \qquad (2.4.8)$$

$$E = \frac{AL}{800}\text{ ft} \qquad (2.4.11)$$

$$y = 4E\left(\frac{x}{L}\right)^2 \qquad (2.4.12)$$

$$X = \frac{LG_1}{G_1 - G_2} \qquad X \geqslant 0 \qquad (2.4.13)$$

$$\text{Elevation of } P = \left[\text{elevation of VPC} + \left(\frac{G_1}{100}\right)x\right] + y \qquad (2.4.14)$$

TABLE 2.4.2 Required Length of Superelevation Runoff for Two-Lane Roads

Superelevation rate, *e*	Length of runoff (ft) for design speed (mi/h) of:							
	20	30	40	50	55	60	65	70
				12-ft lanes				
0.02	50	100	125	150	160	175	190	200
0.04	60	100	125	150	160	175	190	200
0.06	95	110	125	150	160	175	190	200
0.08	125	145	170	190	205	215	230	240
0.10	160	180	210	240	255	270	290	300
0.12	195	215	250	290	305	320	350	360
				10-ft lanes				
0.02	50	100	125	150	160	175	190	200
0.04	50	100	125	150	160	175	190	200
0.06	80	100	125	150	160	175	190	200
0.08	105	120	140	160	170	180	190	200
0.10	130	150	175	200	215	225	240	250
0.12	160	180	210	240	255	270	290	300

TABLE 2.4.3 Stopping Sight Distance

Design speed (mi/h)	Assumed speed for condition (mi/h)	Brake reaction Time (s)	Brake reaction Distance (ft)	Coefficient of friction *f*	Braking distance on level[a] (ft)	Stopping sight distance Computed[a] (ft)	Stopping sight distance Rounded for design (ft)
20	20	2.5	-73.3	0.40	-33.3	-106.7	-125
25	25	2.5	91.7	0.38	-54.8	-146.5	-150
30	30	2.5	-110.0	0.35	-85.7	-195.7	-200
35	35	2.5	-128.3	0.34	-120.1	-248.4	-250
40	-40	2.5	-146.7	0.32	-166.7	-313.3	-325
45	-45	2.5	-165.0	0.31	-217.7	-382.7	-400
50	-50	2.5	-183.3	0.30	-277.8	-461.1	-475
55	-55	2.5	-201.7	0.30	-336.1	-537.8	-550
60	-60	2.5	-220.0	0.29	-413.8	-633.8	-650
65	-65	2.5	-238.3	0.29	-485.6	-724.0	-725
70	-70	2.5	-256.7	0.28	-583.3	-840.0	-850

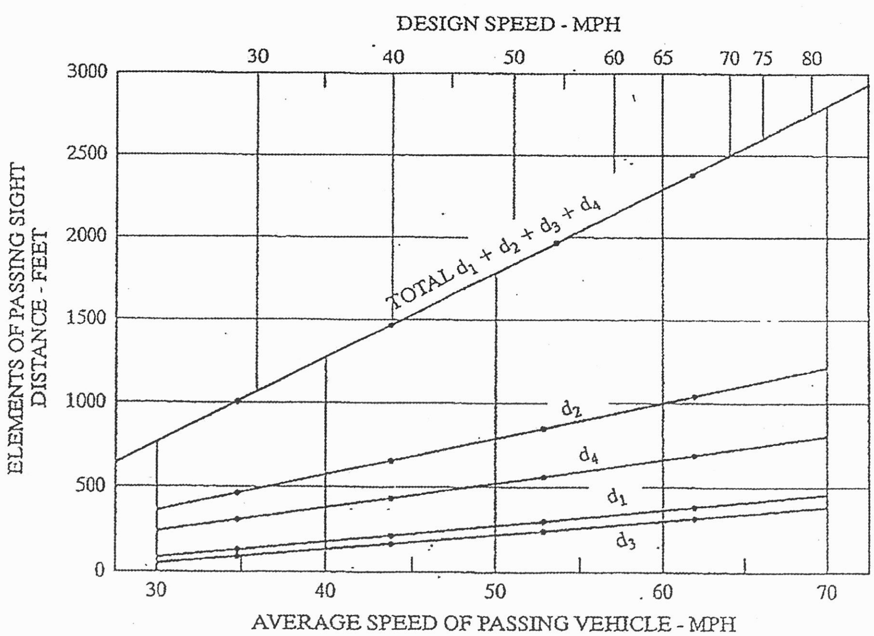


Figure 2.4.13 Passing sight distance.