APPENDIX M

PROCEDURES FOR ESTIMATING WEIGHTED DESIGN SPEED

Weighted design speed (WDS) is defined as the weighted average of the design speeds within the section, when each curve and tangent segment within the section is considered to have an individual design speed.

The weighted design speed is determined for each paved standard sample section. If the section has curve data coded, the curve data is used to determine the weighted design speed. When curve data is not coded for the sample section, the weighted design speed is a default value based on functional system and facility type.

Section with Curve Data Coded

When the paved sample section has curve length reported for at least one of the curve classes, the coded curve length(s) are used to determine the weighted design speed.

Curve Classes			Length of Curves in Class (Miles)
Curve Class	Radius Length (Metric)	Degree of Curvature (English)	
A	506+	0.0-3.4	xx.xxx
B	321-5-5	3.5-5.4	xx.xxx
C	206-320	5.5-8.4	xx.xxx
D	126-205	8.5-13.9	xx.xxx
E	61-125	14.0-27.9	xx.xxx
F	< 61	28+	xx.xxx

Weighted Design Speed = (Sample Section Length / Total Travel Time) * 60 minutes/hour

Where: Total Travel Time (in minutes) = Sum of the travel time for each curve class with a length coded for the class.

The travel time for each curve class (A-F) with a nonzero length is:

Travel Time = (60 / Design Speed for the Curve Class) * Length of Curve Class

Where the design speed for the curve class is defined in the following table:

Curve Class	Design Speed (MPH)
A	70
B	60
C	50
D	40
E	30
F	25

Section with Curve Data NOT Coded

When the paved sample section does not have curve data coded for the section (all curve classes have length coded zero), the weighted design speed is a default value based on functional system and facility type.

The default table is defined as:

	Functional System								
Facility Type	1	2	6	7	11	12	14	16	17
Multilane Divided	70	70	70	65	70	70	70	60	55
Multilane Undivided	70	70	70	60	70	70	70	55	45
2 or 3 Lane	70	70	65	60	70	65	65	55	45

A multilane divided roadway is a section with four or more through lanes and a median type of curbed or positive barrier or median width greater than or equal to four feet. A multilane undivided roadway is a section with four or more lanes without a qualifying median.

Rounding the Weighted Design Speed

The weighted design speed is rounded to the nearest 5 MPH using the following rules:

WDS	< 32.5	set to 30 MPH
WDS	32.5 to < 37.5	set to 35 MPH
WDS	37.5 to < 42.5	set to 40 MPH
WDS	42.5 to < 47.5	set to 45 MPH
WDS	47.5 to < 52.5	set to 50 MPH
WDS	52.5 to < 57.5	set to 55 MPH
WDS	57.5 to < 62.5	set to 60 MPH
WDS	62.5 to < 67.5	set to 65 MPH
WDS	>= 67.5	set to 70 MPH

Determining the WDS for a Section

A worksheet for WDS calculation is provided in Figure M-1. The steps to be taken are as follows:

1. For the section of highway being analyzed, list each nonzero length for the appropriate class in the column headed "Length of Curves in Class."
2. For each curve class with length entered, determine the Travel Time by dividing 60 by the Design Speed for the curve class and multiply by the "length of curve in class". Enter this value in the column labeled "Travel Time."
3. Total the Travel Time for each curve class.
4. Divide the sample section length by the Total Travel Time and then multiply by 60 minutes/hour to obtain the WDS in miles per hour.
5. Round to the nearest 5 MPH.

A sample calculation is shown on the worksheet, Figure M-1. For a rural section, curve class D has a length of 1.20 miles for a travel time of 1.8 minutes, curve class B a length of 1.3 miles for a travel time of 1.3 minutes and curve class A a length of 3.0 miles for a travel time of 2.57 minutes. The total travel time for the curves is 5.67 minutes. The section length (5.50 miles) divided by the total travel time (5.67 minutes) and multiplied by 60 (minutes/hour) yields a WDS of 58.2 MPH. This is then rounded to 60 MPH.

Curve Category[1]	Degree of Curvature[2]	Approximate Design Speed	Length of Curves in Class	Travel Time (Minutes) ((60/Design Speed) * Length of Curves)
F	28.0 +	25		
E	14.0 - 27.9	30		
D	8.5 - 13.9	40	1.20	1.8
C	5.5 - 8.4	50		
B	3.5 - 5.4	60	1.3	1.3
A	0.0 - 3.4	70	3.0	2.57
		Total Travel Time (in minutes)		5.67

Section Length: **5.50** miles

Weighted Design Speed =
(Section Length (**5.50** miles) divided by Total Travel Time (**5.67** minutes)) * 60 minutes/hour

= **58.2** MPH; Rounded WDS = **60** MPH

Figure M-1. Worksheet for Calculating Weighted Design Speed (WDS)

1 Curve categories are from Curves by Class (Items 63-68 in Chapter IV).
2 For maximum super elevation rate of 0.08 foot/foot.