

**TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET**

**General Information**

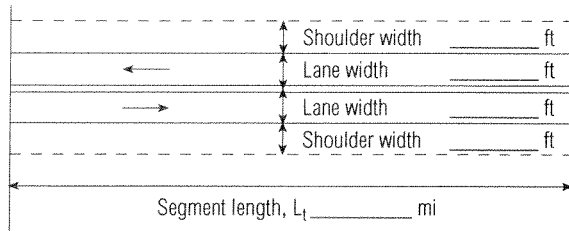
Analyst \_\_\_\_\_  
 Agency or Company \_\_\_\_\_  
 Date Performed \_\_\_\_\_  
 Analysis Time Period \_\_\_\_\_

**Site Information**

Highway \_\_\_\_\_  
 From/To \_\_\_\_\_  
 Jurisdiction \_\_\_\_\_  
 Analysis Year \_\_\_\_\_

Operational (LOS)       Design ( $v_p$ )       Planning (LOS)       Planning ( $v_p$ )

**Input Data**



Class I highway       Class II highway  
 Terrain       Level       Rolling  
 Two-way hourly volume \_\_\_\_\_ veh/h  
 Directional split \_\_\_\_\_ / \_\_\_\_\_  
 Peak-hour factor, PHF \_\_\_\_\_  
 % Trucks and buses,  $P_T$  \_\_\_\_\_ %  
 % Recreational vehicles,  $P_R$  \_\_\_\_\_ %  
 % No-passing zone \_\_\_\_\_ %  
 Access points/mi \_\_\_\_\_ /mi

**Average Travel Speed**

Grade adjustment factor,  $f_G$  (Exhibit 20-7) \_\_\_\_\_  
 Passenger-car equivalents for trucks,  $E_T$  (Exhibit 20-9) \_\_\_\_\_  
 Passenger-car equivalents for RVs,  $E_R$  (Exhibit 20-9) \_\_\_\_\_  
 Heavy-vehicle adjustment factor,  $f_{HV}$   $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$   
 Two-way flow rate,  $v_p$  (pc/h)  $v_p = \frac{V}{PHF * f_G * f_{HV}}$   
 $v_p$  \* highest directional split proportion<sup>2</sup> (pc/h) \_\_\_\_\_  
 Free-Flow Speed from Field Measurement  
 Field measured speed,  $S_{FM}$  \_\_\_\_\_ mi/h  
 Observed volume,  $V_f$  \_\_\_\_\_ veh/h  
 Free-flow speed, FFS \_\_\_\_\_ mi/h  
 $FFS = S_{FM} + 0.00776 \left( \frac{V_f}{f_{HV}} \right)$   
 Adj. for no-passing zones,  $f_{np}$  (mi/h) (Exhibit 20-11) \_\_\_\_\_  
 Average travel speed, ATS (mi/h)  $ATS = FFS - 0.00776 v_p - f_{np}$

Estimated Free-Flow Speed  
 Base free-flow speed, BFFS \_\_\_\_\_ mi/h  
 Adj. for lane width and shoulder width,  $f_{LS}$  (Exhibit 20-5) \_\_\_\_\_ mi/h  
 Adj. for access points,  $f_A$  (Exhibit 20-6) \_\_\_\_\_ mi/h  
 Free-flow speed, FFS \_\_\_\_\_ mi/h  
 $FFS = BFFS - f_{LS} - f_A$

**Percent Time-Spent-Following**

Grade adjustment factor,  $f_G$  (Exhibit 20-8) \_\_\_\_\_  
 Passenger-car equivalents for trucks,  $E_T$  (Exhibit 20-10) \_\_\_\_\_  
 Passenger-car equivalents for RVs,  $E_R$  (Exhibit 20-10) \_\_\_\_\_  
 Heavy-vehicle adjustment factor,  $f_{HV}$   $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$   
 Two-way flow rate,  $v_p$  (pc/h)  $v_p = \frac{V}{PHF * f_G * f_{HV}}$   
 $v_p$  \* highest directional split proportion<sup>2</sup> (pc/h) \_\_\_\_\_  
 Base percent time-spent-following, BPTSF (%)  
 $BPTSF = 100(1 - e^{-0.000879 v_p})$   
 Adj. for directional distribution and no-passing zone,  $f_{d/np}$  (%) (Exhibit 20-12) \_\_\_\_\_  
 Percent time-spent-following, PTSF (%)  $PTSF = BPTSF + f_{d/np}$

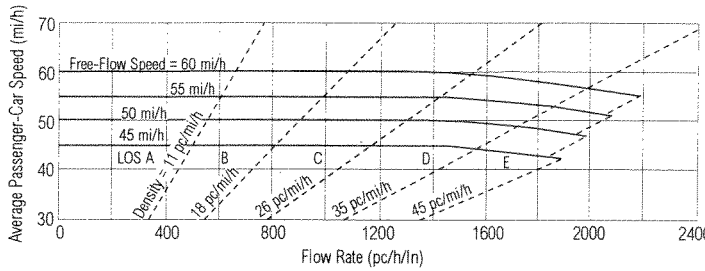
**Level of Service and Other Performance Measures**

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II) \_\_\_\_\_  
 Volume to capacity ratio,  $v/c$   $v/c = \frac{v_p}{3,200}$   
 Peak 15-min vehicle-miles of travel,  $VMT_{15}$  (veh-mi)  
 $VMT_{15} = 0.25 L_1 \left( \frac{V}{PHF} \right)$   
 Peak-hour vehicle-miles of travel,  $VMT_{60}$  (veh-mi)  $VMT_{60} = V * L_1$   
 Peak 15-min total travel time,  $TT_{15}$  (veh-h)  $TT_{15} = \frac{VMT_{15}}{ATS}$

**Notes**

1. If  $v_p \geq 3,200$  pc/h, terminate analysis—the LOS is F.
2. If highest directional split  $v_p \geq 1,700$  pc/h, terminate analysis—the LOS is F.

MULTILANE HIGHWAYS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v <sub>p</sub>	LOS, S, D
Design (N)	FFS, LOS, v <sub>p</sub>	N, S, D
Design (v <sub>p</sub> )	FFS, LOS, N	v <sub>p</sub> , S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v <sub>p</sub> )	FFS, LOS, N	v <sub>p</sub> , S, D

General Information

Site Information

Analyst \_\_\_\_\_  
 Agency or Company \_\_\_\_\_  
 Date Performed \_\_\_\_\_  
 Analysis Time Period \_\_\_\_\_

Highway/Direction of Travel \_\_\_\_\_  
 From/To \_\_\_\_\_  
 Jurisdiction \_\_\_\_\_  
 Analysis Year \_\_\_\_\_

Operational (LOS)     Design (N)     Design (v<sub>p</sub>)     Planning (LOS)     Planning (N)     Planning (v<sub>p</sub>)

Flow Inputs

Volume, V \_\_\_\_\_ veh/h    Peak-hour factor, PHF \_\_\_\_\_  
 Annual avg. daily traffic, AADT \_\_\_\_\_ veh/day    % Trucks and buses, P<sub>T</sub> \_\_\_\_\_  
 Peak-hour proportion of AADT, K \_\_\_\_\_    % RVs, P<sub>R</sub> \_\_\_\_\_  
 Peak-hour direction proportion, D \_\_\_\_\_    General terrain \_\_\_\_\_  
 DDHV = AADT \* K \* D \_\_\_\_\_ veh/h     Level     Rolling     Mountainous  
 Driver type \_\_\_\_\_  
 Commuter/Weekday     Recreational/Weekend    Grade: Length \_\_\_\_\_ mi    Up/Down \_\_\_\_\_ %  
 Number of lanes \_\_\_\_\_

Calculate Flow Adjustments

f<sub>p</sub> pg 21-11 \_\_\_\_\_    E<sub>R</sub> \_\_\_\_\_  
 E<sub>T</sub> \_\_\_\_\_    f<sub>HV</sub> =  $\frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$  \_\_\_\_\_

Speed Inputs

Calculate Speed Adjustments and FFS

Lane width, LW \_\_\_\_\_ ft    f<sub>LW</sub> \_\_\_\_\_ mi/h  
 Total lateral clearance, TLC \_\_\_\_\_ ft    f<sub>LC</sub> \_\_\_\_\_ mi/h  
 Access points, A \_\_\_\_\_ A/mi    f<sub>A</sub> \_\_\_\_\_ mi/h  
 Median type, M     Undivided     Divided    f<sub>M</sub> \_\_\_\_\_ mi/h  
 FFS (measured) \_\_\_\_\_ mi/h    FFS = BFFS - f<sub>LW</sub> - f<sub>LC</sub> - f<sub>A</sub> - f<sub>M</sub> \_\_\_\_\_ mi/h  
 Base free-flow speed, BFFS \_\_\_\_\_ mi/h

Operational, Planning (LOS); Design, Planning (v<sub>p</sub>)

Design, Planning (N)

Operational (LOS) or Planning (LOS)  
 $v_p = \frac{V \text{ or DDHV}}{PHF * N * f_{HV} * f_p}$  \_\_\_\_\_ pc/h/ln  
 S \_\_\_\_\_ mi/h  
 D = v<sub>p</sub>/S \_\_\_\_\_ pc/mi/ln  
 LOS \_\_\_\_\_  
 Design (v<sub>p</sub>) or Planning (v<sub>p</sub>)  
 LOS \_\_\_\_\_  
 v<sub>p</sub> \_\_\_\_\_ pc/h/ln  
 V = v<sub>p</sub> \* PHF \* N \* f<sub>HV</sub> \* f<sub>p</sub> \_\_\_\_\_ veh/h  
 S \_\_\_\_\_ mi/h  
 D = v<sub>p</sub>/S \_\_\_\_\_ pc/mi/ln

Design (N) or Planning (N) 1st Iteration  
 N \_\_\_\_\_ assumed  
 $v_p = \frac{V \text{ or DDHV}}{PHF * N * f_{HV} * f_p}$  \_\_\_\_\_ pc/h/ln  
 LOS \_\_\_\_\_  
 Design (N) or Planning (N) 2nd Iteration  
 N \_\_\_\_\_ assumed  
 $v_p = \frac{V \text{ or DDHV}}{PHF * N * f_{HV} * f_p}$  \_\_\_\_\_ pc/h/ln  
 LOS \_\_\_\_\_  
 S \_\_\_\_\_ mi/h  
 D = v<sub>p</sub>/S \_\_\_\_\_ pc/mi/ln

Glossary

Factor Location

N - Number of lanes    S - Speed  
 V - Hourly volume    D - Density  
 v<sub>p</sub> - Flow rate    FFS - Free-flow speed  
 LOS - Level of service    BFFS - Base free-flow speed  
 DDHV - Directional design-hour volume

E<sub>T</sub> - Exhibit 21-8, 21-9, 21-11    f<sub>LW</sub> - Exhibit 21-4  
 E<sub>R</sub> - Exhibit 21-8, 21-10    f<sub>LC</sub> - Exhibit 21-5  
 f<sub>p</sub> - Page 21-11    f<sub>M</sub> - Exhibit 21-6  
 LOS, S, FFS, v<sub>p</sub> - Exhibit 21-2, 21-3    f<sub>A</sub> - Exhibit 21-7