Problem 3.5

## TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

### General Information

| | | Site Information | |
|---|---|---|---|
| Analyst | J. Buchholz | Highway | River Road |
| Agency or Company | UNF | From/To | — |
| Date Performed | 9/16/06 | Jurisdiction | — |
| Analysis Time Period | Peak Hour | Analysis Year | 2006 |

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

### Input Data

Shoulder width __2__ ft
Lane width __11__ ft
Lane width __11__ ft
Shoulder width __2__ ft

Show North Arrow

Segment length, $L_t$ __25__ mi

☒ Class I highway  ☐ Class II highway
Terrain  ☒ Level  ☐ Rolling  = V
Two-way hourly volume __640__ veh/h
Directional split __80 / 20__
Peak-hour factor, PHF __0.89__ ←
% Trucks and buses, $P_T$ __25__ %
% Recreational vehicles, $P_R$ __10__ %
% No-passing zone __60__ %
Access points/mi __5__ /mi

$\frac{640}{180 \times 4} = 0.89$

### Average Travel Speed

| | |
|---|---|
| Grade adjustment factor, $f_G$ (Exhibit 20-7) | 1.00 |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-9) | 1.2 |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-9) | 1.0 |
| Heavy-vehicle adjustment factor, $f_{HV}$  $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$ | 0.952 |
| Two-way flow rate,[1] $v_p$ (pc/h)  $v_p = \frac{V}{PHF \cdot f_G \cdot f_{HV}}$ | 755 |
| $v_p$ * highest directional split proportion[2] (pc/h) | 755 × 80% = 604 |

→ 755 < 1200 ∴ no iteration required

$\frac{1}{1 + 0.25(1.2-1) + 0.10(1-1)}$

$\frac{640}{0.89(1.00)(0.952)}$

| Free-Flow Speed from Field Measurement | | Estimated Free-Flow Speed | |
|---|---|---|---|
| Field measured speed, $S_{FM}$ | — mi/h | Base free-flow speed, BFFS $50 + 5 =$ __55__ mi/h |
| Observed volume, $V_f$ | — veh/h | Adj. for lane width and shoulder width, $f_{LS}$ (Exhibit 20-5) __3.0__ mi/h |
| Free-flow speed, FFS | — mi/h | Adj. for access points, $f_A$ (Exhibit 20-6) __1.25__ mi/h |
| FFS $= S_{FM} + 0.00776\left(\frac{V_f}{f_{HV}}\right)$ | | Free-flow speed, FFS __50.75__ mi/h |
| | | FFS $= BFFS - f_{LS} - f_A = 55 - 3.0 - 1.25 = 50.75$ |

| | |
|---|---|
| Adj. for no-passing zones, $f_{np}$ (mi/h) (Exhibit 20-11) | 2.4 |
| Average travel speed, ATS (mi/h)  ATS $= FFS - 0.00776 v_p - f_{np}$ | $50.75 - 0.00776(755) - 2.4 = \boxed{42.5}$ |

### Percent Time-Spent-Following

| | |
|---|---|
| Grade adjustment factor, $f_G$ (Exhibit 20-8) | 1.00 |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-10) | 1.1 |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-10) | 1.0 |
| Heavy-vehicle adjustment factor, $f_{HV}$  $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$ | 0.976 |
| Two-way flow rate,[1] $v_p$ (pc/h)  $v_p = \frac{V}{PHF \cdot f_G \cdot f_{HV}}$ | 737 |
| $v_p$ * highest directional split proportion[2] (pc/h) | 737 × 80% = 590 |
| Base percent time-spent-following, BPTSF (%)  BPTSF $= 100(1 - e^{-0.000879 v_p})$ | $100(1 - e^{(-0.000879)(737)}) = 47.7\%$ |
| Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12) | ≈ 18.3% |
| Percent time-spent-following, PTSF (%)  PTSF $= BPTSF + f_{d/np}$ | $47.7\% + 18.3\% = \boxed{66.0\%}$ |

→ 737 < 1200 ∴ no iteration required

$\frac{1}{1 + 0.25(1.1-1) + 0.10(1-1)}$

$\frac{640}{0.89(1.00)(0.976)}$

### Level of Service and Other Performance Measures

| | |
|---|---|
| Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II) | 42.5 mph → LOS D ← 66.0% |
| Volume to capacity ratio, v/c  $v/c = \frac{v_p}{3,200}$ | 755/3200 = 0.24 |
| Peak 15-min vehicle-miles of travel, $VMT_{15}$ (veh-mi)  $VMT_{15} = 0.25 L_t \left(\frac{V}{PHF}\right)$ | $0.25 (25)\left(\frac{640}{0.89}\right) = 4494$ |
| Peak-hour vehicle-miles of travel, $VMT_{60}$ (veh-mi)  $VMT_{60} = V \cdot L_t$ | $640 \times 25 = 16,000$ |
| Peak 15-min total travel time, $TT_{15}$ (veh-h)  $TT_{15} = \frac{VMT_{15}}{ATS}$ | $4494 / 42.5 = 105.7$ |

### Notes

1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.  755 < 3200 ok.
2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.  604 < 1700 o.k.