CE 34500: Transportation Engineering
Homework 3 Solution
Due: Monday, April 1, 2019

1. Determine Level of Service an urban freeway section, if the BFFS = 70 mph. The data are as follows:

    Number of lanes: 4 (one direction)
    Lane width = 12 ft.
    Lateral clearance =5 ft. (right side)
    Interchange density = 1 per mile
    Percent trucks = 14
    Percent RVs = 4
    PHF = 0.95
    Commuter traffic

$FFS = BFFS - f_{LW} - f_{LC} - 3.22 * TRD^{.84}$ = 66.58

$$f_{HV} = \frac{1}{1 + 0.14(1.5 - 1) + 0.04(1.2 - 1)} = 0.927$$

$Vp = \frac{4000}{0.95*4*1*.927}$= 1135 < 1400 at BP-65

Density, $D = \frac{v_p}{S} = \frac{1135}{66.58}$ =17.04

LOS B (Page 454, Section 9.1.2)

Given,

$BFFS = 70$ mph
Lane width = 12 ft.
Lateral clearance = 5 ft. (right side)
Interchange density,TRD = 1 per mile
$flow\ rate, V = 4000$ pc/h

From tables and figures:
$f_{LW} = 0$ (see Table 9.1)
$f_{LC} = 0.2$ (see Table 9.2)

2. Determine Level of Service a two-lane two-way highway for a 2 mile segment if the BFFS = 60 mph. The data are as follows:

Volume = 1600 veh/h (two-way)
Percent trucks = 5
Percent RVs = 1
Peak hour factor = 0.95
Percent directional split = 50-50
Percent no-passing zones = 50
Lane width = 12 ft.
Shoulder width = 4 ft.
Access points per mile = 20
Highway: Class I
Terrain: Rolling

Solution: $P_T = .05, P_R = 0.01, V_i = \frac{1600}{2} = 800, PHF = 0.95$

Calculate adjusted demand for ATS:

$f_{HV,ATS} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)} = 0.98$

$v_{i,ATS} = \frac{V_i}{PHF*f_{g,ATS}*f_{HV,ATS}} = 868$ pc/h

$FFS = BFFS - f_{LS} - f_A = 53.7$ mph

$$ATS_d = FFS - 0.00776(v_{d,ATS} + v_{vo,ATS}) - f_{np,ATS}$$

⇨ 53.7-0.00776(868+868)-0.7=39.5 mph

From tables and figures:
$E_T = 1.4$ & $E_R = 1.1$ (see Table 9.16)
$f_{g,ATS} = 0.99$ (see Table 9.14)
$f_{np} = 0.7$ (see Table 9.20)
$f_{LS} = 1.3$ (see Table 9.9)
$f_A = 5.0$ (see Table 9.10)

Calculate adjusted demand for PTSF:

$f_{HV,PTSF} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)} = 1$

$v_{i,PTSF} = \frac{V_i}{PHF*f_{g,PTSF}*f_{HV,PTSF}} = 842$pc/h

$$BPTSF = 100 * [1 - \exp(av_d^b)] = 100(1 - \exp(-0.0046 * 842^{0.833})) = 71.3\%$$

$$PTSF_d = BPTSF_d + f_{np,PTSF}\left(\frac{v_{d,PTSF}}{v_{d,PTSF} + v_{o,PTSF}}\right)$$

⇨ $71.3 + 21\left(\frac{842}{842+842}\right) = 81.8\%$

$$PFFS = \frac{39.5}{53.3} = 72.4\%$$

Given,
$V = 1600$ veh/hour
$P_T = 0.5$
$P_R = 0.01$
$PHF = 0.95$
$BFFS = 60$ mph

From tables and figures:
$E_T = 1$ & $E_R = 1$ (see Table 9.23)
$f_{g,PTSF} = 1$ (see Table 9.21)
$f_{np,PTSF} = 21$ (see Table 9.25)

$LOS_{ATS} = E,\ LOS_{PTSF} = D$. **SO LOS E**