HIGHPLAN Computational Methodology

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Multilane Methodology

Inputs

Project Properties

Roadway Information:

AreaType := 2 1 = Urbanized, 2 = Transitioning/Urban, 3 = Rural Developed, 4 = Rural Undeveloped

Highway Data

Roadway Variables:

NumberofLanes := 4

Terrain := 2 Level = 1, Rolling = 2

PostedSpeed := 45 mi/h

SegLength := 5 mi

LeftTurnImpact := 1 0 = No, 1 = Yes

Median := 0 0 = No, 1 = Yes

Traffic Variables:

AADT := 39500

K := 0.095

D := 0.55

PHF := 0.925

P_T := 2% Percent trucks

BaseCapacity := 2000

LocalAdjustmentFactor := 1.0

LOS Computational Steps

1. Calculate DDHV (Design Directional Hour Volume)

$DDHV := AADT \cdot K \cdot D$ $DDHV = 2064$

2. Determine E_T (Truck passenger car equivalency factor)

$$\text{PCE(Terrain)} := \begin{array}{|l} \text{out} \leftarrow 1.5 \ \text{ if } \ \text{Terrain} = 1 \\ \text{out} \leftarrow 2.5 \ \text{ if } \ \text{Terrain} = 2 \\ \text{out} \end{array}$$

From Exhibit 14-12
HCM 2010

$\text{PCE(Terrain)} = 2.5$ $E_T := \text{PCE(Terrain)}$ $E_T = 2.5$

3. Calculate heavy vehicle factor (f_{HV})

$$f_{HV} := \frac{1}{1 + P_T \cdot \left(E_T - 1\right)}$$

$f_{HV} = 0.971$

Equation 14-4
HCM 2010

4. Calculate Base Analysis Volume (v_p)

$\text{LAF} := \text{LocalAdjustmentFactor}$

$$v_p := \frac{\text{DDHV}}{\text{PHF} \cdot \frac{\text{NumberofLanes}}{2} \cdot f_{HV} \cdot \text{LAF}}$$

$v_p = 1149.1$ veh/h

Equation 14-3
HCM 2010

5. Determine adjustment for the presence of a median and/or left turn lanes

Left Turn Lane Adjustment (LTadj) = -0.2 for left turn lanes NOT present, LTadj = 0 otherwise. Median Adjustment (MedAdj) = -0.05 for no median present, MedAdj = 0 otherwise. Note: The presence of a median, but no left turn lanes is not a valid option per FDOT guidance.

$\text{LTI} := \text{LeftTurnImpact}$

$$\text{LTadj(LTI)} := \begin{array}{|l} \text{out} \leftarrow -0.2 \ \text{ if } \ \text{LTI} = 1 \\ \text{out} \leftarrow 0 \ \text{ if } \ \text{LTI} = 0 \\ \text{out} \end{array}$$

$$\text{MedAdj(Median)} := \begin{array}{|l} \text{out} \leftarrow -0.05 \ \text{ if } \ \text{Median} = 0 \\ \text{out} \leftarrow 0 \ \text{ if } \ \text{Median} = 1 \\ \text{out} \end{array}$$

$\text{LTadj(LeftTurnImpact)} = -0.2$

$\text{LTadj} := \text{LTadj(LeftTurnImpact)}$

$\text{LTadj} = -0.2$

$\text{MedAdj(Median)} = -0.05$

$\text{MedAdj} := \text{MedAdj(Median)}$

$\text{MedAdj} = -0.05$

Final Adjustment Value for Left Turn Lane and Median:

$\text{AdjMedLTL} := (1 + \text{LTadj} + \text{MedAdj})$ $\text{AdjMedLTL} = 0.75$

6. Calculate Adjusted Analysis Volume (AdjVol)

$$\text{AdjVol} := \frac{v_p}{\text{AdjMedLTL}}$$

$\text{AdjVol} = 1532.1$ veh/h $V := \text{AdjVol}$ $V = 1532.1$ veh/h

7. Determine Average Passenger Car Speed

$FFS := PostedSpeed + 5$ $FFS = 50$

Exhibit 14-3
HCM 2010

$$Speed(FFS, AdjVol) := \begin{array}{|l} out \leftarrow FFS \ \text{ if } AdjVol \le 1400 \\ \text{if } AdjVol > 1400 \\ \quad \begin{array}{|l} out \leftarrow FFS - \left(\frac{3}{10} \cdot FFS - 13\right) \cdot \left(\frac{AdjVol - 1400}{28 \cdot FFS - 880}\right)^{1.31} \ \text{ if } FFS > 55 \\ out \leftarrow FFS - \left(\frac{34}{205} \cdot FFS - \frac{219}{41}\right) \cdot \left(\frac{AdjVol - 1400}{\frac{171}{5} \cdot FFS - 1181}\right)^{1.31} \ \text{ if } 50 < FFS \le 55 \\ out \leftarrow FFS - \left(\frac{10}{43} \cdot FFS - \frac{350}{43}\right) \cdot \left(\frac{AdjVol - 1400}{33 \cdot FFS - 1050}\right)^{1.31} \ \text{ if } 45 < FFS \le 50 \\ out \leftarrow FFS - \left(\frac{1}{5} \cdot FFS - \frac{56}{9}\right) \cdot \left(\frac{AdjVol - 1400}{36 \cdot FFS - 1120}\right)^{1.31} \ \text{ if } FFS = 45 \end{array} \end{array}$$

$Speed(FFS, AdjVol) = 49.5$ $S := Speed(FFS, AdjVol)$ $S = 49.52$ mi/h

8. Calculate Percentage of Free-Flow Speed (%FFS)

$$\%FFS := \frac{S}{FFS} \cdot 100$$

$\%FFS = 99.0$

9. Calculate Free-Flow Delay

$$FFDelay := \left(\frac{SegLength}{S} - \frac{SegLength}{FFS}\right) \cdot 3600$$

$FFDelay = 3.5$ sec/veh

10. Calculate LOS Threshold Delay

$$LOSspeedthresh(AreaType) := \begin{array}{|l} return \ 53 \ \text{ if } AreaType = 1 \\ return \ 60 \ \text{ if } AreaType = 2 \vee AreaType = 3 \vee AreaType = 4 \end{array}$$

$LOSspeedthresh(AreaType) = 60$

$$LOSDelay := \left(\frac{SegLength}{S} - \frac{SegLength}{LOSspeedthresh(AreaType)}\right) \cdot 3600$$

$LOSDelay = 63.5$ sec/veh

11. Calculate v/c ratio

$$vcratio := \frac{V}{BaseCapacity}$$

$vcratio = 0.77$

12. Calculate density

$$Density := \frac{AdjVol}{S}$$

Equation 21-5
HCM 2000

$Density = 30.9$ pc/mi/ln

Determine Level of Service

LOS Thresholds (FDOT specific)

Rural Developed and Rural Undeveloped	Urbanized and Transitioning
A <= 6	A <= 10
B <= 14	B <= 17
C <= 22	C <= 24
D <= 29	D <= 31
E <= 39 for FFS = 45	E <= 39 for FFS = 45
E <= 37 for FFS = 50	E <= 37 for FFS = 50
E <= 35 for FFS = 55	E <= 35 for FFS = 55
E <= 34 for FFS > 60	E <= 34 for FFS > 60

$LOS := D$

Service Volumes Check

The density threshold for Transitioning area type and LOS D is 31 pc/mi/ln

Using the procedure documented above, the following results are obtained for the displayed 1750 veh/h peak direction service volume.

$$InputAADT := Round\left(\frac{2064}{K \cdot D}, 10\right) = 39500$$

$AdjVol = 1532$ veh/h

$S = 49.52$ mi/h

$Density = 30.9$ pc/mi/ln

Thus, the maximum service volume (AADT) for LOS D for the conditions in the example calculations file is ~39,500.