APPENDIX Q

YEAR 2030 TRAFFIC CONDITIONS FREEWAY RAMP LEVEL OF SERVICE CALCULATION WORKSHEETS – *CALTRANS FACILITIES ANALYSIS (HCM METHODOLOGY)*

APPENDIX Q-I

YEAR 2030 WITHOUT PROJECT TRAFFIC CONDITIONS – *CALTRANS FREEWAY RAMP ANALYSIS (HCM METHODOLOGY)*

MERGE/DIVERGE ANALYSIS

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	ZS	Freeway/Dir of Travel	I-5 NB
Agency or Company	LLG Engineers	Junction	On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 without Project

Project Description AM Year 2030 without Project I-5 NB On-Ramp at Katella

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1400 ft

V_u = 370 veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5230	0.95	Level	9	0	0.957	1.00	5753
Ramp	256	0.95	Level	9	0	0.957	1.00	282
UpStream	370	0.95	Level	9	0	0.957	1.00	407
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.342 using Equation 4

V_{12}= 1967 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6035	See Exhibit 25-7	No
V_{R12}	2249	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 19.8 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.323 (Exibit 25-19)

S_R= 61.0 mph (Exhibit 25-19)

S_0= 65.0 mph (Exhibit 25-19)

S= 63.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{Fi}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	ZS	Freeway/Dir of Travel	I-5 NB
Agency or Company	LLG Engineers	Junction	On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 without Project

Project Description PM Year 2030 without Project I-5 NB On-Ramp at Katella

Inputs

Upstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{up} = 1400 ft
Vu = 570 veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8290	0.95	Level	9	0	0.957	1.00	9119
Ramp	395	0.95	Level	9	0	0.957	1.00	435
UpStream	570	0.95	Level	9	0	0.957	1.00	627
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 0.323 using Equation 4
V_{12} = 2943 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9554	See Exhibit 25-7	No
V_{R12}	3378	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 28.5 (pc/ m/ln)
LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.400 (Exibit 25-19)
S_R = 58.8 mph (Exhibit 25-19)
S_0 = 58.7 mph (Exhibit 25-19)
S = 58.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation
V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)
LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	ZS	Freeway/Dir of Travel	I-5 SB
Agency or Company	LLG Engineers	Junction	Off-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 without Project

Project Description AM Year 2030 without Project I-5 SB Off-Ramp at Katella

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☑ Yes ☐ On		☐ Yes ☐ On
☐ No ☑ Off		☑ No ☐ Off
L_{up} = 1130 ft		L_{down} = ft
Vu = 730 veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6230	0.95	Level	9	0	0.957	1.00	6853
Ramp	919	0.95	Level	9	0	0.957	1.00	1011
UpStream	730	0.95	Level	9	0	0.957	1.00	803
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 2263 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5826	9600	No
V_{12}	2263	4400:All	No
$V_{FO} = V_F - V_R$	4815	9600	No
V_R	1011	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 4.8 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.519 (Exhibit 25-19)

S_R= 55.5 mph (Exhibit 25-19)

S_0= 73.7 mph (Exhibit 25-19)

S = 65.4 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	ZS	Freeway/Dir of Travel	I-5 SB
Agency or Company	LLG Engineers	Junction	Off-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 without Project

Project Description: PM Year 2030 without Project I-5 SB Off-Ramp at Katella

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☑ Yes ☐ On		☐ Yes ☐ On
☐ No ☑ Off		☑ No ☐ Off
L_{up} = 1130 ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = 590 veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7770	0.95	Level	9	0	0.957	1.00	8547
Ramp	407	0.95	Level	9	0	0.957	1.00	448
UpStream	590	0.95	Level	9	0	0.957	1.00	649
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 2109 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6838	9600	No
V_{12}	2109	4400:All	No
$V_{FO} = V_F - V_R$	6390	9600	No
V_R	448	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 3.5 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.468 (Exhibit 25-19)

S_R= 56.9 mph (Exhibit 25-19)

S_0= 71.5 mph (Exhibit 25-19)

S = 66.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	ZS	Freeway/Dir of Travel	SR-57 NB
Agency or Company	LLG Engineers	Junction	EB On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 without Project

Project Description AM Year 2030 without Project SR-57 NB EB On-Ramp at Katella

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

Vu = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 1090 ft

VD = 240 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4350	0.95	Level	6	0	0.971	1.00	4716
Ramp	415	0.95	Level	6	0	0.971	1.00	450
UpStream								
DownStream	240	0.95	Level	6	0	0.971	1.00	260

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.321 using Equation 4

V_{12}= 1180 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4129	See Exhibit 25-7	No
V_{R12}	1630	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 14.8 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.306 (Exibit 25-19)

S_R= 61.4 mph (Exhibit 25-19)

S_0= 67.3 mph (Exhibit 25-19)

S= 64.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{Fi}=V_F		See Exhibit 25-14	
V_{12}		4400:All	
V_{FO} = V_F - V_R		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	ZS	Freeway/Dir of Travel	SR-57 NB
Agency or Company	LLG Engineers	Junction	EB On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 without Project

Project Description PM Year 2030 without Project SR-57 NB EB On-Ramp at Katella

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = 1090 ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 520 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8410	0.95	Level	6	0	0.971	1.00	9118
Ramp	523	0.95	Level	6	0	0.971	1.00	567
UpStream								
DownStream	520	0.95	Level	6	0	0.971	1.00	564

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.306 using Equation 4

V_{12}= 2027 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7185	See Exhibit 25-7	No
V_{R12}	2594	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 22.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.338 (Exibit 25-19)

S_R= 60.5 mph (Exhibit 25-19)

S_0= 63.5 mph (Exhibit 25-19)

S= 62.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	ZS	Freeway/Dir of Travel	SR-57 SB
Agency or Company	LLG Engineers	Junction	WB On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 without Project

Project Description AM Year 2030 without Project SR-57 SB WB On-Ramp at Katella

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = 1015 ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 180 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7390	0.95	Level	6	0	0.971	1.00	8012
Ramp	229	0.95	Level	6	0	0.971	1.00	248
UpStream								
DownStream	180	0.95	Level	6	0	0.971	1.00	195

Merge Areas | Diverge Areas

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.346 using Equation 4

V_{12}= 2773 pc/h

Estimation of v_{12}

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8260	See Exhibit 25-7	No
V_{R12}	3021	4600:All	No

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 25.8 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.366 (Exibit 25-19)

S_R= 59.8 mph (Exhibit 25-19)

S_0= 61.6 mph (Exhibit 25-19)

S= 60.9 mph (Exhibit 25-14)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst2	ZS	Freeway/Dir of Travel	SR-57 SB
Agency or Company	LLG Engineers	Junction	WB On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 without Project

Project Description PM Year 2030 without Project SR-57 SB WB On-Ramp at Katella

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 1015 ft

V_D = 510 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7570	0.95	Level	6	0	0.971	1.00	8207
Ramp	412	0.95	Level	6	0	0.971	1.00	447
UpStream								
DownStream	510	0.95	Level	6	0	0.971	1.00	553

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.321 using Equation 4

V_{12}= 2636 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8654	See Exhibit 25-7	No
V_{R12}	3083	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 26.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.371 (Exibit 25-19)

S_R= 59.6 mph (Exhibit 25-19)

S_0= 60.6 mph (Exhibit 25-19)

S= 60.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{Fl}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

WEAVING ANALYSIS

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 NB
Weaving Seg Location	Orangewood On to Katella Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.22
Weaving seg length, L (ft)	1360	Weaving ratio, R	0.28
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	4030	0.95	6	0	1.5	1.2	0.971	1.00	4369
Vo2	20	0.95	6	0	1.5	1.2	0.971	1.00	21
Vw1	835	0.95	6	0	1.5	1.2	0.971	1.00	905
Vw2	320	0.95	6	0	1.5	1.2	0.971	1.00	346
Vw				1251	Vnw				4390
V									5641

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.46	0.20		
Weaving and non-weaving speeds, Si (mi/h)	52.63	60.70		

Number of lanes required for unconstrained operation, Nw 1.34
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	58.70
Weaving segment density, D (pc/mi/ln)	19.22
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	11380
Capacity as a 15-minute flow rate, c (veh/h)	11049
Capacity as a full-hour volume, c_h (veh/h)	10497

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 NB
Weaving Seg Location	Orangewood On to Katella Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.15
Weaving seg length, L (ft)	1360	Weaving ratio, R	0.48
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7750	0.95	6	0	1.5	1.2	0.971	1.00	8402
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	728	0.95	6	0	1.5	1.2	0.971	1.00	789
Vw2	660	0.95	6	0	1.5	1.2	0.971	1.00	715
Vw				1504	Vnw				8434
V									9938

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.60	0.25		
Weaving and non-weaving speeds, Si (mi/h)	49.33	58.96		

Number of lanes required for unconstrained operation, Nw 0.95
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	57.27
Weaving segment density, D (pc/mi/ln)	34.71
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11586
Capacity as a 15-minute flow rate, c (veh/h)	11249
Capacity as a full-hour volume, c_h (veh/h)	10687

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Katella On to Orangewood Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.13
Weaving seg length, L (ft)	1780	Weaving ratio, R	0.15
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	6940	0.95	6	0	1.5	1.2	0.971	1.00	7524
Vo2	10	0.95	6	0	1.5	1.2	0.971	1.00	10
Vw1	860	0.95	6	0	1.5	1.2	0.971	1.00	932
Vw2	148	0.95	6	0	1.5	1.2	0.971	1.00	160
Vw				1092	Vnw				7534
V									8626

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.68	0.33		
Weaving and non-weaving speeds, Si (mi/h)	47.83	56.29		

Number of lanes required for unconstrained operation, Nw 1.20
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	55.06
Weaving segment density, D (pc/mi/ln)	31.33
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11099
Capacity as a 15-minute flow rate, c (veh/h)	10776
Capacity as a full-hour volume, c_h (veh/h)	10237

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Katella On to Orangewood Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.14
Weaving seg length, L (ft)	1780	Weaving ratio, R	0.31
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7750	0.95	6	0	1.5	1.2	0.971	1.00	8402
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	900	0.95	6	0	1.5	1.2	0.971	1.00	975
Vw2	396	0.95	6	0	1.5	1.2	0.971	1.00	429
Vw				1404	Vnw				8434
V									9838

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.79	0.42		
Weaving and non-weaving speeds, Si (mi/h)	45.70	53.81		

Number of lanes required for unconstrained operation, Nw 1.32
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	52.49
Weaving segment density, D (pc/mi/ln)	37.49
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	10982
Capacity as a 15-minute flow rate, c (veh/h)	10662
Capacity as a full-hour volume, c_h (veh/h)	10129

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 NB
Weaving Seg Location	Katella On to Ball Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.21
Weaving seg length, L (ft)	2130	Weaving ratio, R	0.18
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	4000	0.95	6	0	1.5	1.2	0.971	1.00	4336
Vo2	10	0.95	6	0	1.5	1.2	0.971	1.00	10
Vw1	900	0.95	6	0	1.5	1.2	0.971	1.00	975
Vw2	194	0.95	6	0	1.5	1.2	0.971	1.00	210
Vw				1185	Vnw				4346
V									5531

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.36	0.15		
Weaving and non-weaving speeds, Si (mi/h)	55.47	62.68		

Number of lanes required for unconstrained operation, Nw 1.08
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	60.98
Weaving segment density, D (pc/mi/ln)	18.14
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	11642
Capacity as a 15-minute flow rate, c (veh/h)	11303
Capacity as a full-hour volume, c_h (veh/h)	10738

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 NB
Weaving Seg Location	Katella On to Ball Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.13
Weaving seg length, L (ft)	2130	Weaving ratio, R	0.27
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8370	0.95	6	0	1.5	1.2	0.971	1.00	9074
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	950	0.95	6	0	1.5	1.2	0.971	1.00	1030
Vw2	352	0.95	6	0	1.5	1.2	0.971	1.00	381
Vw				1411	Vnw				9106
V									10517

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.48	0.19		
Weaving and non-weaving speeds, Si (mi/h)	52.05	61.06		

Number of lanes required for unconstrained operation, Nw 0.64
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	59.68
Weaving segment density, D (pc/mi/ln)	35.25
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11750
Capacity as a 15-minute flow rate, c (veh/h)	11408
Capacity as a full-hour volume, c_h (veh/h)	10838

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Ball On to Katella Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	4	Volume ratio, VR	0.18
Weaving seg length, L (ft)	2490	Weaving ratio, R	0.42
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	6750	0.95	6	0	1.5	1.2	0.971	1.00	7318
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	882	0.95	6	0	1.5	1.2	0.971	1.00	956
Vw2	640	0.95	6	0	1.5	1.2	0.971	1.00	693
Vw				1649	Vnw				7350
V									8999

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.52	0.25		
Weaving and non-weaving speeds, Si (mi/h)	51.29	59.09		

Number of lanes required for unconstrained operation, Nw 0.67
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	57.49
Weaving segment density, D (pc/mi/ln)	39.13
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	9400
Capacity as a 15-minute flow rate, c (veh/h)	9126
Capacity as a full-hour volume, c_h (veh/h)	8670

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Ball On to Katella Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	4	Volume ratio, VR	0.16
Weaving seg length, L (ft)	2490	Weaving ratio, R	0.42
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	7010	0.95	6	0	1.5	1.2	0.971	1.00	7600
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	749	0.95	6	0	1.5	1.2	0.971	1.00	812
Vw2	550	0.95	6	0	1.5	1.2	0.971	1.00	596
Vw				1408	Vnw				7632
V									9040

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.49	0.22		
Weaving and non-weaving speeds, Si (mi/h)	51.89	60.23		

Number of lanes required for unconstrained operation, Nw 0.55
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	58.76
Weaving segment density, D (pc/mi/ln)	38.46
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	9400
Capacity as a 15-minute flow rate, c (veh/h)	9126
Capacity as a full-hour volume, c_h (veh/h)	8670

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

APPENDIX Q-II

YEAR 2030 WITH PROJECT TRAFFIC CONDITIONS – *CALTRANS FREEWAY RAMP ANALYSIS (HCM METHODOLOGY)*

MERGE/DIVERGE ANALYSIS

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst2	ZS	Freeway/Dir of Travel	I-5 NB
Agency or Company	LLG Engineers	Junction	On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 with Project

Project Description AM Year 2030 with Project I-5 NB On-Ramp at Katella

Inputs

Upstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{up} = 1400 ft
Vu = 370 veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5230	0.95	Level	9	0	0.957	1.00	5753
Ramp	260	0.95	Level	9	0	0.957	1.00	286
UpStream	370	0.95	Level	9	0	0.957	1.00	407
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM}= 0.341 using Equation 4
V_{12}= 1964 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6039	See Exhibit 25-7	No
V_{R12}	2250	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 19.8 (pc/ m/ln)
LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.323 (Exibit 25-19)
S_R= 61.0 mph (Exhibit 25-19)
S_0= 65.0 mph (Exhibit 25-19)
S= 63.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation
V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)
LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst2	ZS	Freeway/Dir of Travel	I-5 NB
Agency or Company	LLG Engineers	Junction	On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Project

Project Description PM Year 2030 With Project I-5 NB On-Ramp at Katella

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☑ Yes ☑ On		☐ Yes ☐ On
☐ No ☐ Off		☑ No ☐ Off
L_{up} = 1400 ft		L_{down} = ft
Vu = 570 veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	VD = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8290	0.95	Level	9	0	0.957	1.00	9119
Ramp	410	0.95	Level	9	0	0.957	1.00	451
UpStream	570	0.95	Level	9	0	0.957	1.00	627
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.321 using Equation 4

V_{12}= 2925 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9570	See Exhibit 25-7	No
V_{R12}	3376	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 28.5 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.400 (Exibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= 58.7 mph (Exhibit 25-19)

S= 58.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{Fl}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	ZS	Freeway/Dir of Travel	I-5 SB
Agency or Company	LLG Engineers	Junction	Off-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Project

Project Description: AM Year 2030 With Project I-5 SB Off-Ramp at Katella

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☑ Yes ☐ On		☐ Yes ☐ On
☐ No ☑ Off		☑ No ☐ Off
L_{up} = 1130 ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = 730 veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6230	0.95	Level	9	0	0.957	1.00	6853
Ramp	940	0.95	Level	9	0	0.957	1.00	1034
UpStream	730	0.95	Level	9	0	0.957	1.00	803
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 2280 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5826	9600	No
V_{12}	2280	4400:All	No
$V_{FO} = V_F - V_R$	4792	9600	No
V_R	1034	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 5.0 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.521 (Exhibit 25-19)

S_R= 55.4 mph (Exhibit 25-19)

S_0= 73.8 mph (Exhibit 25-19)

S = 65.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	ZS	Freeway/Dir of Travel	I-5 SB
Agency or Company	LLG Engineers	Junction	Off-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Project

Project Description: PM Year 2030 With Project I-5 SB Off-Ramp at Katella

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☑ Yes ☐ On		☐ Yes ☐ On
☐ No ☑ Off		☑ No ☐ Off
L_{up} = 1130 ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = 590 veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7770	0.95	Level	9	0	0.957	1.00	8547
Ramp	410	0.95	Level	9	0	0.957	1.00	451
UpStream	590	0.95	Level	9	0	0.957	1.00	649
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 2112 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6838	9600	No
V_{12}	2112	4400:All	No
$V_{FO} = V_F - V_R$	6387	9600	No
V_R	451	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 3.5 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.469 (Exhibit 25-19)

S_R= 56.9 mph (Exhibit 25-19)

S_0= 71.5 mph (Exhibit 25-19)

S = 66.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst2	ZS	Freeway/Dir of Travel	SR-57 NB
Agency or Company	LLG Engineers	Junction	EB On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Project

Project Description AM Year 2030 With Project SR-57 NB EB On-Ramp at Katella

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

Vu = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 1090 ft

VD = 240 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4350	0.95	Level	6	0	0.971	1.00	4716
Ramp	400	0.95	Level	6	0	0.971	1.00	434
UpStream								
DownStream	240	0.95	Level	6	0	0.971	1.00	260

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.323 using Equation 4

V_{12}= 1188 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4113	See Exhibit 25-7	No
V_{R12}	1622	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 14.8 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.306 (Exibit 25-19)

S_R= 61.4 mph (Exhibit 25-19)

S_0= 67.3 mph (Exhibit 25-19)

S= 64.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{Fl}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst2	ZS	Freeway/Dir of Travel	SR-57 NB
Agency or Company	LLG Engineers	Junction	EB On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Project

Project Description PM Year 2030 With Project SR-57 NB EB On-Ramp at Katella

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
Vu = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 1090 ft
VD = 520 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	$f_{HV.}$	f_p	v=V/PHF f_{HV} f_p
Freeway	8410	0.95	Level	6	0	0.971	1.00	9118
Ramp	500	0.95	Level	6	0	0.971	1.00	542
UpStream								
DownStream	520	0.95	Level	6	0	0.971	1.00	564

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.309 using Equation 4

V_{12}= 2047 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7160	See Exhibit 25-7	No
V_{R12}	2589	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 22.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.338 (Exibit 25-19)

S_R= 60.5 mph (Exhibit 25-19)

S_0= 63.6 mph (Exhibit 25-19)

S= 62.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst2	ZS	Freeway/Dir of Travel	SR-57 SB
Agency or Company	LLG Engineers	Junction	WB On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Project

Project Description AM Year 2030 With Project SR-57 SB WB On-Ramp at Katella

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

Vu = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 1015 ft

VD = 180 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7390	0.95	Level	6	0	0.971	1.00	8012
Ramp	260	0.95	Level	6	0	0.971	1.00	282
UpStream								
DownStream	180	0.95	Level	6	0	0.971	1.00	195

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.342 using Equation 4

V_{12}= 2739 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8294	See Exhibit 25-7	No
V_{R12}	3021	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 25.8 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.366 (Exibit 25-19)

S_R= 59.8 mph (Exhibit 25-19)

S_0= 61.5 mph (Exhibit 25-19)

S= 60.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst2	ZS	Freeway/Dir of Travel	SR-57 SB
Agency or Company	LLG Engineers	Junction	WB On-Ramp at Katella
Date Performed	07/14/10	Jurisdiction	Caltrans D12
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Project

Project Description PM Year 2030 With Project SR-57 SB WB On-Ramp at Katella

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
Vu = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 1015 ft
VD = 510 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7570	0.95	Level	6	0	0.971	1.00	8207
Ramp	510	0.95	Level	6	0	0.971	1.00	553
UpStream								
DownStream	510	0.95	Level	6	0	0.971	1.00	553

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM}= 0.308 using Equation 4
V_{12}= 2527 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8760	See Exhibit 25-7	No
V_{R12}	3080	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 26.1 (pc/ m/ln)
LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.371 (Exibit 25-19)
S_R= 59.6 mph (Exhibit 25-19)
S_0= 60.2 mph (Exhibit 25-19)
S= 60.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation
V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)
LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

WEAVING ANALYSIS

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 NB
Weaving Seg Location	Orangewood On to Katella Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.24
Weaving seg length, L (ft)	1360	Weaving ratio, R	0.25
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	4030	0.95	6	0	1.5	1.2	0.971	1.00	4369
Vo2	20	0.95	6	0	1.5	1.2	0.971	1.00	21
Vw1	950	0.95	6	0	1.5	1.2	0.971	1.00	1030
Vw2	320	0.95	6	0	1.5	1.2	0.971	1.00	346
Vw				1376	Vnw				4390
V									5766

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.48	0.23		
Weaving and non-weaving speeds, Si (mi/h)	52.08	59.87		

Number of lanes required for unconstrained operation, Nw 1.43
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	57.80
Weaving segment density, D (pc/mi/ln)	19.95
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	11341
Capacity as a 15-minute flow rate, c (veh/h)	11011
Capacity as a full-hour volume, c_h (veh/h)	10460

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 NB
Weaving Seg Location	Orangewood On to Katella Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.15
Weaving seg length, L (ft)	1360	Weaving ratio, R	0.47
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7750	0.95	6	0	1.5	1.2	0.971	1.00	8402
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	740	0.95	6	0	1.5	1.2	0.971	1.00	802
Vw2	660	0.95	6	0	1.5	1.2	0.971	1.00	715
Vw				1517	Vnw				8434
V									9951

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.60	0.25		
Weaving and non-weaving speeds, Si (mi/h)	49.29	58.90		

Number of lanes required for unconstrained operation, Nw 0.96
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	57.20
Weaving segment density, D (pc/mi/ln)	34.79
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11582
Capacity as a 15-minute flow rate, c (veh/h)	11245
Capacity as a full-hour volume, c_h (veh/h)	10683

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Katella On to Orangewood Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.13
Weaving seg length, L (ft)	1780	Weaving ratio, R	0.16
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	6940	0.95	6	0	1.5	1.2	0.971	1.00	7524
Vo2	10	0.95	6	0	1.5	1.2	0.971	1.00	10
Vw1	860	0.95	6	0	1.5	1.2	0.971	1.00	932
Vw2	170	0.95	6	0	1.5	1.2	0.971	1.00	184
Vw				1116	Vnw				7534
V									8650

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.68	0.34		
Weaving and non-weaving speeds, Si (mi/h)	47.74	56.16		

Number of lanes required for unconstrained operation, Nw 1.22
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	54.91
Weaving segment density, D (pc/mi/ln)	31.50
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11081
Capacity as a 15-minute flow rate, c (veh/h)	10758
Capacity as a full-hour volume, c_h (veh/h)	10220

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Katella On to Orangewood Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.15
Weaving seg length, L (ft)	1780	Weaving ratio, R	0.35
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7750	0.95	6	0	1.5	1.2	0.971	1.00	8402
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	900	0.95	6	0	1.5	1.2	0.971	1.00	975
Vw2	480	0.95	6	0	1.5	1.2	0.971	1.00	520
Vw				1495	Vnw				8434
V									9929

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.81	0.43		
Weaving and non-weaving speeds, Si (mi/h)	45.38	53.36		

Number of lanes required for unconstrained operation, Nw 1.36
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	51.98
Weaving segment density, D (pc/mi/ln)	38.20
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	10925
Capacity as a 15-minute flow rate, c (veh/h)	10607
Capacity as a full-hour volume, c_h (veh/h)	10077

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 NB
Weaving Seg Location	Katella On to Ball Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.22
Weaving seg length, L (ft)	2130	Weaving ratio, R	0.20
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	4000	0.95	6	0	1.5	1.2	0.971	1.00	4336
Vo2	10	0.95	6	0	1.5	1.2	0.971	1.00	10
Vw1	900	0.95	6	0	1.5	1.2	0.971	1.00	975
Vw2	230	0.95	6	0	1.5	1.2	0.971	1.00	249
Vw				1224	Vnw				4346
V									5570

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.36	0.16		
Weaving and non-weaving speeds, Si (mi/h)	55.31	62.46		

Number of lanes required for unconstrained operation, Nw 1.11
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	60.73
Weaving segment density, D (pc/mi/ln)	18.34
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	11600
Capacity as a 15-minute flow rate, c (veh/h)	11262
Capacity as a full-hour volume, c_h (veh/h)	10699

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 NB
Weaving Seg Location	Katella On to Ball Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.15
Weaving seg length, L (ft)	2130	Weaving ratio, R	0.34
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	8370	0.95	6	0	1.5	1.2	0.971	1.00	9074
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	950	0.95	6	0	1.5	1.2	0.971	1.00	1030
Vw2	490	0.95	6	0	1.5	1.2	0.971	1.00	531
Vw				1561	Vnw				9106
V									10667

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.50	0.21		
Weaving and non-weaving speeds, Si (mi/h)	51.65	60.46		

Number of lanes required for unconstrained operation, Nw 0.70
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	58.99
Weaving segment density, D (pc/mi/ln)	36.17
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11750
Capacity as a 15-minute flow rate, c (veh/h)	11408
Capacity as a full-hour volume, c_h (veh/h)	10838

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Ball On to Katella Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	4	Volume ratio, VR	0.20
Weaving seg length, L (ft)	2490	Weaving ratio, R	0.37
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	6750	0.95	6	0	1.5	1.2	0.971	1.00	7318
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	1070	0.95	6	0	1.5	1.2	0.971	1.00	1160
Vw2	640	0.95	6	0	1.5	1.2	0.971	1.00	693
Vw				1853	Vnw				7350
V									9203

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.54	0.28		
Weaving and non-weaving speeds, Si (mi/h)	50.68	58.06		

Number of lanes required for unconstrained operation, Nw 0.75
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	56.41
Weaving segment density, D (pc/mi/ln)	40.79
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	9394
Capacity as a 15-minute flow rate, c (veh/h)	9120
Capacity as a full-hour volume, c_h (veh/h)	8664

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Ball On to Katella Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	4	Volume ratio, VR	0.16
Weaving seg length, L (ft)	2490	Weaving ratio, R	0.42
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7010	0.95	6	0	1.5	1.2	0.971	1.00	7600
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	770	0.95	6	0	1.5	1.2	0.971	1.00	834
Vw2	550	0.95	6	0	1.5	1.2	0.971	1.00	596
Vw				1430	Vnw				7632
V									9062

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.49	0.22		
Weaving and non-weaving speeds, Si (mi/h)	51.82	60.13		

Number of lanes required for unconstrained operation, Nw 0.56
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	58.64
Weaving segment density, D (pc/mi/ln)	38.63
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	9400
Capacity as a 15-minute flow rate, c (veh/h)	9126
Capacity as a full-hour volume, c_h (veh/h)	8670

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.60. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

APPENDIX Q-III

YEAR 2030 WITH PROJECT WITH MITIGATION TRAFFIC CONDITIONS – *CALTRANS FREEWAY RAMP ANALYSIS (HCM METHODOLOGY)*

MERGE/DIVERGE ANALYSIS

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WEAVING ANALYSIS

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Katella On to Orangewood Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project With Mi

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.13
Weaving seg length, L (ft)	1780	Weaving ratio, R	0.16
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	5783	0.95	6	0	1.5	1.2	0.971	1.00	6269
Vo2	8	0.95	6	0	1.5	1.2	0.971	1.00	8
Vw1	717	0.95	6	0	1.5	1.2	0.971	1.00	777
Vw2	142	0.95	6	0	1.5	1.2	0.971	1.00	153
Vw				930	Vnw				6277
V									7207

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.57	0.27		
Weaving and non-weaving speeds, Si (mi/h)	50.04	58.47		

Number of lanes required for unconstrained operation, Nw 1.19
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	57.23
Weaving segment density, D (pc/mi/ln)	25.19
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	11081
Capacity as a 15-minute flow rate, c (veh/h)	10758
Capacity as a full-hour volume, c_h (veh/h)	10220

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Katella On to Orangewood Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project With Mi

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.15
Weaving seg length, L (ft)	1780	Weaving ratio, R	0.35
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	6458	0.95	6	0	1.5	1.2	0.971	1.00	7001
Vo2	25	0.95	6	0	1.5	1.2	0.971	1.00	27
Vw1	750	0.95	6	0	1.5	1.2	0.971	1.00	813
Vw2	400	0.95	6	0	1.5	1.2	0.971	1.00	433
Vw				1246	Vnw				7028
V									8274

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.68	0.34		
Weaving and non-weaving speeds, Si (mi/h)	47.75	55.98		

Number of lanes required for unconstrained operation, Nw 1.33
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	54.56
Weaving segment density, D (pc/mi/ln)	30.33
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	10925
Capacity as a 15-minute flow rate, c (veh/h)	10607
Capacity as a full-hour volume, c_h (veh/h)	10077

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 NB
Weaving Seg Location	Katella On to Ball Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project With Mi

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.22
Weaving seg length, L (ft)	2130	Weaving ratio, R	0.20
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	3333	0.95	6	0	1.5	1.2	0.971	1.00	3613
Vo2	8	0.95	6	0	1.5	1.2	0.971	1.00	8
Vw1	750	0.95	6	0	1.5	1.2	0.971	1.00	813
Vw2	192	0.95	6	0	1.5	1.2	0.971	1.00	208
Vw				1021	Vnw				3621
V									4642

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.32	0.13		
Weaving and non-weaving speeds, Si (mi/h)	56.64	63.56		

Number of lanes required for unconstrained operation, Nw 1.13
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	61.90
Weaving segment density, D (pc/mi/ln)	15.00
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	11599
Capacity as a 15-minute flow rate, c (veh/h)	11261
Capacity as a full-hour volume, c_h (veh/h)	10698

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 NB
Weaving Seg Location	Katella On to Ball Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project With Mi

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.15
Weaving seg length, L (ft)	2130	Weaving ratio, R	0.34
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	6975	0.95	6	0	1.5	1.2	0.971	1.00	7562
Vo2	25	0.95	6	0	1.5	1.2	0.971	1.00	27
Vw1	792	0.95	6	0	1.5	1.2	0.971	1.00	858
Vw2	408	0.95	6	0	1.5	1.2	0.971	1.00	442
Vw				1300	Vnw				7589
V									8889

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.44	0.17		
Weaving and non-weaving speeds, Si (mi/h)	53.17	61.82		

Number of lanes required for unconstrained operation, Nw 0.71
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	60.38
Weaving segment density, D (pc/mi/ln)	29.44
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11750
Capacity as a 15-minute flow rate, c (veh/h)	11408
Capacity as a full-hour volume, c_h (veh/h)	10838

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	AM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Ball On to Katella Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project With Mi

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.20
Weaving seg length, L (ft)	2490	Weaving ratio, R	0.37
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	6750	0.95	6	0	1.5	1.2	0.971	1.00	7318
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	1070	0.95	6	0	1.5	1.2	0.971	1.00	1160
Vw2	640	0.95	6	0	1.5	1.2	0.971	1.00	693
Vw				1853	Vnw				7350
V									9203

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.46	0.22		
Weaving and non-weaving speeds, Si (mi/h)	52.59	60.02		

Number of lanes required for unconstrained operation, Nw 0.94
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	58.36
Weaving segment density, D (pc/mi/ln)	31.54
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11742
Capacity as a 15-minute flow rate, c (veh/h)	11400
Capacity as a full-hour volume, c_h (veh/h)	10830

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	ZS
Agency/Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Weaving Seg Location	Ball On to Katella Off
Jurisdiction	Caltrans D12
Analysis Year	Year 2030 With Project With Mi

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.16
Weaving seg length, L (ft)	2490	Weaving ratio, R	0.42
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7010	0.95	6	0	1.5	1.2	0.971	1.00	7600
Vo2	30	0.95	6	0	1.5	1.2	0.971	1.00	32
Vw1	770	0.95	6	0	1.5	1.2	0.971	1.00	834
Vw2	550	0.95	6	0	1.5	1.2	0.971	1.00	596
Vw				1430	Vnw				7632
V									9062

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.42	0.17		
Weaving and non-weaving speeds, Si (mi/h)	53.67	61.81		

Number of lanes required for unconstrained operation, Nw 0.72
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	60.36
Weaving segment density, D (pc/mi/ln)	30.02
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11750
Capacity as a 15-minute flow rate, c (veh/h)	11408
Capacity as a full-hour volume, c_h (veh/h)	10838

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.