APPENDIX N

YEAR 2013 TRAFFIC CONDITIONS FREEWAY RAMP LEVEL OF SERVICE CALCULATION WORKSHEETS – *CALTRANS FACILITIES ANALYSIS (HCM METHODOLOGY)*

APPENDIX N-I

YEAR 2013 WITHOUT 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 2013 Without Project

Project Description AM Year 2013 Without 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 = 262 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	4828	0.90	Level	9	0	0.957	1.00	5606
Ramp	213	0.90	Level	9	0	0.957	1.00	247
UpStream	262	0.90	Level	9	0	0.957	1.00	304
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM}= 0.346 using Equation 4

V_{12}= 1941 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5853	See Exhibit 25-7	No
V_{R12}	2188	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 = 19.3 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.321 (Exibit 25-19)

S_R= 61.0 mph (Exhibit 25-19)

S_0= 65.2 mph (Exhibit 25-19)

S= 63.6 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	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 2013 Without Project

Project Description PM Year 2013 Without Project I-5 NB On-Ramp at Katella

Site Information

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1400 ft

Vu = 377 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	7471	0.90	Level	9	0	0.957	1.00	8675
Ramp	306	0.90	Level	9	0	0.957	1.00	355
UpStream	377	0.90	Level	9	0	0.957	1.00	438
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM}= 0.333 using Equation 4

V_{12}= 2886 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9030	See Exhibit 25-7	No
V_{R12}	3241	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 = 27.5 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.386 (Exibit 25-19)

S_R= 59.2 mph (Exhibit 25-19)

S_0= 59.9 mph (Exhibit 25-19)

S= 59.7 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?
$V_{FI}=V_F$		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 2013 Without Project

Project Description AMYear 2013 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 = 514 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	5735	0.90	Level	9	0	0.957	1.00	6659
Ramp	626	0.90	Level	9	0	0.957	1.00	727
UpStream	514	0.90	Level	9	0	0.957	1.00	597
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} = 2010 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5661	9600	No
V_{12}	2010	4400:All	No
$V_{FO} = V_F - V_R$	4934	9600	No
V_R	727	3800	No

Level of Service Determination (if not F)

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

D_R = 2.6 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.493 (Exhibit 25-19)

S_R= 56.2 mph (Exhibit 25-19)

S_0= 73.6 mph (Exhibit 25-19)

S = 66.3 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 2013 Without Project

Project Description: PM Year 2013 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 = 474 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	7121	0.90	Level	9	0	0.957	1.00	8268
Ramp	247	0.90	Level	9	0	0.957	1.00	287
UpStream	474	0.90	Level	9	0	0.957	1.00	550
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} = 1932 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6615	9600	No
V_{12}	1932	4400:All	No
$V_{FO} = V_F - V_R$	6328	9600	No
V_R	287	3800	No

Level of Service Determination (if not F)

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

D_R = 2.0 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.454 (Exhibit 25-19)

S_R= 57.3 mph (Exhibit 25-19)

S_0= 71.6 mph (Exhibit 25-19)

S = 66.7 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 2013 Without Project

Project Description AM Year 2013 Without Project SR-57 NB EB 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} = 1090 ft

V_D = 170 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	4087	0.87	Level	6	0	0.971	1.00	4839
Ramp	326	0.87	Level	6	0	0.971	1.00	386
UpStream								
DownStream	170	0.87	Level	6	0	0.971	1.00	201

Merge Areas

Estimation of v_{12}

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

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

P_{FM}= 0.329 using Equation 4

V_{12}= 1591 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5225	See Exhibit 25-7	No
V_{R12}	1977	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 = 17.6 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.314 (Exibit 25-19)

S_R= 61.2 mph (Exhibit 25-19)

S_0= 66.0 mph (Exhibit 25-19)

S= 64.1 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 2013 Without Project

Project Description PM Year 2013 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 = 304 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	7498	0.87	Level	6	0	0.971	1.00	8877
Ramp	467	0.87	Level	6	0	0.971	1.00	553
UpStream								
DownStream	304	0.87	Level	6	0	0.971	1.00	360

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}= 2734 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9430	See Exhibit 25-7	No
V_{R12}	3287	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 = 27.7 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.390 (Exibit 25-19)

S_R= 59.1 mph (Exhibit 25-19)

S_0= 58.8 mph (Exhibit 25-19)

S= 58.9 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 / 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 2013 Without Project

Project Description AM Year 2013 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 = 165 veh/h

Conversion to pc/h Under Base Conditions

	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5922	0.87	Level	6	0	0.971	1.00	7011
Ramp	237	0.87	Level	6	0	0.971	1.00	281
UpStream								
DownStream	165	0.87	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}= 2397 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7292	See Exhibit 25-7	No
V_{R12}	2678	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 = 23.1 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.343 (Exibit 25-19)

S_R= 60.4 mph (Exhibit 25-19)

S_0= 63.4 mph (Exhibit 25-19)

S= 62.3 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
Agency or Company	LLG Engineers
Date Performed	07/14/10
Analysis Time Period	PM Peak Hour

Site Information

Freeway/Dir of Travel	SR-57 SB
Junction	WB On-Ramp at Katella
Jurisdiction	Caltrans D12
Analysis Year	Year 2013 Without Project

Project Description PM Year 2013 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 = 394 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	6890	0.87	Level	6	0	0.971	1.00	8157
Ramp	449	0.87	Level	6	0	0.971	1.00	532
UpStream								
DownStream	394	0.87	Level	6	0	0.971	1.00	466

Merge Areas

Estimation of v_{12}

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

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

P_{FM}= 0.311 using Equation 4

V_{12}= 2533 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8689	See Exhibit 25-7	No
V_{R12}	3065	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 = 26.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.370 (Exibit 25-19)

S_R= 59.7 mph (Exhibit 25-19)

S_0= 60.4 mph (Exhibit 25-19)

S= 60.1 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 2013 Without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.19
Weaving seg length, L (ft)	1360	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	3899	0.87	6	0	1.5	1.2	0.971	1.00	4616
Vo2	12	0.87	6	0	1.5	1.2	0.971	1.00	14
Vw1	754	0.87	6	0	1.5	1.2	0.971	1.00	892
Vw2	189	0.87	6	0	1.5	1.2	0.971	1.00	223
Vw				1115	Vnw				4630
V									5745

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	0.18		
Weaving and non-weaving speeds, Si (mi/h)	53.07	61.59		

Number of lanes required for unconstrained operation, Nw 1.20
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)	59.73
Weaving segment density, D (pc/mi/ln)	19.24
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	11449
Capacity as a 15-minute flow rate, c (veh/h)	11116
Capacity as a full-hour volume, c_h (veh/h)	9671

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 2013 Without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.12
Weaving seg length, L (ft)	1360	Weaving ratio, R	0.38
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	7140	0.87	6	0	1.5	1.2	0.971	1.00	8453
Vo2	15	0.87	6	0	1.5	1.2	0.971	1.00	17
Vw1	590	0.87	6	0	1.5	1.2	0.971	1.00	698
Vw2	359	0.87	6	0	1.5	1.2	0.971	1.00	425
Vw				1123	Vnw				8470
V									9593

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	0.55	0.20		
Weaving and non-weaving speeds, Si (mi/h)	50.49	60.75		

Number of lanes required for unconstrained operation, Nw 0.78
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)	59.34
Weaving segment density, D (pc/mi/ln)	32.33
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11695
Capacity as a 15-minute flow rate, c (veh/h)	11354
Capacity as a full-hour volume, c_h (veh/h)	9878

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 2013 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	0.17
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	5820	0.87	6	0	1.5	1.2	0.971	1.00	6890
Vo2	10	0.87	6	0	1.5	1.2	0.971	1.00	11
Vw1	736	0.87	6	0	1.5	1.2	0.971	1.00	871
Vw2	150	0.87	6	0	1.5	1.2	0.971	1.00	177
Vw				1048	Vnw				6901
V									7949

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	0.63	0.30		
Weaving and non-weaving speeds, Si (mi/h)	48.74	57.17		

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)	55.90
Weaving segment density, D (pc/mi/ln)	28.44
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11061
Capacity as a 15-minute flow rate, c (veh/h)	10739
Capacity as a full-hour volume, c_h (veh/h)	9343

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 2013 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	0.32
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	6923	0.87	6	0	1.5	1.2	0.971	1.00	8196
Vo2	22	0.87	6	0	1.5	1.2	0.971	1.00	26
Vw1	753	0.87	6	0	1.5	1.2	0.971	1.00	891
Vw2	353	0.87	6	0	1.5	1.2	0.971	1.00	417
Vw				1308	Vnw				8222
V									9530

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	0.76	0.39		
Weaving and non-weaving speeds, Si (mi/h)	46.26	54.50		

Number of lanes required for unconstrained operation, Nw 1.28
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)	53.20
Weaving segment density, D (pc/mi/ln)	35.83
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11022
Capacity as a 15-minute flow rate, c (veh/h)	10701
Capacity as a full-hour volume, c_h (veh/h)	9310

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 2013 Without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	4	Volume ratio, VR	0.21
Weaving seg length, L (ft)	2130	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	3691	0.87	6	0	1.5	1.2	0.971	1.00	4369
Vo2	10	0.87	6	0	1.5	1.2	0.971	1.00	11
Vw1	854	0.87	6	0	1.5	1.2	0.971	1.00	1011
Vw2	152	0.87	6	0	1.5	1.2	0.971	1.00	179
Vw				1190	Vnw				4380
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	0.42	0.19		
Weaving and non-weaving speeds, Si (mi/h)	53.70	61.11		

Number of lanes required for unconstrained operation, Nw 0.85
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)	59.36
Weaving segment density, D (pc/mi/ln)	23.46
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	9317
Capacity as a 15-minute flow rate, c (veh/h)	9046
Capacity as a full-hour volume, c_h (veh/h)	7870

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 2013 Without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	4	Volume ratio, VR	0.12
Weaving seg length, L (ft)	2130	Weaving ratio, R	0.26
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	7350	0.87	6	0	1.5	1.2	0.971	1.00	8701
Vo2	15	0.87	6	0	1.5	1.2	0.971	1.00	17
Vw1	726	0.87	6	0	1.5	1.2	0.971	1.00	859
Vw2	258	0.87	6	0	1.5	1.2	0.971	1.00	305
Vw				1164	Vnw				8718
V									9882

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	0.53	0.21		
Weaving and non-weaving speeds, Si (mi/h)	51.06	60.50		

Number of lanes required for unconstrained operation, Nw 0.43
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)	59.21
Weaving segment density, D (pc/mi/ln)	41.72
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)	7940

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 2013 Without Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	4	Volume ratio, VR	0.21
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	5313	0.87	6	0	1.5	1.2	0.971	1.00	6290
Vo2	30	0.87	6	0	1.5	1.2	0.971	1.00	35
Vw1	850	0.87	6	0	1.5	1.2	0.971	1.00	1006
Vw2	609	0.87	6	0	1.5	1.2	0.971	1.00	721
Vw				1727	Vnw				6325
V									8052

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	0.51	0.26		
Weaving and non-weaving speeds, Si (mi/h)	51.54	58.69		

Number of lanes required for unconstrained operation, Nw 0.81
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)	56.99
Weaving segment density, D (pc/mi/ln)	35.32
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	9331
Capacity as a 15-minute flow rate, c (veh/h)	9059
Capacity as a full-hour volume, c_h (veh/h)	7881

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 2013 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	0.43
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	6376	0.87	6	0	1.5	1.2	0.971	1.00	7548
Vo2	30	0.87	6	0	1.5	1.2	0.971	1.00	35
Vw1	680	0.87	6	0	1.5	1.2	0.971	1.00	805
Vw2	511	0.87	6	0	1.5	1.2	0.971	1.00	604
Vw				1409	Vnw				7583
V									8992

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)	51.91	60.24		

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)	58.76
Weaving segment density, D (pc/mi/ln)	38.26
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)	7940

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 N-II

YEAR 2013 WITH 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 2013 With Project

Project Description AM Year 2013 With Project I-5 NB On-Ramp at Katella

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1400 ft

Vu = 262 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	4828	0.90	Level	9	0	0.957	1.00	5606
Ramp	217	0.90	Level	9	0	0.957	1.00	252
UpStream	262	0.90	Level	9	0	0.957	1.00	304
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM}= 0.346 using Equation 4

V_{12}= 1937 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5858	See Exhibit 25-7	No
V_{R12}	2189	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 = 19.3 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.321 (Exibit 25-19)

S_R= 61.0 mph (Exhibit 25-19)

S_0= 65.2 mph (Exhibit 25-19)

S= 63.6 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 2013 With Project

Project Description PM Year 2013 With Project I-5 NB On-Ramp at Katella

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1400 ft

V_u = 377 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	7471	0.90	Level	9	0	0.957	1.00	8675
Ramp	321	0.90	Level	9	0	0.957	1.00	373
UpStream	377	0.90	Level	9	0	0.957	1.00	438
DownStream								

Merge Areas

Estimation of v_{12}

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

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

P_{FM}= 0.330 using Equation 4

V_{12}= 2867 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9048	See Exhibit 25-7	No
V_{R12}	3240	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 = 27.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.386 (Exibit 25-19)

S_R= 59.2 mph (Exhibit 25-19)

S_0= 59.8 mph (Exhibit 25-19)

S= 59.6 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 2013 With Project

Project Description: AM Year 2013 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		L_{down} = ft
Vu = 514 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	5735	0.90	Level	9	0	0.957	1.00	6659
Ramp	647	0.90	Level	9	0	0.957	1.00	751
UpStream	514	0.90	Level	9	0	0.957	1.00	597
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} = 2028 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5661	9600	No
V_{12}	2028	4400:All	No
$V_{FO} = V_F - V_R$	4910	9600	No
V_R	751	3800	No

Level of Service Determination (if not F)

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

D_R = 2.8 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.496 (Exhibit 25-19)

S_R= 56.1 mph (Exhibit 25-19)

S_0= 73.6 mph (Exhibit 25-19)

S = 66.2 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 2013 With Project

Project Description: PM Year 2013 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 = 474 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	7121	0.90	Level	9	0	0.957	1.00	8268
Ramp	250	0.90	Level	9	0	0.957	1.00	290
UpStream	474	0.90	Level	9	0	0.957	1.00	550
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} = 1934 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6615	9600	No
V_{12}	1934	4400:All	No
$V_{FO} = V_F - V_R$	6325	9600	No
V_R	290	3800	No

Level of Service Determination (if not F)

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

D_R = 2.0 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.454 (Exhibit 25-19)

S_R= 57.3 mph (Exhibit 25-19)

S_0= 71.6 mph (Exhibit 25-19)

S = 66.7 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 2013 With Project

Project Description AM Year 2013 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 = 170 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	4087	0.87	Level	6	0	0.971	1.00	4839
Ramp	311	0.87	Level	6	0	0.971	1.00	368
UpStream								
DownStream	170	0.87	Level	6	0	0.971	1.00	201

Merge Areas

Estimation of v_{12}

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

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

P_{FM}= 0.331 using Equation 4

V_{12}= 1602 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5207	See Exhibit 25-7	No
V_{R12}	1970	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 = 17.5 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.314 (Exibit 25-19)

S_R= 61.2 mph (Exhibit 25-19)

S_0= 66.0 mph (Exhibit 25-19)

S= 64.1 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 2013 With Project

Project Description PM Year 2013 With Project SR-57 NB EB 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} = 1090 ft
V_D = 304 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	7498	0.87	Level	6	0	0.971	1.00	8877
Ramp	444	0.87	Level	6	0	0.971	1.00	526
UpStream								
DownStream	304	0.87	Level	6	0	0.971	1.00	360

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM}= 0.311 using Equation 4
V_{12}= 2764 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9403	See Exhibit 25-7	No
V_{R12}	3290	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 = 27.8 (pc/ m/ln)
LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.391 (Exibit 25-19)
S_R= 59.1 mph (Exhibit 25-19)
S_0= 58.9 mph (Exhibit 25-19)
S= 59.0 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)

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 2013 With Project

Project Description AM Year 2013 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 = 165 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	5922	0.87	Level	6	0	0.971	1.00	7011
Ramp	268	0.87	Level	6	0	0.971	1.00	317
UpStream								
DownStream	165	0.87	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}= 0.337 using Equation 4

V_{12}= 2366 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7328	See Exhibit 25-7	No
V_{R12}	2683	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 = 23.1 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.343 (Exibit 25-19)

S_R= 60.4 mph (Exhibit 25-19)

S_0= 63.3 mph (Exhibit 25-19)

S= 62.2 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?
$V_{FI}=V_F$		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	PM Peak Hour	Analysis Year	Year 2013 With Project

Project Description PM Year 2013 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 = 394 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	6890	0.87	Level	6	0	0.971	1.00	8157
Ramp	547	0.87	Level	6	0	0.971	1.00	648
UpStream								
DownStream	394	0.87	Level	6	0	0.971	1.00	466

Merge Areas

Estimation of v_{12}

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

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

P_{FM}= 0.296 using Equation 4

V_{12}= 2415 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8805	See Exhibit 25-7	No
V_{R12}	3063	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 = 25.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.369 (Exibit 25-19)

S_R= 59.7 mph (Exhibit 25-19)

S_0= 60.0 mph (Exhibit 25-19)

S= 59.9 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?
$V_{Ff}=V_F$		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 2013 With 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)	1360	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	3899	0.87	6	0	1.5	1.2	0.971	1.00	4616
Vo2	12	0.87	6	0	1.5	1.2	0.971	1.00	14
Vw1	869	0.87	6	0	1.5	1.2	0.971	1.00	1028
Vw2	189	0.87	6	0	1.5	1.2	0.971	1.00	223
Vw				1251	Vnw				4630
V									5881

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	0.47	0.20		
Weaving and non-weaving speeds, Si (mi/h)	52.47	60.72		

Number of lanes required for unconstrained operation, Nw 1.29
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)	20.02
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	11401
Capacity as a 15-minute flow rate, c (veh/h)	11069
Capacity as a full-hour volume, c_h (veh/h)	9630

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 2013 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65		
Weaving number of lanes, N	5	Weaving type	B
Weaving seg length, L (ft)	1360	Volume ratio, VR	0.12
Terrain	Level	Weaving ratio, R	0.37

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7140	0.87	6	0	1.5	1.2	0.971	1.00	8453
Vo2	15	0.87	6	0	1.5	1.2	0.971	1.00	17
Vw1	602	0.87	6	0	1.5	1.2	0.971	1.00	712
Vw2	359	0.87	6	0	1.5	1.2	0.971	1.00	425
Vw				1137	Vnw				8470
V									9607

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	0.55	0.20		
Weaving and non-weaving speeds, Si (mi/h)	50.44	60.69		

Number of lanes required for unconstrained operation, Nw 0.78
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)	59.26
Weaving segment density, D (pc/mi/ln)	32.42
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11691
Capacity as a 15-minute flow rate, c (veh/h)	11350
Capacity as a full-hour volume, c_h (veh/h)	9875

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 2013 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	0.19
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	5820	0.87	6	0	1.5	1.2	0.971	1.00	6890
Vo2	10	0.87	6	0	1.5	1.2	0.971	1.00	11
Vw1	736	0.87	6	0	1.5	1.2	0.971	1.00	871
Vw2	172	0.87	6	0	1.5	1.2	0.971	1.00	203
Vw				1074	Vnw				6901
V									7975

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	0.64	0.31		
Weaving and non-weaving speeds, Si (mi/h)	48.63	57.03		

Number of lanes required for unconstrained operation, Nw 1.24
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)	55.73
Weaving segment density, D (pc/mi/ln)	28.62
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11040
Capacity as a 15-minute flow rate, c (veh/h)	10718
Capacity as a full-hour volume, c_h (veh/h)	9325

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 2013 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	0.37
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	6923	0.87	6	0	1.5	1.2	0.971	1.00	8196
Vo2	22	0.87	6	0	1.5	1.2	0.971	1.00	26
Vw1	753	0.87	6	0	1.5	1.2	0.971	1.00	891
Vw2	437	0.87	6	0	1.5	1.2	0.971	1.00	517
Vw				1408	Vnw				8222
V									9630

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	0.78	0.41		
Weaving and non-weaving speeds, Si (mi/h)	45.89	53.99		

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)	52.63
Weaving segment density, D (pc/mi/ln)	36.59
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	10957
Capacity as a 15-minute flow rate, c (veh/h)	10638
Capacity as a full-hour volume, c_h (veh/h)	9255

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 2013 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	4	Volume ratio, VR	0.22
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	3691	0.87	6	0	1.5	1.2	0.971	1.00	4369
Vo2	10	0.87	6	0	1.5	1.2	0.971	1.00	11
Vw1	854	0.87	6	0	1.5	1.2	0.971	1.00	1011
Vw2	188	0.87	6	0	1.5	1.2	0.971	1.00	222
Vw				1233	Vnw				4380
V									5613

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	0.43	0.20		
Weaving and non-weaving speeds, Si (mi/h)	53.51	60.83		

Number of lanes required for unconstrained operation, Nw 0.87
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)	59.05
Weaving segment density, D (pc/mi/ln)	23.76
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	9280
Capacity as a 15-minute flow rate, c (veh/h)	9010
Capacity as a full-hour volume, c_h (veh/h)	7839

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 2013 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	4	Volume ratio, VR	0.13
Weaving seg length, L (ft)	2130	Weaving ratio, R	0.35
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	7350	0.87	6	0	1.5	1.2	0.971	1.00	8701
Vo2	15	0.87	6	0	1.5	1.2	0.971	1.00	17
Vw1	726	0.87	6	0	1.5	1.2	0.971	1.00	859
Vw2	396	0.87	6	0	1.5	1.2	0.971	1.00	468
Vw				1327	Vnw				8718
V									10045

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	0.55	0.23		
Weaving and non-weaving speeds, Si (mi/h)	50.57	59.75		

Number of lanes required for unconstrained operation, Nw 0.49
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)	58.35
Weaving segment density, D (pc/mi/ln)	43.04
Level of service, LOS	F
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)	7940

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 2013 With Project

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	B
Weaving number of lanes, N	4	Volume ratio, VR	0.24
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	5313	0.87	6	0	1.5	1.2	0.971	1.00	6290
Vo2	30	0.87	6	0	1.5	1.2	0.971	1.00	35
Vw1	1038	0.87	6	0	1.5	1.2	0.971	1.00	1228
Vw2	609	0.87	6	0	1.5	1.2	0.971	1.00	721
Vw				1949	Vnw				6325
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)	0.08	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	0.53	0.29		
Weaving and non-weaving speeds, Si (mi/h)	50.84	57.47		

Number of lanes required for unconstrained operation, Nw 0.90
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)	55.76
Weaving segment density, D (pc/mi/ln)	37.10
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	9232
Capacity as a 15-minute flow rate, c (veh/h)	8963
Capacity as a full-hour volume, c_h (veh/h)	7798

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 2013 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	6376	0.87	6	0	1.5	1.2	0.971	1.00	7548
Vo2	30	0.87	6	0	1.5	1.2	0.971	1.00	35
Vw1	701	0.87	6	0	1.5	1.2	0.971	1.00	829
Vw2	511	0.87	6	0	1.5	1.2	0.971	1.00	604
Vw				1433	Vnw				7583
V									9016

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)	51.83	60.12		

Number of lanes required for unconstrained operation, Nw 0.57
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)	58.63
Weaving segment density, D (pc/mi/ln)	38.44
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)	7940

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 N-III

YEAR 2013 WITH PROJECT WITH MITIGATION TRAFFIC CONDITIONS – *CALTRANS FREEWAY RAMP ANALYSIS (HCM METHODOLOGY)*

MERGE/DIVERGE ANALYSIS

THIS PAGE LEFT BLANK INTENTIONALLY

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 2013 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	0.19
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	4850	0.87	6	0	1.5	1.2	0.971	1.00	5741
Vo2	8	0.87	6	0	1.5	1.2	0.971	1.00	9
Vw1	613	0.87	6	0	1.5	1.2	0.971	1.00	725
Vw2	143	0.87	6	0	1.5	1.2	0.971	1.00	169
Vw				894	Vnw				5750
V									6644

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	0.53	0.24		
Weaving and non-weaving speeds, Si (mi/h)	50.89	59.24		

Number of lanes required for unconstrained operation, Nw 1.21
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)	57.96
Weaving segment density, D (pc/mi/ln)	22.93
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	11041
Capacity as a 15-minute flow rate, c (veh/h)	10719
Capacity as a full-hour volume, c_h (veh/h)	9326

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 2013 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	0.37
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	5769	0.87	6	0	1.5	1.2	0.971	1.00	6829
Vo2	18	0.87	6	0	1.5	1.2	0.971	1.00	21
Vw1	628	0.87	6	0	1.5	1.2	0.971	1.00	743
Vw2	364	0.87	6	0	1.5	1.2	0.971	1.00	430
Vw				1173	Vnw				6850
V									8023

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	0.65	0.32		
Weaving and non-weaving speeds, Si (mi/h)	48.26	56.55		

Number of lanes required for unconstrained operation, Nw 1.30
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)	55.16
Weaving segment density, D (pc/mi/ln)	29.09
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	10957
Capacity as a 15-minute flow rate, c (veh/h)	10638
Capacity as a full-hour volume, c_h (veh/h)	9255

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 2013 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	0.18
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	3691	0.87	6	0	1.5	1.2	0.971	1.00	4369
Vo2	10	0.87	6	0	1.5	1.2	0.971	1.00	11
Vw1	854	0.87	6	0	1.5	1.2	0.971	1.00	1011
Vw2	188	0.87	6	0	1.5	1.2	0.971	1.00	222
Vw				1233	Vnw				4380
V									5613

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	0.37	0.16		
Weaving and non-weaving speeds, Si (mi/h)	55.26	62.41		

Number of lanes required for unconstrained operation, Nw 1.10
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)	60.68
Weaving segment density, D (pc/mi/ln)	18.50
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	11601
Capacity as a 15-minute flow rate, c (veh/h)	11263
Capacity as a full-hour volume, c_h (veh/h)	9799

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 2013 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	0.13
Weaving seg length, L (ft)	2130	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	7350	0.87	6	0	1.5	1.2	0.971	1.00	8701
Vo2	15	0.87	6	0	1.5	1.2	0.971	1.00	17
Vw1	726	0.87	6	0	1.5	1.2	0.971	1.00	859
Vw2	396	0.87	6	0	1.5	1.2	0.971	1.00	468
Vw				1327	Vnw				8718
V									10045

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	0.47	0.18		
Weaving and non-weaving speeds, Si (mi/h)	52.49	61.48		

Number of lanes required for unconstrained operation, Nw 0.63
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)	60.12
Weaving segment density, D (pc/mi/ln)	33.42
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)	9925

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 2013 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	0.24
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	5313	0.87	6	0	1.5	1.2	0.971	1.00	6290
Vo2	30	0.87	6	0	1.5	1.2	0.971	1.00	35
Vw1	1038	0.87	6	0	1.5	1.2	0.971	1.00	1228
Vw2	609	0.87	6	0	1.5	1.2	0.971	1.00	721
Vw				1949	Vnw				6325
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)	0.08	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	0.24		
Weaving and non-weaving speeds, Si (mi/h)	52.74	59.50		

Number of lanes required for unconstrained operation, Nw 1.12
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)	57.76
Weaving segment density, D (pc/mi/ln)	28.65
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11542
Capacity as a 15-minute flow rate, c (veh/h)	11206
Capacity as a full-hour volume, c_h (veh/h)	9749

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 2013 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	6376	0.87	6	0	1.5	1.2	0.971	1.00	7548
Vo2	30	0.87	6	0	1.5	1.2	0.971	1.00	35
Vw1	701	0.87	6	0	1.5	1.2	0.971	1.00	829
Vw2	511	0.87	6	0	1.5	1.2	0.971	1.00	604
Vw				1433	Vnw				7583
V									9016

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	0.18		
Weaving and non-weaving speeds, Si (mi/h)	53.68	61.80		

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)	60.35
Weaving segment density, D (pc/mi/ln)	29.88
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)	9925

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.