RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst	JRE	Freeway/Dir of Travel	I-80 Eastbound
Agency or Company	AECOM	Junction	Int. 303 to Route 611
Date Performed	9/11/2014	Jurisdiction	
Analysis Time Period	A.M. Peak Hour	Analysis Year	Alt B1 Ph II 2045
Project Description	Interstate 80 Reconstruction		

Inputs

Upstream Adj Ramp					Downstream Adj Ramp	
☐ Yes	☐ On	Number of Lanes, N	2		☑ Yes	☑ On
		Acceleration Lane Length, L_A				
☑ No	☐ Off	Deceleration Lane Length L_D	1000		☐ No	☐ Off
		Freeway Volume, V_F	2689			
$L_{up} =$ ft		Ramp Volume, V_R	557		$L_{down} =$	1500 ft
		Freeway Free-Flow Speed, S_{FF}	70.0			
$V_u =$ veh/h		Ramp Free-Flow Speed, S_{FR}	35.0		$V_D =$	170 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2689	0.94	Rolling	10	1	0.862	0.95	3493
Ramp	557	0.72	Rolling	1	0	0.985	0.95	827
UpStream								
DownStream	170	0.72	Rolling	1	0	0.985	0.95	252

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge) / Estimation of v_{12} (Diverge)

Merge:

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

$L_{EQ} =$ (Equation 13-6 or 13-7)

$P_{FM} =$ using Equation (Exhibit 13-6)

$V_{12} =$ pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)

Diverge:

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

$L_{EQ} =$ (Equation 13-12 or 13-13)

$P_{FD} =$ 1.000 using Equation (Exhibit 13-7)

$V_{12} =$ 3493 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

Merge:

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Diverge:

	Actual	Capacity		LOS F?
V_F	3493	Exhibit 13-8	4800	No
$V_{FO} = V_F - V_R$	2666	Exhibit 13-8	4800	No
V_R	827	Exhibit 13-10	4000	No

Flow Entering Merge Influence Area / Flow Entering Diverge Influence Area

Merge:

	Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8	

Diverge:

	Actual	Max Desirable	Violation?
V_{12}	3493	Exhibit 13-8 4400:All	No

Level of Service Determination (if not F)

Merge:

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

$D_R =$ (pc/mi/ln)

LOS = (Exhibit 13-2)

Diverge:

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

$D_R =$ 2.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

Merge:

$M_S =$ (Exibit 13-11)

$S_R =$ mph (Exhibit 13-11)

$S_0 =$ mph (Exhibit 13-11)

$S =$ mph (Exhibit 13-13)

Diverge:

$D_s =$ 0.502 (Exhibit 13-12)

$S_R =$ 55.9 mph (Exhibit 13-12)

$S_0 =$ N/A mph (Exhibit 13-12)

$S =$ 55.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information   Site Information

Analyst	AJM	Freeway/Dir of Travel	I-80 Eastbound
Agency or Company	AECOM	Junction	Int. 303 to Rt 611, 209 & Main
Date Performed	7/31/2013	Jurisdiction	
Analysis Time Period	P.M. Peak Hour	Analysis Year	Alt 2B 2045

Project Description   Interstate 80 Reconstruction

Inputs

Upstream Adj Ramp			Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N	2	☑ Yes ☑ On
	Acceleration Lane Length, L_A		
☑ No ☐ Off	Deceleration Lane Length L_D	1000	☐ No ☐ Off
	Freeway Volume, V_F	3390	
L_{up} = ft	Ramp Volume, V_R	731	L_{down} = 1750 ft
	Freeway Free-Flow Speed, S_{FF}	70.0	
V_u = veh/h	Ramp Free-Flow Speed, S_{FR}	35.0	V_D = 239 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3390	0.94	Rolling	12	1	0.840	0.95	4517
Ramp	731	0.97	Rolling	1	0	0.985	0.95	805
UpStream								
DownStream	239	0.97	Rolling	1	0	0.985	0.95	263

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge) | ### Estimation of v_{12} (Diverge)

Merge Areas	Diverge Areas
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = using Equation (Exhibit 13-6)	P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = pc/h	V_{12} = 4517 pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks | ### Capacity Checks

	Actual	Capacity		LOS F?		Actual	Capacity		LOS F?
					V_F	4517	Exhibit 13-8	4800	No
V_{FO}		Exhibit 13-8			$V_{FO} = V_F - V_R$	3712	Exhibit 13-8	4800	No
					V_R	805	Exhibit 13-10	4000	No

Flow Entering Merge Influence Area | ### Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?		Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8		V_{12}	4517	Exhibit 13-8 4400:All	Yes

Level of Service Determination (if not F) | ### Level of Service Determination (if not F)

Merge	Diverge
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/mi/ln)	D_R = 11.6 (pc/mi/ln)
LOS = (Exhibit 13-2)	LOS = B (Exhibit 13-2)

Speed Determination | ### Speed Determination

Merge	Diverge
M_S = (Exibit 13-11)	D_s = 0.500 (Exhibit 13-12)
S_R = mph (Exhibit 13-11)	S_R = 56.0 mph (Exhibit 13-12)
S_0 = mph (Exhibit 13-11)	S_0 = N/A mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 56.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	JRE	Freeway/Dir of Travel	I-80 Eastbound
Agency or Company	AECOM	Junction	Int. 307 to Route 611
Date Performed	9/11/2014	Jurisdiction	
Analysis Time Period	A.M. Peak Hour	Analysis Year	Alt B1 Ph II 2045
Project Description	Interstate 80 Reconstruction		

Inputs

Upstream Adj Ramp			
☑ Yes	☑ On		
☐ No	☐ Off		
L_{up} =	3200 ft		
V_u =	434 veh/h		

Number of Lanes, N — 3
Acceleration Lane Length, L_A
Deceleration Lane Length L_D — 750
Freeway Volume, V_F — 4204
Ramp Volume, V_R — 718
Freeway Free-Flow Speed, S_{FF} — 70.0
Ramp Free-Flow Speed, S_{FR} — 35.0

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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4204	0.94	Rolling	10	1	0.862	0.95	5461
Ramp	718	0.72	Rolling	1	0	0.985	0.95	1065
UpStream	434	0.72	Rolling	1	0	0.985	0.95	644
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12}

Merge Areas

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

L_{EQ} =   (Equation 13-6 or 13-7)
P_{FM} =   using Equation   (Exhibit 13-6)
V_{12} =   pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} =   pc/h (Equation 13-16, 13-18, or 13-19)

Diverge Areas

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

L_{EQ} =   5567.90 (Equation 13-12 or 13-13)
P_{FD} =   0.626 using Equation (Exhibit 13-7)
V_{12} =   3815 pc/h
V_3 or V_{av34} 1646 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} =   pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

Merge Areas

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Diverge Areas

	Actual	Capacity		LOS F?
V_F	5461	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	4396	Exhibit 13-8	7200	No
V_R	1065	Exhibit 13-10	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}	3815	Exhibit 13-8 4400:All	No

Level of Service Determination (if not F)

Merge Areas

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

D_R =   (pc/mi/ln)
LOS =   (Exhibit 13-2)

Diverge Areas

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

D_R =   30.3 (pc/mi/ln)
LOS =   D (Exhibit 13-2)

Speed Determination

Merge Areas

M_S =   (Exibit 13-11)
S_R =   mph (Exhibit 13-11)
S_0 =   mph (Exhibit 13-11)
S =   mph (Exhibit 13-13)

Diverge Areas

D_s =   0.524 (Exhibit 13-12)
S_R =   55.3 mph (Exhibit 13-12)
S_0 =   74.3 mph (Exhibit 13-12)
S =   59.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst	JRE	Freeway/Dir of Travel	I-80 Eastbound
Agency or Company	AECOM	Junction	Int. 307 to Route 611
Date Performed	9/11/2014	Jurisdiction	
Analysis Time Period	P.M. Peak Hour	Analysis Year	Alt B1 Ph II 2045
Project Description	Interstate 80 Reconstruction		

Inputs

Upstream Adj Ramp			Downstream Adj Ramp
☑ Yes ☑ On	Number of Lanes, N	3	☐ Yes ☐ On
	Acceleration Lane Length, L_A		
☐ No ☐ Off	Deceleration Lane Length L_D	750	☑ No ☐ Off
	Freeway Volume, V_F	4686	
L_{up} = 3200 ft	Ramp Volume, V_R	648	L_{down} = ft
	Freeway Free-Flow Speed, S_{FF}	70.0	
V_u = 454 veh/h	Ramp Free-Flow Speed, S_{FR}	35.0	V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4686	0.94	Rolling	12	1	0.840	0.95	6245
Ramp	648	0.97	Rolling	1	0	0.985	0.95	714
UpStream	454	0.97	Rolling	1	0	0.985	0.95	500
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge) / Estimation of v_{12} (Diverge)

Merge	Diverge
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 13-6 or 13-7)	L_{EQ} = 3117.77 (Equation 13-12 or 13-13)
P_{FM} = using Equation (Exhibit 13-6)	P_{FD} = 0.571 using Equation (Exhibit 13-7)
V_{12} = pc/h	V_{12} = 3872 pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} 2373 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

Merge

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Diverge

	Actual	Capacity		LOS F?
V_F	6245	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	5531	Exhibit 13-8	7200	No
V_R	714	Exhibit 13-10	2000	No

Flow Entering Merge Influence Area / Flow Entering Diverge Influence Area

Merge

	Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8	

Diverge

	Actual	Max Desirable	Violation?
V_{12}	3872	Exhibit 13-8 4400:All	No

Level of Service Determination (if not F)

Merge

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

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Diverge

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

D_R = 30.8 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

Merge

M_S = (Exibit 13-11)

S_R = mph (Exhibit 13-11)

S_0 = mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge

D_s = 0.492 (Exhibit 13-12)

S_R = 56.2 mph (Exhibit 13-12)

S_0 = 71.4 mph (Exhibit 13-12)

S = 61.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	JRE	Freeway/Dir of Travel	I-80 Westbound
Agency or Company	AECOM	Junction	Int. 304 to Rt 209
Date Performed	9/11/2014	Jurisdiction	
Analysis Time Period	A.M. Peak Hour	Analysis Year	Alt D1 Ph II 2045
Project Description	Interstate 80 Reconstruction		

Inputs

Upstream Adj Ramp			Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N	4	
	Acceleration Lane Length, L_A		☑ Yes ☑ On
☑ No ☐ Off	Deceleration Lane Length L_D	250	
	Freeway Volume, V_F	3206	☐ No ☐ Off
$L_{up} =$ ft	Ramp Volume, V_R	1129	$L_{down} =$ 3000 ft
	Freeway Free-Flow Speed, S_{FF}	70.0	
$V_u =$ veh/h	Ramp Free-Flow Speed, S_{FR}	35.0	$V_D =$ 196 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3206	0.93	Rolling	12	1	0.840	0.95	4318
Ramp	1129	0.84	Rolling	1	0	0.985	0.95	1436
UpStream								
DownStream	196	0.84	Rolling	1	0	0.985	0.95	249

Merge Areas	Diverge Areas

Estimation of v_{12} / Estimation of v_{12}

Merge	Diverge
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
$L_{EQ} =$ (Equation 13-6 or 13-7)	$L_{EQ} =$ (Equation 13-12 or 13-13)
$P_{FM} =$ using Equation (Exhibit 13-6)	$P_{FD} =$ 0.260 using Equation (Exhibit 13-7)
$V_{12} =$ pc/h	$V_{12} =$ 2185 pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} 1066 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)	If Yes, $V_{12a} =$ pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks / Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

	Actual	Capacity		LOS F?
V_F	4318	Exhibit 13-8	9600	No
$V_{FO} = V_F - V_R$	2882	Exhibit 13-8	9600	No
V_R	1436	Exhibit 13-10	4000	No

Flow Entering Merge Influence Area / Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8	

	Actual	Max Desirable	Violation?
V_{12}	2185	Exhibit 13-8 4400:All	No

Level of Service Determination (if not F) / Level of Service Determination (if not F)

Merge	Diverge
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
$D_R =$ (pc/mi/ln)	$D_R =$ 5.0 (pc/mi/ln)
LOS = (Exhibit 13-2)	LOS = A (Exhibit 13-2)

Speed Determination / Speed Determination

Merge	Diverge
$M_S =$ (Exibit 13-11)	$D_s =$ 0.557 (Exhibit 13-12)
$S_R =$ mph (Exhibit 13-11)	$S_R =$ 54.4 mph (Exhibit 13-12)
$S_0 =$ mph (Exhibit 13-11)	$S_0 =$ 76.5 mph (Exhibit 13-12)
$S =$ mph (Exhibit 13-13)	$S =$ 63.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information | Site Information

General Information		Site Information	
Analyst	JRE	Freeway/Dir of Travel	I-80 Westbound
Agency or Company	AECOM	Junction	Int. 304 to Rt 209
Date Performed	9/11/2014	Jurisdiction	
Analysis Time Period	P.M. Peak Hour	Analysis Year	Alt B1 Ph II 2045

Project Description	Interstate 80 Reconstruction

Inputs

Upstream Adj Ramp
- ☑ Yes   ☐ On
- ☐ No   ☑ Off

L_{up} = 3000 ft

V_u = 377 veh/h

Number of Lanes, N	4	
Acceleration Lane Length, L_A		
Deceleration Lane Length L_D	250	
Freeway Volume, V_F	6672	
Ramp Volume, V_R	2205	
Freeway Free-Flow Speed, S_{FF}	70.0	
Ramp Free-Flow Speed, S_{FR}	35.0	

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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	6672	0.96	Rolling	13	1	0.830	0.95	8816
Ramp	2205	0.90	Rolling	1	0	0.985	0.95	2618
UpStream	377	0.90	Rolling	1	0	0.985	0.95	448
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12}

Merge:

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

L_{EQ} =   (Equation 13-6 or 13-7)
P_{FM} =   using Equation (Exhibit 13-6)
V_{12} =   pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} =   pc/h (Equation 13-16, 13-18, or 13-19)

Diverge:

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

L_{EQ} =   (Equation 13-12 or 13-13)
P_{FD} =   0.260 using Equation (Exhibit 13-7)
V_{12} =   4229 pc/h
V_3 or V_{av34} 2293 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} =   pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

Merge:

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Diverge:

	Actual	Capacity		LOS F?
V_F	8816	Exhibit 13-8	9600	No
$V_{FO} = V_F - V_R$	6198	Exhibit 13-8	9600	No
V_R	2618	Exhibit 13-10	4000	No

Flow Entering Merge Influence Area | Flow Entering Diverge Influence Area

Merge:

	Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8	

Diverge:

	Actual	Max Desirable	Violation?
V_{12}	4229	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

Merge:

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

D_R =   (pc/mi/ln)
LOS =   (Exhibit 13-2)

Diverge:

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

D_R =   22.6 (pc/mi/ln)
LOS =   C (Exhibit 13-2)

Speed Determination

Merge:

M_S =   (Exibit 13-11)
S_R =   mph (Exhibit 13-11)
S_0 =   mph (Exhibit 13-11)
S =   mph (Exhibit 13-13)

Diverge:

D_s =   0.664 (Exhibit 13-12)
S_R =   51.4 mph (Exhibit 13-12)
S_0 =   71.7 mph (Exhibit 13-12)
S =   60.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst	JRE	Freeway/Dir of Travel	I-80 Westbound
Agency or Company	AECOM	Junction	Int. 305 to Main St
Date Performed	9/11/14	Jurisdiction	
Analysis Time Period	A.M. Peak Hour	Analysis Year	Alt B1 Ph II 2045
Project Description	Interstate 80 Reconstruction		

Inputs

Upstream Adj Ramp			Downstream Adj Ramp	
☐ Yes ☐ On	Number of Lanes, N	4	☑ Yes	☑ On
	Acceleration Lane Length, L_A			
☑ No ☐ Off	Deceleration Lane Length L_D	750	☐ No	☐ Off
	Freeway Volume, V_F	3206		
L_{up} = ft	Ramp Volume, V_R	279	L_{down} = 3000 ft	
	Freeway Free-Flow Speed, S_{FF}	70.0		
V_u = veh/h	Ramp Free-Flow Speed, S_{FR}	35.0	V_D = 196 veh/h	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3206	0.93	Rolling	12	1	0.840	0.95	4318
Ramp	279	0.84	Rolling	1	0	0.985	0.95	355
UpStream								
DownStream	196	0.84	Rolling	1	0	0.985	0.95	249

Merge Areas	**Diverge Areas**

Estimation of v_{12}	*Estimation of v_{12}*
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = using Equation (Exhibit 13-6)	P_{FD} = 0.436 using Equation (Exhibit 13-7)
V_{12} = pc/h	V_{12} = 2083 pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} 1117 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Capacity Checks				
	Actual	Capacity		LOS F?
V_F	4318	Exhibit 13-8	9600	No
$V_{FO} = V_F - V_R$	3963	Exhibit 13-8	9600	No
V_R	355	Exhibit 13-10	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}	2083	Exhibit 13-8 4400:All	No

Level of Service Determination (if not F)

Merge	Diverge
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/mi/ln)	D_R = 15.4 (pc/mi/ln)
LOS = (Exhibit 13-2)	LOS = B (Exhibit 13-2)

Speed Determination

Merge	Diverge
M_S = (Exibit 13-11)	D_s = 0.460 (Exhibit 13-12)
S_R = mph (Exhibit 13-11)	S_R = 57.1 mph (Exhibit 13-12)
S_0 = mph (Exhibit 13-11)	S_0 = 76.3 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 65.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	JRE	Freeway/Dir of Travel	I-80 Westbound
Agency or Company	AECOM	Junction	Int. 305 to Main St
Date Performed	9/11/2014	Jurisdiction	
Analysis Time Period	P.M. Peak Hour	Analysis Year	Alt B1 Ph II 2045
Project Description	Interstate 80 Reconstruction		

Inputs

Upstream Adj Ramp				Downstream Adj Ramp	
☐ Yes ☐ On	Number of Lanes, N	4		☑ Yes	☑ On
	Acceleration Lane Length, L_A				
☑ No ☐ Off	Deceleration Lane Length L_D	750		☐ No	☐ Off
	Freeway Volume, V_F	6672			
L_{up} = ft	Ramp Volume, V_R	602		L_{down} =	3000 ft
	Freeway Free-Flow Speed, S_{FF}	70.0			
V_u = veh/h	Ramp Free-Flow Speed, S_{FR}	35.0		V_D =	360 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	6672	0.96	Rolling	13	1	0.830	0.95	8816
Ramp	602	0.90	Rolling	1	0	0.985	0.95	715
UpStream								
DownStream	360	0.90	Rolling	1	0	0.985	0.95	427

Merge Areas	**Diverge Areas**

Estimation of v_{12} (Merge) / Estimation of v_{12} (Diverge)

Merge	Diverge
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = using Equation (Exhibit 13-6)	P_{FD} = 0.436 using Equation (Exhibit 13-7)
V_{12} = pc/h	V_{12} = 4247 pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} 2284 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

	Actual	Capacity		LOS F?
V_F	8816	Exhibit 13-8	9600	No
$V_{FO} = V_F - V_R$	8101	Exhibit 13-8	9600	No
V_R	715	Exhibit 13-10	2000	No

Flow Entering Merge Influence Area / Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}		Exhibit 13-8	

	Actual	Max Desirable	Violation?
V_{12}	4247	Exhibit 13-8 4400:All	No

Level of Service Determination (if not F)

Merge	Diverge
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/mi/ln)	D_R = 34.0 (pc/mi/ln)
LOS = (Exhibit 13-2)	LOS = D (Exhibit 13-2)

Speed Determination

Merge	Diverge
M_S = (Exibit 13-11)	D_s = 0.492 (Exhibit 13-12)
S_R = mph (Exhibit 13-11)	S_R = 56.2 mph (Exhibit 13-12)
S_0 = mph (Exhibit 13-11)	S_0 = 71.8 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 63.3 mph (Exhibit 13-13)