RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

		Site Information	
Analyst	JRE	Freeway/Dir of Travel	I-80 Eastbound
Agency or Company	AECOM	Junction	Int. 304 from US09
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	3		☑ Yes	☑ On
	Acceleration Lane Length, L_A	1050			
☑ No ☐ Off	Deceleration Lane Length L_D			☐ No	☐ Off
	Freeway Volume, V_F	2302			
L_{up} = ft	Ramp Volume, V_R	1468		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 = 434 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	2302	0.94	Rolling	10	1	0.862	0.95	2990
Ramp	1468	0.94	Rolling	5	1	0.922	0.95	1784
UpStream								
DownStream	434	0.82	Rolling	2	0	0.971	0.95	574

Merge Areas	Diverge Areas

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

Merge Areas — Estimation of v_{12}

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

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

P_{FM} =   0.607 using Equation (Exhibit 13-6)

V_{12} =   1815 pc/h

V_3 or V_{av34} 1175 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 — Estimation of v_{12}

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

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

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

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)

Capacity Checks (Merge)

	Actual	Capacity	LOS F?
V_{FO}	4774	Exhibit 13-8	No

Capacity Checks (Diverge)

	Actual	Capacity	LOS F?
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3599	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}		Exhibit 13-8	

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 =   26.1 (pc/mi/ln)

LOS =   C (Exhibit 13-2)

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

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination (Merge)

M_S =   0.390 (Exibit 13-11)

S_R =   59.1 mph (Exhibit 13-11)

S_0 =   67.6 mph (Exhibit 13-11)

S =   61.0 mph (Exhibit 13-13)

Speed Determination (Diverge)

D_S =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information | Site Information

Analyst	JRE	Freeway/Dir of Travel	I-80 Eastbound
Agency or Company	AECOM	Junction	Int. 304 from US209
Date Performed	9/11/2014	Jurisdiction	
Analysis Time Period	P.M. Peak Hour	Analysis Year	Alt D1 Ph II 2045

Project Description   Interstate 80 Reconstruction

Inputs

Upstream Adj Ramp

☐ Yes   ☐ On

☑ No   ☐ Off

L_{up} =   ft

V_u =   veh/h

Number of Lanes, N	3
Acceleration Lane Length, L_A	1050
Deceleration Lane Length L_D	
Freeway Volume, V_F	2898
Ramp Volume, V_R	1334
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} =   1500   ft

V_D =   454   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 x f_{HV} x f_p
Freeway	2898	0.94	Rolling	10	1	0.862	0.95	3764
Ramp	1334	0.94	Rolling	5	1	0.922	0.95	1621
UpStream								
DownStream	454	0.82	Rolling	2	0	0.971	0.95	600

Merge Areas	Diverge Areas

Estimation of v_{12} | Estimation of v_{12}

Merge Areas — Estimation of v_{12}

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

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

P_{FM} =   0.607   using Equation (Exhibit 13-6)

V_{12} =   2284   pc/h

V_3 or V_{av34} 1480   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 — Estimation of v_{12}

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

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

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

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)

Capacity Checks | Capacity Checks

Merge — Capacity Checks

	Actual	Capacity	LOS F?
V_{FO}	5385	Exhibit 13-8	No

Diverge — Capacity Checks

	Actual	Capacity	LOS F?
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Merge Influence Area | Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}	3905	Exhibit 13-8 4600:All	No

	Actual	Max Desirable	Violation?
V_{12}		Exhibit 13-8	

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

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

D_R =   28.6 (pc/mi/ln)

LOS =   D (Exhibit 13-2)

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination | Speed Determination

Merge

M_S =   0.441 (Exibit 13-11)

S_R =   57.6 mph (Exhibit 13-11)

S_0 =   66.5 mph (Exhibit 13-11)

S =   59.8 mph (Exhibit 13-13)

Diverge

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   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 D1 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	4204	
L_{up} = 3200 ft	Ramp Volume, V_R	718	L_{down} = ft
	Freeway Free-Flow Speed, S_{FF}	70.0	
V_u = 434 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	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	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} = 5567.90 (Equation 13-12 or 13-13)
P_{FM} = using Equation (Exhibit 13-6)	P_{FD} = 0.626 using Equation (Exhibit 13-7)
V_{12} = pc/h	V_{12} = 3815 pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)	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} > 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	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 / Flow Entering Diverge Influence Area

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

	Actual	Max Desirable	Violation?
V_{12}	3815	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 = 30.3 (pc/mi/ln)
LOS = (Exhibit 13-2)	LOS = D (Exhibit 13-2)

Speed Determination

Merge	Diverge
M_S = (Exibit 13-11)	D_s = 0.524 (Exhibit 13-12)
S_R = mph (Exhibit 13-11)	S_R = 55.3 mph (Exhibit 13-12)
S_0 = mph (Exhibit 13-11)	S_0 = 74.3 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	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 D1 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}

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

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

	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

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

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/mi/ln)	D_R = 30.8 (pc/mi/ln)
LOS = (Exhibit 13-2)	LOS = D (Exhibit 13-2)

Speed Determination

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 = 71.4 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	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. 303 from Route 611
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

☑ Yes   ☐ On

☐ No   ☑ Off

L_{up} =   2600 ft

V_u =   174 veh/h

Number of Lanes, N	3
Acceleration Lane Length, L_A	600
Deceleration Lane Length L_D	
Freeway Volume, V_F	2136
Ramp Volume, V_R	173
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	2136	0.97	Rolling	12	1	0.840	0.95	2758
Ramp	173	0.74	Rolling	2	0	0.971	0.95	253
UpStream	174	0.94	Rolling	8	1	0.885	0.95	220
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge)

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

L_{EQ} =   338.95 (Equation 13-6 or 13-7)

P_{FM} =   0.594 using Equation (Exhibit 13-6)

V_{12} =   1639 pc/h

V_3 or V_{av34} 1119 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)

Estimation of v_{12} (Diverge)

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

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

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

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)

Capacity Checks (Merge)

	Actual	Capacity	LOS F?
V_{FO}	3011	Exhibit 13-8	No

Capacity Checks (Diverge)

	Actual	Capacity	LOS F?
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}	1892	Exhibit 13-8 4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}		Exhibit 13-8	

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 =   16.4 (pc/mi/ln)

LOS =   B (Exhibit 13-2)

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

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination (Merge)

M_S =   0.305 (Exibit 13-11)

S_R =   61.5 mph (Exhibit 13-11)

S_0 =   67.8 mph (Exhibit 13-11)

S =   63.7 mph (Exhibit 13-13)

Speed Determination (Diverge)

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   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. 303 from Route 611
Date Performed	9/11/2014	Jurisdiction	
Analysis Time Period	P.M. Peak Hour	Analysis Year	Alt D1 Ph II 2045

Project Description   Interstate 80 Reconstruction

Inputs

Upstream Adj Ramp

☑ Yes   ☐ On

☐ No   ☑ Off

L_{up} =   2600 ft

V_u =   269 veh/h

Number of Lanes, N	3
Acceleration Lane Length, L_A	600
Deceleration Lane Length L_D	
Freeway Volume, V_F	4414
Ramp Volume, V_R	332
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	4414	0.97	Rolling	13	1	0.830	0.95	5772
Ramp	332	0.87	Rolling	1	0	0.985	0.95	408
UpStream	269	0.94	Rolling	2	1	0.962	0.95	313
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12} | Estimation of v_{12}

Merge:

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

L_{EQ} =   1017.12   (Equation 13-6 or 13-7)

P_{FM} =   0.594   using Equation (Exhibit 13-6)

V_{12} =   3430   pc/h

V_3 or V_{av34} 2342   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} =   using Equation (Exhibit 13-7)

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)

Capacity Checks | Capacity Checks

Merge:

	Actual	Capacity	LOS F?
V_{FO}	6180	Exhibit 13-8	No

Diverge:

	Actual	Capacity	LOS F?
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Merge Influence Area | Flow Entering Diverge Influence Area

Merge:

	Actual	Max Desirable		Violation?
V_{R12}	3838	Exhibit 13-8	4600:All	No

Diverge:

	Actual	Max Desirable	Violation?
V_{12}		Exhibit 13-8	

Level of Service Determination (if not F) | 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 =   31.5 (pc/mi/ln)

LOS =   D (Exhibit 13-2)

Diverge:

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination | Speed Determination

Merge:

M_S =   0.460 (Exibit 13-11)

S_R =   57.1 mph (Exhibit 13-11)

S_0 =   63.2 mph (Exhibit 13-11)

S =   59.3 mph (Exhibit 13-13)

Diverge:

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   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 from Main St
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

☑ Yes   ☐ On

☐ No   ☑ Off

L_{up} =   2700   ft

V_u =   1302 veh/h

Number of Lanes, N	3
Acceleration Lane Length, L_A	1500
Deceleration Lane Length L_D	
Freeway Volume, V_F	1904
Ramp Volume, V_R	196
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	1904	0.97	Rolling	12	1	0.840	0.95	2459
Ramp	196	0.94	Rolling	8	1	0.885	0.95	248
UpStream	1302	0.94	Rolling	8	1	0.885	0.95	1648
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge)

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

L_{EQ} =   673.50   (Equation 13-6 or 13-7)

P_{FM} =   0.619   using Equation (Exhibit 13-6)

V_{12} =   1523   pc/h

V_3 or V_{av34} 936   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)

Estimation of v_{12} (Diverge)

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

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

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

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)

Capacity Checks (Merge)

	Actual	Capacity	LOS F?
V_{FO}	2707	Exhibit 13-8	No

Capacity Checks (Diverge)

	Actual	Capacity	LOS F?
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1771	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}		Exhibit 13-8	

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 =   9.8 (pc/mi/ln)

LOS =   A (Exhibit 13-2)

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

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination (Merge)

M_S =   0.239 (Exibit 13-11)

S_R =   63.3 mph (Exhibit 13-11)

S_0 =   68.4 mph (Exhibit 13-11)

S =   65.0 mph (Exhibit 13-13)

Speed Determination (Diverge)

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   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 from Main St
Date Performed	9/11/2014	Jurisdiction	
Analysis Time Period	P.M. Peak Hour	Analysis Year	Alt D1 Ph II 2045

Project Description   Interstate 80 Reconstruction

Inputs

Upstream Adj Ramp

☑ Yes   ☐ On

☐ No   ☑ Off

L_{up} =   2700   ft

V_u =   2603 veh/h

Number of Lanes, N	3
Acceleration Lane Length, L_A	1500
Deceleration Lane Length L_D	
Freeway Volume, V_F	4069
Ramp Volume, V_R	360
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 x f_{HV} x f_p
Freeway	4069	0.97	Rolling	13	1	0.830	0.95	5321
Ramp	360	0.94	Rolling	2	1	0.962	0.95	419
UpStream	2603	0.94	Rolling	2	1	0.962	0.95	3031
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge)

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

L_{EQ} =   1322.56   (Equation 13-6 or 13-7)

P_{FM} =   0.619   using Equation (Exhibit 13-6)

V_{12} =   3296   pc/h

V_3 or V_{av34} 2025   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)

Estimation of v_{12} (Diverge)

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

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

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

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)

Capacity Checks (Merge)

	Actual	Capacity	LOS F?
V_{FO}	5740	Exhibit 13-8	No

Capacity Checks (Diverge)

	Actual	Capacity	LOS F?
V_F		Exhibit 13-8	
$V_{FO} = V_F - V_R$		Exhibit 13-8	
V_R		Exhibit 13-10	

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3715	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}		Exhibit 13-8	

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 =   24.9 (pc/mi/ln)

LOS =   C (Exhibit 13-2)

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

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination (Merge)

M_S =   0.376 (Exibit 13-11)

S_R =   59.5 mph (Exhibit 13-11)

S_0 =   64.5 mph (Exhibit 13-11)

S =   61.2 mph (Exhibit 13-13)

Speed Determination (Diverge)

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   mph (Exhibit 13-13)

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