Indiana Department of Transportation

MAJOR MOVES

THE NEW US 31
HAMILTON COUNTY

Capacity Analysis Report

Appendix: HCS Output, Part 1

JACOBS
Edwards and Kelcey

1. US 31 (Meridian Street) & 96th Street Intersection

2015 AM
2015 PM
2035 AM
2035 PM

SHORT REPORT

General Information		Site Information	
Analyst	*Sarah Headlee*	Intersection	*US 31 & 96th ST*
Agency or Co.	*Jacobs Edwards and Kelcey*	Area Type	*All other areas*
Date Performed	*02/19/2008*	Jurisdiction	*Hamilton*
Time Period	*AM Peak*	Analysis Year	*2015*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	3	2	0	2	2	2	1	4	1	2	3	2
Lane Group	L	TR		L	T	R	L	T	R	L	T	R
Volume (vph)	451	215	205	112	116	284	82	1546	141	1053	1852	582
% Heavy Vehicles	2	1	1	2	3	4	10	2	6	1	2	2
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Pretimed/Actuated (P/A)	A	A	A	A	A	A	A	A	A	A	A	A
Startup Lost Time	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Extension of Effective Green	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Arrival Type	3	3		3	3	3	3	3	3	3	3	3
Unit Extension	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Ped/Bike/RTOR Volume	0	0	20	0	0	0	0	0	113	0	0	0
Lane Width	12.0	12.0		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0	0		0	0	0	0	0	0	0	0	0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	Excl. Left	Thru & RT	03	04	Excl. Left	SB Only	Thru & RT	08
Timing	G = 16.0	G = 16.0	G =	G =	G = 11.0	G = 22.0	G = 30.0	G =
	Y = 5	Y = 5	Y =	Y =	Y = 5	Y = 5	Y = 5	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 120.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	501	445		124	129	316	91	1718	31	1170	2058	647
Lane Group Capacity	683	472		487	498	1375	164	1748	660	1128	2452	1845
v/c Ratio	0.73	0.94		0.25	0.26	0.23	0.55	0.98	0.05	1.04	0.84	0.35
Green Ratio	0.14	0.14		0.14	0.14	0.50	0.10	0.26	0.43	0.32	0.48	0.66
Uniform Delay d_1	49.3	51.0		45.9	45.9	16.9	51.5	44.2	19.7	40.5	26.9	9.1
Delay Factor k	0.29	0.46		0.11	0.11	0.11	0.15	0.49	0.11	0.50	0.37	0.11
Incremental Delay d_2	4.1	27.6		0.3	0.3	0.1	4.1	17.5	0.0	36.9	2.8	0.1
PF Factor	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Control Delay	53.4	78.6		46.1	46.2	17.0	55.6	61.8	19.7	77.4	29.7	9.2
Lane Group LOS	D	E		D	D	B	E	E	B	E	C	A
Approach Delay	65.3			30.0			60.8			40.7		
Approach LOS	E			C			E			D		
Intersection Delay	48.2			Intersection LOS						D		

SHORT REPORT

General Information		Site Information	
Analyst	*Sarah Headlee*	Intersection	*US 31 & 96th ST*
Agency or Co.	*Jacobs Edwards and Kelcey*	Area Type	*All other areas*
Date Performed	*02/19/2008*	Jurisdiction	*Hamilton*
Time Period	*PM Peak*	Analysis Year	*2015*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	3	2	0	2	2	2	1	4	1	2	3	2
Lane Group	L	TR		L	T	R	L	T	R	L	T	R
Volume (vph)	404	218	168	315	191	807	74	1641	164	574	945	145
% Heavy Vehicles	6	0	3	1	1	2	1	4	1	0	0	1
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Pretimed/Actuated (P/A)	A	A	A	A	A	A	A	A	A	A	A	A
Startup Lost Time	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Extension of Effective Green	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Arrival Type	3	3		3	3	3	3	3	3	3	3	3
Unit Extension	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Ped/Bike/RTOR Volume	0	0	20	0	0	0	0	0	122	0	0	0
Lane Width	12.0	12.0		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0	0		0	0	0	0	0	0	0	0	0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	Excl. Left	Thru & RT	03	04	Excl. Left	SB Only	Thru & RT	08
Timing	G = 16.0	G = 18.0	G =	G =	G = 11.0	G = 11.0	G = 39.0	G =
	Y = 5	Y = 5	Y =	Y =	Y = 5	Y = 5	Y = 5	Y =

Duration of Analysis (hrs) = *0.25* | Cycle Length C = *120.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	449	406		350	212	897	82	1823	47	638	1050	161
Lane Group Capacity	657	532		492	567	1191	179	2212	813	818	2415	1816
v/c Ratio	0.68	0.76		0.71	0.37	0.75	0.46	0.82	0.06	0.78	0.43	0.09
Green Ratio	0.14	0.16		0.14	0.16	0.43	0.10	0.33	0.51	0.23	0.47	0.64
Uniform Delay d_1	48.9	48.3		49.2	45.2	29.2	50.9	36.8	14.9	43.1	21.4	8.2
Delay Factor k	0.25	0.32		0.27	0.11	0.31	0.11	0.36	0.11	0.33	0.11	0.11
Incremental Delay d_2	2.9	6.5		4.8	0.4	2.8	1.9	2.7	0.0	4.9	0.1	0.0
PF Factor	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Control Delay	51.9	54.8		53.9	45.6	31.9	52.8	39.4	15.0	48.0	21.5	8.2
Lane Group LOS	D	D		D	D	C	D	D	B	D	C	A
Approach Delay	53.3			39.2			39.4			29.5		
Approach LOS	D			D			D			C		
Intersection Delay	38.3			Intersection LOS						D		

SHORT REPORT

General Information		Site Information	
Analyst	*Sarah Headlee*	Intersection	*US 31 & 96th ST*
Agency or Co.	*Jacobs Edwards and Kelcey*	Area Type	*All other areas*
Date Performed	*02/19/2008*	Jurisdiction	*Hamilton*
Time Period	*AM Peak*	Analysis Year	*2035*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	3	2	0	2	2	2	1	4	1	2	3	2
Lane Group	L	TR		L	T	R	L	T	R	L	T	R
Volume (vph)	625	267	314	210	139	480	121	2580	331	1586	2858	777
% Heavy Vehicles	8	1	1	3	2	4	9	2	4	1	2	2
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Pretimed/Actuated (P/A)	A	A	A	A	A	A	A	A	A	A	A	A
Startup Lost Time	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Extension of Effective Green	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Arrival Type	3	3		3	3	3	3	3	3	3	3	3
Unit Extension	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Ped/Bike/RTOR Volume	0	0	94	0	0	0	0	0	167	0	0	0
Lane Width	12.0	12.0		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0	0		0	0	0	0	0	0	0	0	0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	Excl. Left	Thru & RT	03	04	SB Only	Thru & RT	NB Only	08
Timing	G = *11.8*	G = *19.2*	G =	G =	G = *46.0*	G = *41.7*	G = *6.3*	G =
	Y = *5*	Y = *5*	Y =	Y =	Y = *5*	Y = *5*	Y = *5*	Y =

Duration of Analysis (hrs) = *0.25* | Cycle Length C = *150.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	694	541		233	154	533	134	2867	182	1762	3176	863
Lane Group Capacity	389	450		290	478	1305	81	2435	733	1088	3170	1990
v/c Ratio	1.78	1.20		0.80	0.32	0.41	1.65	1.18	0.25	1.62	1.00	0.43
Green Ratio	0.09	0.13		0.09	0.13	0.47	0.05	0.36	0.47	0.31	0.62	0.71
Uniform Delay d_1	68.6	64.9		67.4	58.7	25.7	71.3	48.0	23.7	51.5	28.2	9.1
Delay Factor k	0.50	0.50		0.35	0.11	0.11	0.50	0.50	0.11	0.50	0.50	0.11
Incremental Delay d_2	363.1	110.6		15.0	0.4	0.2	342.7	84.5	0.2	283.0	16.4	0.2
PF Factor	1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Control Delay	431.7	175.5		82.4	59.1	25.9	414.1	132.5	23.9	334.5	44.6	9.3
Lane Group LOS	F	F		F	E	C	F	F	C	F	D	A
Approach Delay	319.4			45.8			138.1			127.4		
Approach LOS	F			D			F			F		
Intersection Delay	145.0			Intersection LOS						F		

SHORT REPORT

General Information		Site Information	
Analyst	*Sarah Headlee*	Intersection	*US 31 & 96th ST*
Agency or Co.	*Jacobs Edwards and Kelcey*	Area Type	*All other areas*
Date Performed	*02/19/2008*	Jurisdiction	*Hamilton*
Time Period	*PM Peak*	Analysis Year	*2035*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*3*	*2*	*0*	*2*	*2*	*2*	*1*	*4*	*1*	*2*	*3*	*2*
Lane Group	*L*	*TR*		*L*	*T*	*R*	*L*	*T*	*R*	*L*	*T*	*R*
Volume (vph)	*601*	*279*	*244*	*439*	*312*	*1188*	*92*	*2111*	*208*	*744*	*1328*	*166*
% Heavy Vehicles	*8*	*1*	*1*	*1*	*2*	*2*	*1*	*5*	*1*	*0*	*0*	*0*
PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Pretimed/Actuated (P/A)	*A*	*A*	*A*	*A*	*A*	*A*	*A*	*A*	*A*	*A*	*A*	*A*
Startup Lost Time	*2.0*	*2.0*		*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*
Extension of Effective Green	*3.0*	*3.0*		*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Arrival Type	*3*	*3*		*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Unit Extension	*3.0*	*3.0*		*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*	*133*	*0*	*0*	*0*	*0*	*0*	*128*	*0*	*0*	*0*
Lane Width	*12.0*	*12.0*		*12.0*	*12.0*	*12.0*	*12.0*	*12.0*	*12.0*	*12.0*	*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*	*0*		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	Thru & RT	WB Only	04	SB Only	Thru & RT	NB Only	08
Timing	G = *16.7*	G = *2.0*	G = *20.9*	G =	G = *26.1*	G = *21.2*	G = *15.1*	G =
	Y = *5*	Y = *5*	Y = *5*	Y =	Y = *5*	Y = *5*	Y = *5*	Y =

Duration of Analysis (hrs) = *0.25* | Cycle Length C = *132.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*668*	*433*		*488*	*347*	*1320*	*102*	*2346*	*89*	*827*	*1476*	*184*
Lane Group Capacity	*611*	*642*		*576*	*777*	*1274*	*218*	*2106*	*778*	*720*	*2090*	*1538*
v/c Ratio	*1.09*	*0.67*		*0.85*	*0.45*	*1.04*	*0.47*	*1.11*	*0.11*	*1.15*	*0.71*	*0.12*
Green Ratio	*0.13*	*0.19*		*0.17*	*0.22*	*0.45*	*0.12*	*0.32*	*0.49*	*0.21*	*0.40*	*0.54*
Uniform Delay d_1	*57.1*	*49.9*		*53.4*	*44.6*	*36.0*	*54.0*	*44.8*	*18.4*	*52.5*	*32.8*	*15.1*
Delay Factor k	*0.50*	*0.25*		*0.38*	*0.11*	*0.50*	*0.11*	*0.50*	*0.11*	*0.50*	*0.27*	*0.11*
Incremental Delay d_2	*64.5*	*2.8*		*11.3*	*0.4*	*35.0*	*1.6*	*58.6*	*0.1*	*82.5*	*1.1*	*0.0*
PF Factor	*1.000*	*1.000*		*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*
Control Delay	*121.6*	*52.7*		*64.8*	*45.0*	*71.0*	*55.5*	*103.4*	*18.5*	*135.0*	*33.9*	*15.1*
Lane Group LOS	*F*	*D*		*E*	*D*	*E*	*E*	*F*	*B*	*F*	*C*	*B*
Approach Delay	*94.5*			*65.4*			*98.5*			*66.1*		
Approach LOS	*F*			*E*			*F*			*E*		
Intersection Delay	*79.7*			Intersection LOS						*E*		

2a. US 31 (Meridian Street) between 96th Street & off-ramp to EB 465 NB

2015 AM
2015 PM
2035 AM
2035 PM

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sarah Headlee
Agency or Company:	Jacobs Edwards and Kelcey
Date Performed:	01/07/2008
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	US 31 NB
From/To:	96th St to I-465
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Flow Inputs and Adjustments

Volume, V	2281	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	634	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	640	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	56.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	640	pc/h/ln
Free-flow speed, FFS	56.0	mi/h
Average passenger-car speed, S	56.0	mi/h
Number of lanes, N	4	
Density, D	11.4	pc/mi/ln

Level of service, LOS B

Overall results are not computed when free-flow speed is less than 55 mph.

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Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sarah Headlee
Agency or Company:	Jacobs Edwards and Kelcey
Date Performed:	01/08/2008
Analysis Time Period:	PM Peak
Freeway/Direction:	US 31 NB
From/To:	96th St to I-465
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Flow Inputs and Adjustments

Volume, V	2852	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	792	v
Trucks and buses	4	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.980	
Driver population factor, fp	1.00	
Flow rate, vp	808	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	56.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	808	pc/h/ln
Free-flow speed, FFS	56.0	mi/h
Average passenger-car speed, S	56.0	mi/h
Number of lanes, N	4	
Density, D	14.4	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sarah Headlee
Agency or Company:	Jacobs Edwards and Kelcey
Date Performed:	01/08/2008
Analysis Time Period:	AM Peak
Freeway/Direction:	US 31 NB
From/To:	96th St to I-465
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Flow Inputs and Adjustments

Volume, V	3685	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1024	v
Trucks and buses	3	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.985	
Driver population factor, fp	1.00	
Flow rate, vp	1039	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	56.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1039	pc/h/ln
Free-flow speed, FFS	56.0	mi/h
Average passenger-car speed, S	56.0	mi/h
Number of lanes, N	4	
Density, D	18.6	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sarah Headlee
Agency or Company:	Jacobs Edwards and Kelcey
Date Performed:	01/08/2008
Analysis Time Period:	PM Peak
Freeway/Direction:	US 31 NB
From/To:	96th St to I-465
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Flow Inputs and Adjustments

Volume, V	3900	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1083	v
Trucks and buses	4	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.980	
Driver population factor, fp	1.00	
Flow rate, vp	1105	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	56.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1105	pc/h/ln
Free-flow speed, FFS	56.0	mi/h
Average passenger-car speed, S	56.0	mi/h
Number of lanes, N	4	
Density, D	19.7	pc/mi/ln

Level of service, LOS	C

Overall results are not computed when free-flow speed is less than 55 mph.

2b. US 31 (Meridian Street) between 96th Street & off-ramp to EB 465 SB

2015 AM
2015 PM
2035 AM
2035 PM

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Will Tolbert
Agency or Company:	Jacobs Edwards and Kelcey
Date Performed:	12/19/2007
Analysis Time Period:	AM Peak
Freeway/Direction:	
From/To:	I-465 to 96th St.
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Flow Inputs and Adjustments

Volume, V	3487	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	969	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	978	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	56.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	978	pc/h/ln
Free-flow speed, FFS	56.0	mi/h
Average passenger-car speed, S	56.0	mi/h
Number of lanes, N	4	
Density, D	17.5	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Will Tolbert
Agency or Company:	Jacobs Edwards and Kelcey
Date Performed:	12/19/2007
Analysis Time Period:	PM Peak
Freeway/Direction:	US 31 SB
From/To:	I-465 to 96th St.
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Flow Inputs and Adjustments

Volume, V	1664	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	462	v
Trucks and buses	0	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	1.000	
Driver population factor, fp	1.00	
Flow rate, vp	462	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	56.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	462	pc/h/ln
Free-flow speed, FFS	56.0	mi/h
Average passenger-car speed, S	56.0	mi/h
Number of lanes, N	4	
Density, D	8.3	pc/mi/ln

Level of service, LOS	A

Overall results are not computed when free-flow speed is less than 55 mph.

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Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Will Tolbert
Agency or Company:	Jacobs Edwards and Kelcey
Date Performed:	12/19/2007
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	US 31 SB
From/To:	I-465 to 96th St.
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Flow Inputs and Adjustments

Volume, V	5221	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1450	v
Trucks and buses	2	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.990	
Driver population factor, fp	1.00	
Flow rate, vp	1465	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	56.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1465	pc/h/ln
Free-flow speed, FFS	56.0	mi/h
Average passenger-car speed, S	56.0	mi/h
Number of lanes, N	4	
Density, D	26.2	pc/mi/ln

Level of service, LOS	D

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sarah Headlee
Agency or Company:	Jacobs Edwards and Kelcey
Date Performed:	01/08/2008
Analysis Time Period:	PM Peak
Freeway/Direction:	US 31 SB
From/To:	I-465 to 96th St.
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Flow Inputs and Adjustments

Volume, V	2238	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	622	v
Trucks and buses	0	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	1.000	
Driver population factor, fp	1.00	
Flow rate, vp	622	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	56.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	622	pc/h/ln
Free-flow speed, FFS	56.0	mi/h
Average passenger-car speed, S	56.0	mi/h
Number of lanes, N	4	
Density, D	11.1	pc/mi/ln

Level of service, LOS	B

Overall results are not computed when free-flow speed is less than 55 mph.

3a. US 31 (Meridian Street) & I-465 Interchange
NB Diverge (NB 31 to off-ramp to EB 465)

2015 AM
2015 PM
2035 AM
2035 PM

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/12/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	I-465 EB
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	60.0	mph
Volume on freeway	2281	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	801	vph
Length of first accel/decel lane	450	ft
Length of second accel/decel lane	100	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	189	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	1050	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2281	801	189	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	634	223	53	v
Trucks and buses	2	1	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.990	0.995	0.985	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2560	894	213	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.260 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1327 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2560	9200	No
$v_{FO} = v_F - v_R$	1666	9200	No
v_R	894	3800	No
v_3 or v_{av34}	616 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1327	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 6.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.508

Space mean speed in ramp influence area, S_R = 50.8 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 57.1 mph

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Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/12/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	I-465 EB
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	60.0	mph
Volume on freeway	2852	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1231	vph
Length of first accel/decel lane	450	ft
Length of second accel/decel lane	100	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	467	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	1050	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	2852		1231		467		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	792		342		130		v
Trucks and buses	4		4		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.980	0.980	0.980	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3232	1395	529	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.260 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1873 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3232	9200	No
$v_{FO} = v_F - v_R$	1837	9200	No
v_R	1395	3800	No
v_3 or v_{av34}	679 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1873	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 11.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.554

Space mean speed in ramp influence area, S_R = 50.0 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 55.6 mph

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Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/12/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	I-465 EB
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	60.0	mph
Volume on freeway	3685	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1296	vph
Length of first accel/decel lane	450	ft
Length of second accel/decel lane	100	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	401	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	1050	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3685		1296		401		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	1024		360		111		v
Trucks and buses	3		4		3		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.985	0.980	0.985	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4156	1469	452	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.260 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2168 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4156	9200	No
$v_{FO} = v_F - v_R$	2687	9200	No
v_R	1469	3800	No
v_3 or v_{av34}	994 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2168	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 13.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.560

Space mean speed in ramp influence area, S_R = 49.9 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 56.4 mph

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Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/12/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	I-465 EB
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	60.0	mph
Volume on freeway	3900	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1432	vph
Length of first accel/decel lane	450	ft
Length of second accel/decel lane	100	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	827	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	1050	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3900		1432		827		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	1083		398		230		v
Trucks and buses	4		4		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.980	0.980	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4420	1623	942	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.260 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2350 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4420	9200	No
$v_{FO} = v_F - v_R$	2797	9200	No
v_R	1623	3800	No
v_3 or v_{av34}	1035 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2350	4600	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 15.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.574

Space mean speed in ramp influence area, S_R = 49.7 mph

Space mean speed in outer lanes, S_O = 65.7 mph

Space mean speed for all vehicles, S = 56.1 mph

3b. US 31 (Meridian Street) & I-465 Interchange
EB Merge (465)

2015 AM
2015 PM
2035 AM
2035 PM

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	01/30/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	I 465 EB
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	5526	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	50.0	mph
Volume on ramp	1379	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5526	1379		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1535	383		v
Trucks and buses	5	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	6294	1548	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.555 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3493 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	7842	6900	Yes
v_3 or v_{av34}	2801 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	Yes	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	Yes	
If yes, v_{12A} = 3594		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3594	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 16.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 0.538	
Space mean speed in ramp influence area,	S_R = 50.3	mph
Space mean speed in outer lanes,	S_O = 51.1	mph
Space mean speed for all vehicles,	S = 50.6	mph

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Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	01/30/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	I 465 EB
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	4727	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	50.0	mph
Volume on ramp	2141	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4727	2141		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1313	595		v
Trucks and buses	6	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.971	0.985	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5410	2415	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.555 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3003 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	7825	6900	Yes
v_3 or v_{av34}	2407 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	Yes	
If yes, v_{12A} = 3091		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3091	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 19.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 0.831	
Space mean speed in ramp influence area,	S_R = 45.0	mph
Space mean speed in outer lanes,	S_O = 53.4	mph
Space mean speed for all vehicles,	S = 47.2	mph

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Freeway/Dir of Travel:	US 31 NB
Junction:	I 465 EB
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	7923	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	50.0	mph
Volume on ramp	2235	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	7923	2235		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	2201	621		v
Trucks and buses	5	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV		0.976	0.985	
Driver population factor, fP		1.00	1.00	
Flow rate, vp		9023	2521	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.555 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 5008 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	11544	6900	Yes
v_3 or v_{av34}	4015 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12} /2		Yes	
If yes, v_{12A} = 6323		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	6323	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 45.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 26.908	
Space mean speed in ramp influence area,	S_R = -424.4	mph
Space mean speed in outer lanes,	S_O = 51.1	mph
Space mean speed for all vehicles,	S = 360.4	mph

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Merge Analysis

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Analysis time period:	PM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	I 465 EB
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	5864	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	50.0	mph
Volume on ramp	2563	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5864	2563		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1629	712		v
Trucks and buses	7	3		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV		0.966	0.985
Driver population factor, fP		1.00	1.00
Flow rate, vp		6744	2890 pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.555 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3743 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	9634	6900	Yes
v_3 or v_{av34}	3001 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34}	> 2700 pc/h?	Yes	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	Yes	
If yes, v_{12A} = 4044		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	4044	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 30.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 3.875	
Space mean speed in ramp influence area,	S_R = -9.7	mph
Space mean speed in outer lanes,	S_O = 51.1	mph
Space mean speed for all vehicles,	S =	mph

3c. US 31 (Meridian Street) & I-465 Interchange
NB Diverge (NB 31 to off-ramp to WB 465)

2015 AM
2015 PM
2035 AM
2035 PM

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Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/12/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	I-465 WB
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	1480	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	189	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	801	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	1050	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	1480		189		801		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	411		53		223		v
Trucks and buses	3		3		1		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.985	0.985	0.995	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1669	213	894	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.708 Using Equation 5

$v_{12} = v_R + (v - v_F) P_{FD}$ = 1245 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1669	6900	No
$v_{FO} = v - v_F - v_R$	1456	6900	No
v_R	213	2000	No
v_3 or v_{av34}	424 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1245	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 1.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.447

Space mean speed in ramp influence area, S_R = 52.0 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 54.9 mph

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Diverge Analysis

Analyst:	Sarah Headlee
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Date performed:	02/12/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	I-465 WB
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	1621	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	467	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	1231	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	1050	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	1621		467		1231		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	450		130		342		v
Trucks and buses	4		4		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.980	0.980	0.980	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1837	529	1395	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.690 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1431 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1837	6900	No
$v_{FO} = v_F - v_R$	1308	6900	No
v_R	529	2000	No
v_3 or v_{av34}	406 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1431	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 3.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.476

Space mean speed in ramp influence area, S_R = 51.4 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 54.0 mph

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Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/12/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	I-465 WB
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	2390	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	401	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	1296	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	1050	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	2390		401		1296		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	664		111		360		v
Trucks and buses	2		3		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.990	0.985	0.980	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2682	452	1469	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.672 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1951 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2682	6900	No
$v_{FO} = v_F - v_R$	2230	6900	No
v_R	452	2000	No
v_3 or v_{av34}	731 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1951	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 7.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.469

Space mean speed in ramp influence area, S_R = 51.6 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 54.8 mph

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Diverge Analysis

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Freeway/Dir of Travel:	US 31 NB
Junction:	I-465 WB
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	2468	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	827	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	1432	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	1050	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	2468		827		1432		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	686		230		398		v
Trucks and buses	4		5		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.980	0.976	0.980	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2797	942	1623	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.647 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2142 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2797	6900	No
$v_{FO} = v_F - v_R$	1855	6900	No
v_R	942	2000	No
v_3 or v_{av34}	655 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2142	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 9.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.513	
Space mean speed in ramp influence area,	S_R = 50.8	mph
Space mean speed in outer lanes,	S_O = 65.8	mph
Space mean speed for all vehicles,	S = 53.6	mph

3d. US 31 (Meridian Street) & I-465 Interchange
WB Merge (465)

2015 AM
2015 PM
2035 AM
2035 PM

Phone: Fax:
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Merge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	01/30/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	US 31 SB
Junction:	I 465 WB
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	4747	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	50.0	mph
Volume on ramp	1442	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4747	1442		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1319	401		v
Trucks and buses	5	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.976	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5406	1634	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.555 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3000 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	7040	6900	Yes
v_{3} or v_{av34}	2406 pc/h	(Equation 25-4 or 25-5)	
Is v_{3} or v_{av34} > 2700 pc/h?		No	
Is v_{3} or v_{av34} > 1.5 v_{12} /2		Yes	
If yes, v_{12A} = 3089		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3089	4400	No

!

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 13.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 0.310	
Space mean speed in ramp influence area,	S_R = 54.4	mph
Space mean speed in outer lanes,	S_O = 53.4	mph
Space mean speed for all vehicles,	S = 54.1	mph

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Merge Analysis

Analyst:	Sarah Headlee
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Date performed:	01/30/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	US 31 SB
Junction:	I 465 WB
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	4631	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	50.0	mph
Volume on ramp	1997	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4631	1997		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1286	555		v
Trucks and buses	7	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV		0.966	0.980
Driver population factor, fP		1.00	1.00
Flow rate, vp		5326	2263 pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.555 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2956 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	7589	6900	Yes
v_3 or v_{av34}	2370 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		Yes	
If yes, v_{12A} = 3043		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3043	4400	No

!

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 17.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 0.657	
Space mean speed in ramp influence area,	S_R = 48.2	mph
Space mean speed in outer lanes,	S_O = 53.6	mph
Space mean speed for all vehicles,	S = 49.7	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	01/30/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	US 31 SB
Junction:	I 465 WB
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	7283	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	50.0	mph
Volume on ramp	2320	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	7283	2320		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	2023	644		v
Trucks and buses	6	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.971	0.980	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	8335	2629	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.555 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 4626 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	10964	6900	Yes
$v_{3 \text{ or } av34}$	3709 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	Yes	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	Yes	
If yes, v_{12A} = 5635		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	5635	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 40.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 15.009	
Space mean speed in ramp influence area,	S_R = -210.2	mph
Space mean speed in outer lanes,	S_O = 51.1	mph
Space mean speed for all vehicles,	S = 809.3	mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	01/30/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	US 31 SB
Junction:	I 465 WB
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	5870	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	50.0	mph
Volume on ramp	2967	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5870	2967		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1631	824		v
Trucks and buses	9	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV		0.957	0.980
Driver population factor, fP		1.00	1.00
Flow rate, vp		6816	3363 pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.555 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3783 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	10179	6900	Yes
v_3 or v_{av34}	3033 pc/h	(Equation 25-4 or 25-5)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12} /2		Yes	
If yes, v_{12A} = 4116		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	4116	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 34.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable, M_S = 6.776

Space mean speed in ramp influence area, S_R = -62.0 mph

Space mean speed in outer lanes, S_0 = 51.1 mph

Space mean speed for all vehicles, S = mph

SHORT REPORT

General Information		Site Information	
Analyst	*Sarah Headlee*	Intersection	*I 465 WB & US 31*
Agency or Co.	*Jacobs Edwards and Kelcey*	Area Type	*All other areas*
Date Performed	*02/19/2008*	Jurisdiction	*Hamilton*
Time Period	*AM Peak*	Analysis Year	*2035*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*3*				*3*			*3*	
Lane Group				*L*				*T*			*T*	
Volume (vph)				*1872*				*1988*			*1841*	
% Heavy Vehicles				*0*				*2*			*1*	
PHF				*0.90*				*0.90*			*0.90*	
Pretimed/Actuated (P/A)				*A*				*A*			*A*	
Startup Lost Time				*2.0*				*2.0*			*2.0*	
Extension of Effective Green				*3.0*				*3.0*			*3.0*	
Arrival Type				*3*				*3*			*3*	
Unit Extension				*3.0*				*3.0*			*3.0*	
Ped/Bike/RTOR Volume				*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width				*12.0*				*12.0*			*12.0*	
Parking/Grade/Parking				*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*				*0*			*0*	
Minimum Pedestrian Time					*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	Thru Only	06	07	08
Timing	G = *32.0*	G =	G =	G =	G = *33.0*	G =	G =	G =
	Y = *5*	Y =	Y =	Y =	Y = *5*	Y =	Y =	Y =

Duration of Analysis (hrs) = *0.25* | Cycle Length C = *75.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*2080*				*2209*			*2046*	
Lane Group Capacity				*2163*				*2300*			*2323*	
v/c Ratio				*0.96*				*0.96*			*0.88*	
Green Ratio				*0.44*				*0.45*			*0.45*	
Uniform Delay d_1				*20.4*				*19.8*			*18.7*	
Delay Factor k				*0.47*				*0.47*			*0.41*	
Incremental Delay d_2				*11.7*				*11.0*			*4.3*	
PF Factor				*1.000*				*1.000*			*1.000*	
Control Delay				*32.1*				*30.9*			*23.0*	
Lane Group LOS				*C*				*C*			*C*	
Approach Delay				*32.1*			*30.9*			*23.0*		
Approach LOS				*C*			*C*			*C*		
Intersection Delay	*28.7*			Intersection LOS						*C*		

3e. US 31 (Meridian Street) & I-465 Interchange
US 31 (Meridian Street) & WB ramp
from WB 465 Intersection

2015 AM
2015 PM
2035 AM
2035 PM

SHORT REPORT

General Information		Site Information	
Analyst	*Sarah Headlee*	Intersection	*I 465 WB & US 31*
Agency or Co.	*Jacobs Edwards and Kelcey*	Area Type	*All other areas*
Date Performed	*02/19/2008*	Jurisdiction	*Hamilton*
Time Period	*AM Peak*	Analysis Year	*2015*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*3*				*3*			*3*	
Lane Group				*L*				*T*			*T*	
Volume (vph)				*1180*				*1291*			*1200*	
% Heavy Vehicles				*0*				*3*			*2*	
PHF				*0.92*				*0.92*			*0.92*	
Pretimed/Actuated (P/A)				*A*				*A*			*A*	
Startup Lost Time				*2.0*				*2.0*			*2.0*	
Extension of Effective Green				*3.0*				*3.0*			*3.0*	
Arrival Type				*3*				*3*			*3*	
Unit Extension				*3.0*				*3.0*			*3.0*	
Ped/Bike/RTOR Volume				*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width				*12.0*				*12.0*			*12.0*	
Parking/Grade/Parking				*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*				*0*			*0*	
Minimum Pedestrian Time					*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	Thru Only	06	07	08
Timing	G = *55.0*	G =	G =	G =	G = *55.0*	G =	G =	G =
	Y = *5*	Y =	Y =	Y =	Y = *5*	Y =	Y =	Y =

Duration of Analysis (hrs) = *0.25* | Cycle Length C = *120.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*1283*				*1403*			*1304*	
Lane Group Capacity				*2295*				*2345*			*2368*	
v/c Ratio				*0.56*				*0.60*			*0.55*	
Green Ratio				*0.47*				*0.47*			*0.47*	
Uniform Delay d_1				*23.1*				*23.7*			*23.0*	
Delay Factor k				*0.16*				*0.19*			*0.15*	
Incremental Delay d_2				*0.3*				*0.4*			*0.3*	
PF Factor				*1.000*				*1.000*			*1.000*	
Control Delay				*23.4*				*24.1*			*23.2*	
Lane Group LOS				*C*				*C*			*C*	
Approach Delay				*23.4*			*24.1*			*23.2*		
Approach LOS				*C*			*C*			*C*		
Intersection Delay	*23.6*			Intersection LOS						*C*		

SHORT REPORT

General Information		Site Information	
Analyst	*Sarah Headlee*	Intersection	*I 465 WB & US 31*
Agency or Co.	*Jacobs Edwards and Kelcey*	Area Type	*All other areas*
Date Performed	*02/19/2008*	Jurisdiction	*Hamilton*
Time Period	*PM Peak*	Analysis Year	*2015*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*3*				*3*			*3*	
Lane Group				*L*				*T*			*T*	
Volume (vph)				*613*				*1154*			*519*	
% Heavy Vehicles				*0*				*4*			*0*	
PHF				*0.90*				*0.90*			*0.90*	
Pretimed/Actuated (P/A)				*A*				*A*			*A*	
Startup Lost Time				*2.0*				*2.0*			*2.0*	
Extension of Effective Green				*3.0*				*3.0*			*3.0*	
Arrival Type				*3*				*3*			*3*	
Unit Extension				*3.0*				*3.0*			*3.0*	
Ped/Bike/RTOR Volume				*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width				*12.0*				*12.0*			*12.0*	
Parking/Grade/Parking				*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*				*0*			*0*	
Minimum Pedestrian Time					*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	Thru Only	06	07	08
Timing	G = *48.0*	G =	G =	G =	G = *62.0*	G =	G =	G =
	Y = *5*	Y =	Y =	Y =	Y = *5*	Y =	Y =	Y =

Duration of Analysis (hrs) = *0.25* | Cycle Length C = *120.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*681*				*1282*			*577*	
Lane Group Capacity				*2008*				*2613*			*2717*	
v/c Ratio				*0.34*				*0.49*			*0.21*	
Green Ratio				*0.41*				*0.52*			*0.52*	
Uniform Delay d_1				*24.4*				*18.2*			*15.2*	
Delay Factor k				*0.11*				*0.11*			*0.11*	
Incremental Delay d_2				*0.1*				*0.1*			*0.0*	
PF Factor				*1.000*				*1.000*			*1.000*	
Control Delay				*24.5*				*18.4*			*15.3*	
Lane Group LOS				*C*				*B*			*B*	
Approach Delay				*24.5*			*18.4*			*15.3*		
Approach LOS				*C*			*B*			*B*		
Intersection Delay	*19.3*			Intersection LOS						*B*		

SHORT REPORT

General Information		Site Information	
Analyst	*Sarah Headlee*	Intersection	*I 465 WB & US 31*
Agency or Co.	*Jacobs Edwards and Kelcey*	Area Type	*All other areas*
Date Performed	*02/19/2008*	Jurisdiction	*Hamilton*
Time Period	*PM Peak*	Analysis Year	*2035*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*3*				*3*			*3*	
Lane Group				*L*				*T*			*T*	
Volume (vph)				*680*				*1641*			*813*	
% Heavy Vehicles				*0*				*3*			*0*	
PHF				*0.90*				*0.90*			*0.90*	
Pretimed/Actuated (P/A)				*A*				*A*			*A*	
Startup Lost Time				*2.0*				*2.0*			*2.0*	
Extension of Effective Green				*3.0*				*3.0*			*3.0*	
Arrival Type				*3*				*3*			*3*	
Unit Extension				*3.0*				*3.0*			*3.0*	
Ped/Bike/RTOR Volume				*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width				*12.0*				*12.0*			*12.0*	
Parking/Grade/Parking				*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*				*0*			*0*	
Minimum Pedestrian Time					*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	Thru Only	06	07	08
Timing	G = *25.0*	G =	G =	G =	G = *40.0*	G =	G =	G =
	Y = *5*	Y =	Y =	Y =	Y = *5*	Y =	Y =	Y =

Duration of Analysis (hrs) = *0.25* | Cycle Length C = *75.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*756*				*1823*			*903*	
Lane Group Capacity				*1705*				*2747*			*2830*	
v/c Ratio				*0.44*				*0.66*			*0.32*	
Green Ratio				*0.35*				*0.55*			*0.55*	
Uniform Delay d_1				*18.9*				*12.1*			*9.3*	
Delay Factor k				*0.11*				*0.24*			*0.11*	
Incremental Delay d_2				*0.2*				*0.6*			*0.1*	
PF Factor				*1.000*				*1.000*			*1.000*	
Control Delay				*19.1*				*12.7*			*9.4*	
Lane Group LOS				*B*				*B*			*A*	
Approach Delay				*19.1*			*12.7*			*9.4*		
Approach LOS				*B*			*B*			*A*		
Intersection Delay	*13.2*			Intersection LOS						*B*		

3f. US 31 (Meridian Street) & I-465 Interchange
WB Diverge (465)

2015 AM
2015 PM
2035 AM
2035 PM

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-465 WB
Junction:	US 31
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	55.0	mph
Volume on freeway	6908	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	2161	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	6908		2161			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1919		600			v
Trucks and buses	4		1			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.980	0.995	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	7829	2413	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4850 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	7829	6750	Yes
$v_{FO} = v_F - v_R$	5416	6750	No
v_R	2413	4100	No
v_3 or v_{av34}	2979 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	

If yes, v_{12A} = 5129 (Equation 25-18)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	5129	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 7.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable, D_S = 0.515

Space mean speed in ramp influence area, S_R = 48.3 mph

Space mean speed in outer lanes, S_O = 53.7 mph

Space mean speed for all vehicles, S = 50.0 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-465 WB
Junction:	US 31
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	55.0	mph
Volume on freeway	5637	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1006	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	5637		1006			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1566		279			v
Trucks and buses	6		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.971	1.000	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	6451	1118	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3518 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6451	6750	No
$v_{FO} = v_F - v_R$	5333	6750	No
v_R	1118	4100	No
v_3 or v_{av34}	2933 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12} /2		Yes	

If yes, v_{12A} = 3751 (Equation 25-18)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3751	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = -4.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.399

Space mean speed in ramp influence area, S_R = 49.8 mph

Space mean speed in outer lanes, S_O = 53.7 mph

Space mean speed for all vehicles, S = 51.4 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-465 WB
Junction:	US 31
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	55.0	mph
Volume on freeway	10723	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	3440	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	10723		3440			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2979		956			v
Trucks and buses	4		1			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.980	0.995	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	12153	3841	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 7581 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	12153	6750	Yes
$v_{FO} = v_F - v_R$	8312	6750	Yes
v_R	3841	4100	No
v_3 or v_{av34}	4572 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	

If yes, v_{12A} = 9453 (Equation 25-18)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	9453	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 45.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	D_S = 0.644	
Space mean speed in ramp influence area,	S_R = 46.6	mph
Space mean speed in outer lanes,	S_O = 53.7	mph
Space mean speed for all vehicles,	S = 48.0	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-465 WB
Junction:	US 31
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	55.0	mph
Volume on freeway	7164	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1293	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	1500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	7164	1293		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1990	359		v
Trucks and buses	7	1		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.966	0.995	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	8239	1444	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4502 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	8239	6750	Yes
$v_{FO} = v_F - v_R$	6795	6750	Yes
v_R	1444	4100	No
v_3 or v_{av34}	3737 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	
If yes, v_{12A} = 5539		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	5539	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 11.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable, D_S = 0.428

Space mean speed in ramp influence area, S_R = 49.4 mph

Space mean speed in outer lanes, S_O = 53.7 mph

Space mean speed for all vehicles, S = 50.8 mph

3g. US 31 (Meridian Street) & I-465 Interchange Ramp Diverge (ramp from WB 465 to NB 106th Street CD or NB 31 or intersection 3e)

2015 AM
2015 PM
2035 AM
2035 PM

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-465 WB split
Junction:	US 31 NB and SB
Jurisdiction:	Hamilton County
Analysis Year:	2015

Description: US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	2161	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	40.0	mph
Volume on ramp	981	vph
Length of first accel/decel lane	1200	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	2161	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2161	981	2161	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	600	273	600	v
Trucks and buses	4	5	1	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.980	0.976	0.995	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2449	1117	2413	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2449 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2449	4500	No
$v_{FO} = v_F - v_R$	1332	4500	No
v_R	1117	4100	No
v_3 or v_{av34}	0 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2449	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = -0.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.464

Space mean speed in ramp influence area, S_R = 49.0 mph

Space mean speed in outer lanes, S_O = N/A mph

Space mean speed for all vehicles, S = 49.0 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-465 WB split
Junction:	US 31 NB and SB
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	1006	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	40.0	mph
Volume on ramp	393	vph
Length of first accel/decel lane	1200	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	1006	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	1006		393		1006		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	279		109		279		v
Trucks and buses	0		0		0		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1118	437	1118	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1118 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1118	4500	No
$v_{FO} = v_F - v_R$	681	4500	No
v_R	437	4100	No
v_3 or v_{av34}	0 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1118	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = -12.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.402	
Space mean speed in ramp influence area,	S_R = 49.8	mph
Space mean speed in outer lanes,	S_O = N/A	mph
Space mean speed for all vehicles,	S = 49.8	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	I-465 WB split
Junction:	US 31 NB and SB
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	3440	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	40.0	mph
Volume on ramp	1568	vph
Length of first accel/decel lane	1200	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	3440	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3440	1568	3440	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	956	436	956	v
Trucks and buses	0	6	1	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	1.000	0.971	0.995	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3822	1794	3841	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3822 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3822	4500	No
$v_{FO} = v_F - v_R$	2028	4500	No
v_R	1794	4100	No
v_3 or v_{av34}	0 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3822	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 11.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.524

Space mean speed in ramp influence area, S_R = 48.2 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 48.2 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	I-465 WB split
Junction:	US 31 NB and SB
Jurisdiction:	Hamilton County
Analysis Year:	2035

Description: US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	1293	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	40.0	mph
Volume on ramp	613	vph
Length of first accel/decel lane	1200	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	1293	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1293	613	1293	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	359	170	359	v
Trucks and buses	0	3	1	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	1.000	0.985	0.995	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1437	691	1444	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1437 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1437	4500	No
$v_{FO} = v_F - v_R$	746	4500	No
v_R	691	4100	No
v_3 or v_{av34}	0 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1437	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = -9.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.425	
Space mean speed in ramp influence area,	S_R = 49.5	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 49.5	mph

3h. US 31 (Meridian Street) & I-465 Interchange
NB Diverge (NB 31 to NB 106th Street CD)

2015 AM
2015 PM
2035 AM
2035 PM

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	106th St
Jurisdiction:	Hamilton County
Analysis Year:	2015
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	1291	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	40.0	mph
Volume on ramp	295	vph
Length of first accel/decel lane	200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1291		295			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	359		82			v
Trucks and buses	3		1			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.985	0.995	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1456	329	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.708 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1127 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1456	6900	No
$v_{FO} = v_F - v_R$	1127	6900	No
v_R	329	2100	No
v_3 or v_{av34}	329 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1127	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 12.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.393

Space mean speed in ramp influence area, S_R = 52.9 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 55.4 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	106th ST
Jurisdiction:	Hamilton County
Analysis Year:	2015

Description: US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	1154	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	40.0	mph
Volume on ramp	178	vph
Length of first accel/decel lane	200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1154		178			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	321		49			v
Trucks and buses	4		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.980	1.000	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1308	198	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.718 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 995 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1308	6900	No
$v_{FO} = v_F - v_R$	1110	6900	No
v_R	198	2100	No
v_3 or v_{av34}	313 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	995	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 11.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.381

Space mean speed in ramp influence area, S_R = 53.1 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 55.7 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	AM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	106th ST
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	1988	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	40.0	mph
Volume on ramp	514	vph
Length of first accel/decel lane	200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1988	514		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	552	143		v
Trucks and buses	2	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.990	1.000	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2231	571	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.678 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1696 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2231	6900	No
$v_{FO} = v_F - v_R$	1660	6900	No
v_R	571	2100	No
v_3 or v_{av34}	535 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1696	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 17.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.414

Space mean speed in ramp influence area, S_R = 52.5 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 55.2 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sarah Headlee
Agency/Co.:	Jacobs Edwards and Kelcey
Date performed:	02/13/08
Analysis time period:	PM Peak
Freeway/Dir of Travel:	US 31 NB
Junction:	106th ST
Jurisdiction:	Hamilton County
Analysis Year:	2035
Description:	US 31 Expressway Capacity Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	60.0	mph
Volume on freeway	1641	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	40.0	mph
Volume on ramp	252	vph
Length of first accel/decel lane	200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1641		252			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	456		70			v
Trucks and buses	3		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.985	1.000	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1851	280	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.701 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1381 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1851	6900	No
$v_{FO} = v_F - v_R$	1571	6900	No
v_R	280	2100	No
v_3 or v_{av34}	470 pc/h	(Equation 25-15 or 25-16)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1381	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 14.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.388

Space mean speed in ramp influence area, S_R = 53.0 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 55.8 mph