HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
E-mail:

Merge Analysis

Analyst:
Agency/Co.: Stantec
Date performed: 11/10/2016
Analysis time period: 2:00PM:3:00PM
Freeway/Dir of Travel: I-85 Northbound
Junction: Shelby Hwy On Ramp to I-85 NB
Jurisdiction: SCDOT
Analysis Year: 2040 Build Conditions
Description:

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	69.5	mph
Volume on freeway	3361	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	330	vph
Length of first accel/decel lane	560	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	217	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1675	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3361	330	217	vph
Peak-hour factor, PHF	0.94	0.94	0.94	
Peak 15-min volume, v15	894	88	58	v
Trucks and buses	30	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	1.5	1.5	
Recreational vehicle PCE, ER	2.0	1.2	1.2	

Heavy vehicle adjustment, fHV	0.690	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5185	351	231	pcph

Estimation of V12 Merge Areas

L_{EQ} = 861.54 (Equation 13-6 or 13-7)

P_{FM} = 0.593 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3076 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5536	7185	No
v_3 or v_{av34}	2109 pc/h	(Equation 13-14 or 13-17)	
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} = 3076 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3427	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 28.5 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.402	
Space mean speed in ramp influence area,	S_R = 58.4	mph
Space mean speed in outer lanes,	S_0 = 63.7	mph
Space mean speed for all vehicles,	S = 60.3	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	Stantec
Date performed:	11/10/2016
Analysis time period:	2:00PM-3:00PM
Freeway/Dir of Travel:	I-85 Northbound
Junction:	Shelby Hwy On Ramp to I-85 NB
Jurisdiction:	SCDOT
Analysis Year:	2040 Build Conditions
Description:	

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	69.5	mph
Volume on freeway	3361	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	217	vph
Length of first accel/decel lane	560	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	10	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	5100	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3361	217	10	vph
Peak-hour factor, PHF	0.94	0.94	0.94	
Peak 15-min volume, v15	894	58	3	v
Trucks and buses	30	0	100	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	1.5	1.5	
Recreational vehicle PCE, ER	2.0	1.2	1.2	

Heavy vehicle adjustment, fHV	0.690	1.000	0.667	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5185	231	16	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.593 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3076 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5416	7185	No
v_3 or v_{av34}	2109 pc/h	(Equation 13-14 or 13-17)	

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} = 3076 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3307	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 27.7 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.388	
Space mean speed in ramp influence area,	S_R = 58.8	mph
Space mean speed in outer lanes,	S_0 = 63.7	mph
Space mean speed for all vehicles,	S = 60.6	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	Stantec
Date performed:	11/10/2016
Analysis time period:	2:00PM-3:00PM
Freeway/Dir of Travel:	I-85 Northbound
Junction:	Gaffney Ferry On Ramp to I-85
Jurisdiction:	SCDOT
Analysis Year:	2040 Build Conditions
Description:	

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	69.8	mph
Volume on freeway	3578	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	10	vph
Length of first accel/decel lane	780	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	217	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	5100	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3578	10	217	vph
Peak-hour factor, PHF	0.94	0.94	0.94	
Peak 15-min volume, v15	952	3	58	v
Trucks and buses	30	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	1.5	1.5	
Recreational vehicle PCE, ER	2.0	1.2	1.2	

Heavy vehicle adjustment, fHV	0.690	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5519	11	231	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.599 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3308 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5530	7194	No
v_3 or v_{av34}	2211 pc/h	(Equation 13-14 or 17)	

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} = 3308 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3319	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 26.5 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.374	
Space mean speed in ramp influence area,	S_R = 59.4	mph
Space mean speed in outer lanes,	S_0 = 63.6	mph
Space mean speed for all vehicles,	S = 61.0	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
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Merge Analysis

Analyst:	
Agency/Co.:	Stantec
Date performed:	11/10/2016
Analysis time period:	2:00PM-3:00PM
Freeway/Dir of Travel:	I-85 Northbound
Junction:	Gaffney Ferry On Ramp to I-85
Jurisdiction:	SCDOT
Analysis Year:	2040 Build Conditions
Description:	

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	69.8	mph
Volume on freeway	3578	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	10	vph
Length of first accel/decel lane	780	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	4	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	4730	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3578	10	4	vph
Peak-hour factor, PHF	0.94	0.94	0.94	
Peak 15-min volume, v15	952	3	1	v
Trucks and buses	30	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	1.5	1.5	
Recreational vehicle PCE, ER	2.0	1.2	1.2	

Heavy vehicle adjustment, fHV	0.690	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5519	11	4	pcph

Estimation of V12 Merge Areas

L_{EQ} = 20.72 (Equation 13-6 or 13-7)

P_{FM} = 0.599 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3308 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5530	7194	No
v_3 or v_{av34}	2211 pc/h	(Equation 13-14 or 13-17)	

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} = 3308 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3319	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 26.5 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, M_S = 0.374

Space mean speed in ramp influence area, S_R = 59.4 mph

Space mean speed in outer lanes, S_O = 63.6 mph

Space mean speed for all vehicles, S = 61.0 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
E-mail:

Merge Analysis

Analyst:
Agency/Co.: Stantec
Date performed: 11/10/2016
Analysis time period: 2:00PM-3:00PM
Freeway/Dir of Travel: I-85 Northbound
Junction: Blacksburg On Ramp to I-85 NB
Jurisdiction: SCDOT
Analysis Year: 2040 Build Conditions
Description:

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	69.8	mph
Volume on freeway	3297	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	97	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	287	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1440	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3297	97	287	vph
Peak-hour factor, PHF	0.94	0.94	0.94	
Peak 15-min volume, v15	877	26	76	v
Trucks and buses	30	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	1.5	1.5	
Recreational vehicle PCE, ER	2.0	1.2	1.2	

Heavy vehicle adjustment, fHV	0.690	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5086	103	305	pcph

Estimation of V12 Merge Areas

L_{EQ} = 938.25 (Equation 13-6 or 13-7)

P_{FM} = 0.603 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3065 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5189	7194	No
v_3 or v_{av34}	2021 pc/h	(Equation 13-14 or 13-17)	

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} = 3065 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3168	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 24.5 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, M_S = 0.351

Space mean speed in ramp influence area, S_R = 60.1 mph

Space mean speed in outer lanes, S_O = 64.3 mph

Space mean speed for all vehicles, S = 61.6 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	Stantec
Date performed:	11/10/2016
Analysis time period:	2:00PM-3:00PM
Freeway/Dir of Travel:	I-85 Northbound
Junction:	SC 5 On Ramp to I-85 NB
Jurisdiction:	SCDOT
Analysis Year:	2040 Build Conditions
Description:	

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.7	mph
Volume on freeway	2939	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	138	vph
Length of first accel/decel lane	1375	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	355	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	3940	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2939	138	355	vph
Peak-hour factor, PHF	0.94	0.94	0.94	
Peak 15-min volume, v15	782	37	94	v
Trucks and buses	30	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	1.5	1.5	
Recreational vehicle PCE, ER	2.0	1.2	1.2	

Heavy vehicle adjustment, fHV	0.690	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4534	147	378	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 0.616 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2793 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4681	7200	No
v_3 or v_{av34}	1741 pc/h	(Equation 13-14 or 13-17)	

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} = 2793 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2940	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 19.7 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.299	
Space mean speed in ramp influence area,	S_R = 62.1	mph
Space mean speed in outer lanes,	S_0 = 66.2	mph
Space mean speed for all vehicles,	S = 63.6	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
E-mail:

Merge Analysis

Analyst:
Agency/Co.: Stantec
Date performed: 11/10/2016
Analysis time period: 2:00PM-3:00PM
Freeway/Dir of Travel: I-85 Northbound
Junction: Tribal Rd On Ramp to I-85 NB
Jurisdiction: SCDOT
Analysis Year: 2040 Build Conditions
Description:

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.3	mph
Volume on freeway	2887	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	190	vph
Length of first accel/decel lane	1080	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	164	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1111	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2887	190	164	vph
Peak-hour factor, PHF	0.94	0.94	0.94	
Peak 15-min volume, v15	768	51	44	v
Trucks and buses	30	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	1.5	1.5	
Recreational vehicle PCE, ER	2.0	1.2	1.2	

Heavy vehicle adjustment, fHV	0.690	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4453	202	174	pcph

Estimation of V12 Merge Areas

L_{EQ} = 903.89 (Equation 13-6 or 13-7)

P_{FM} = 0.608 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2706 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4655	7200	No
v_3 or v_{av34}	1747 pc/h	(Equation 13-14 or 17)	
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} = 2706 (Equation 13-15, 13-16, 18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2908	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 21.3 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, M_S = 0.317

Space mean speed in ramp influence area, S_R = 61.3 mph

Space mean speed in outer lanes, S_O = 65.8 mph

Space mean speed for all vehicles, S = 62.9 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
E-mail:

Merge Analysis

Analyst:
Agency/Co.: Stantec
Date performed: 11/10/2016
Analysis time period: 2:00PM-3:00PM
Freeway/Dir of Travel: I-85 Northbound
Junction: US 29 On Ramp to I-85 NB
Jurisdiction: SCDOT
Analysis Year: 2040 Build Conditions
Description:

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.7	mph
Volume on freeway	2941	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	113	vph
Length of first accel/decel lane	580	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	110	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	745	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2941	113	110	vph
Peak-hour factor, PHF	0.94	0.94	0.94	
Peak 15-min volume, v15	782	30	29	v
Trucks and buses	30	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	1.5	1.5	
Recreational vehicle PCE, ER	2.0	1.2	1.2	

Heavy vehicle adjustment, fHV	0.690	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4537	120	117	pcph

Estimation of V12 Merge Areas

L_{EQ} = 682.32 (Equation 13-6 or 13-7)

P_{FM} = 0.594 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2694 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4657	7200	No
v_3 or v_{av34}	1843 pc/h	(Equation 13-14 or 13-17)	
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} = 2694 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2814	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 23.7 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.345	
Space mean speed in ramp influence area,	S_R = 60.8	mph
Space mean speed in outer lanes,	S_O = 65.9	mph
Space mean speed for all vehicles,	S = 62.7	mph