Isolated and Coordinated signal design using Synchro 5

CEE 5220/6220

Traffic Engineering

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Project objective

The project is the class project for CEE 6220 Traffic Engineering course. The main objective of the project is to collect the data from the field and to design a signal based on those data using the Synchro software. The class was divided into four groups and data were collected for four intersections along the 400N corridor in Logan, Utah. Using the Synchro 5 software the collected data was analyzed, mapped to get the signal designs, timing delay, phase and so on. Optimization for carried out for the isolated intersection as well as coordinated network.

Data collection

As mentioned the class was divided into four groups and the four individual intersection location were 400N & 100W, 400N & Main Street, 400N & 100 E, 400N & 200 E. All of the four intersections are shown below in the google map with red location marking. Figure 1 below shows the google map of the intersections in the study.

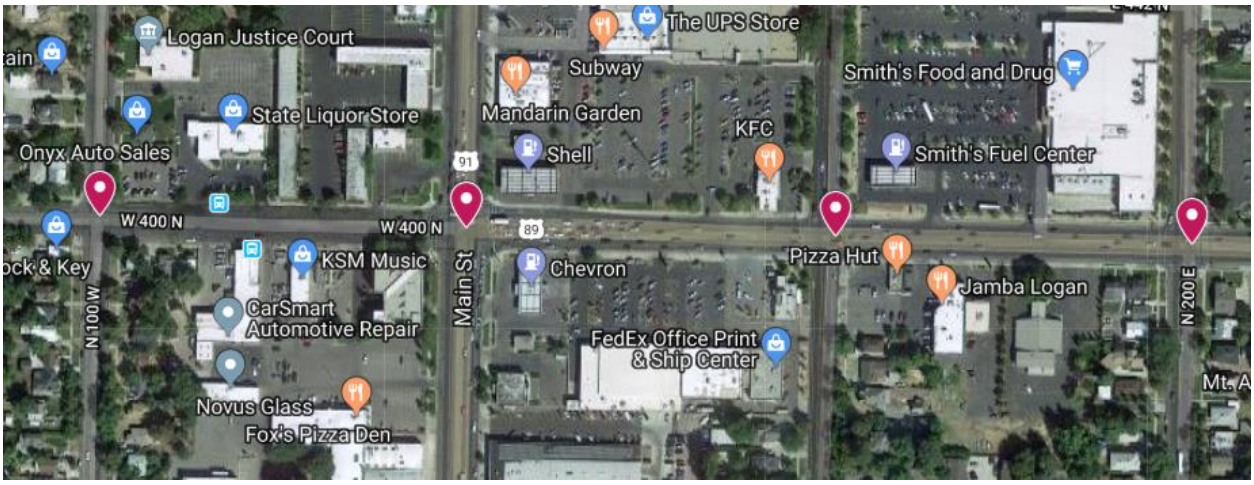


***Figure 1: Figure showing the google map of the four intersections for the project*.**

As each group was assigned to an individual intersection, our group was assigned to intersection 400N & Main street. The data was collected on Tuesday October,15 ,2019. and the weather condition was clear. Three approaches east, north and south approach were busy streets along main street and I-89 highway. The group of four people were assigned to collect data in each approach and the volume of the vehicle count was recorded. The number of truck and cars were recorded separately and along each approach left turn vehicle count, through vehicle count and right turn vehicle count. The collection of data was done from 4:30 pm to 5:30 pm and the vehicle counts were recorded for each 15 minutes to get the peak hour factor. East approach data was collected by Ahadul, north approach data was collected by Rafiur, west approach data was collected by Niranjan and south approach data was collected by Ashikur. The data collection was done using the tally sheet. Peak hour factor and percentage of the heavy vehicles were also calculated from the data collected. Similarly, the data collected from

other groups were also collected and compiled together to provide input to the Synchro 5 software.

Synchro software

After the data were collected from all the four group we will input the data in the software and the process used in the software are explained below.

Network coding

To start with using the “Add Link” option in the synchro 5 segments were drawn, one horizontal segment and 4 other vertical segments. The point where these line segments intersect represent four intersections in our project. Next we double click on each link to get insert the properties of the road segments- speed limit. The speed for major streets were input as 40 miles/hour and speed limit for other streets was taken 25 miles/hour. Next we double click on intersections to edit the properties of intersection, one intersection was given x-y coordinate of (0,0) and by calculating the length between other intersections from google map other intersection were given respective co-ordinates. The map of the corridor as seen in the synchro software is shown in the following figure 2.

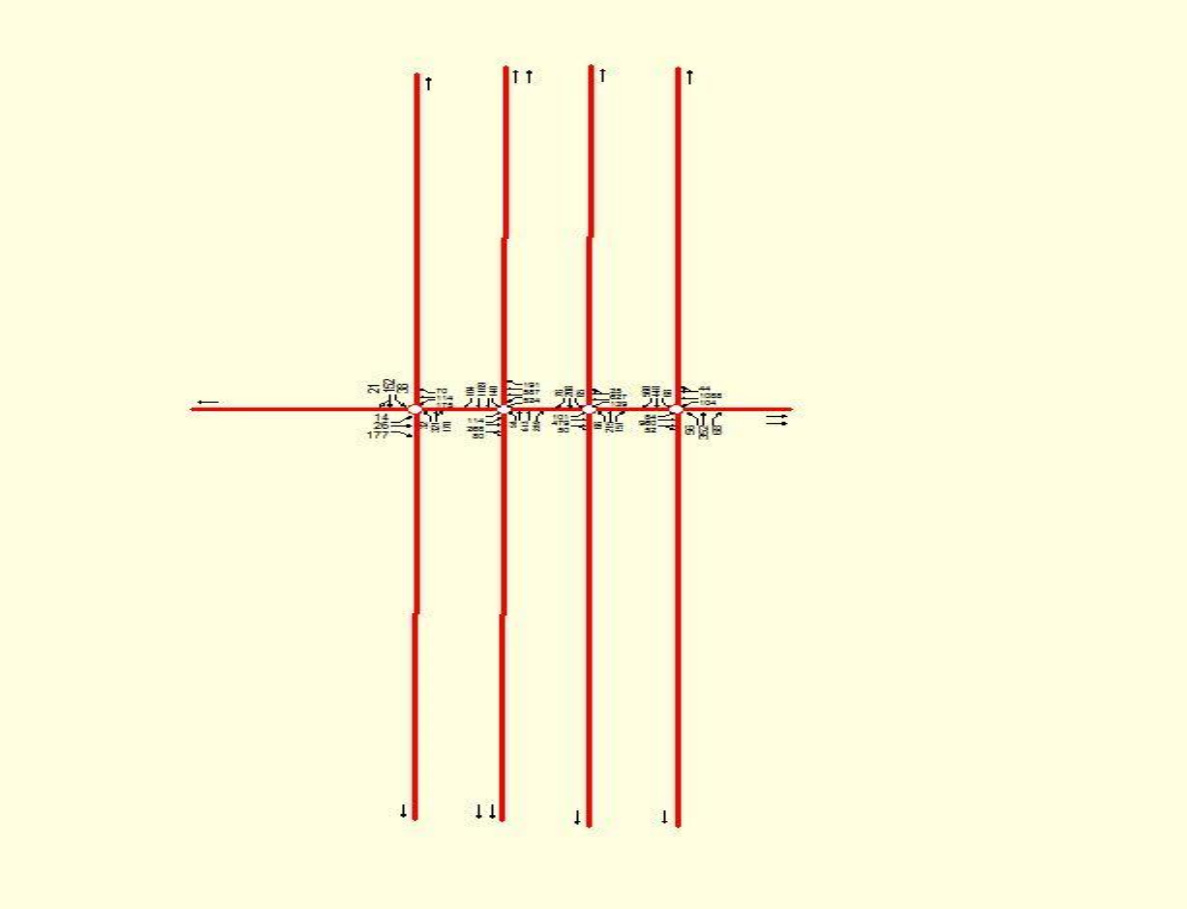


Figure 2: Figure showing the map of the corridor as seen in the synchro software.

Lane grouping design

Selecting each intersection at a time, “Lane Window” button in the toolbox was selected which gives us the lane design window. In this window designated lane groups and related parameters were input. Shortage lane and shortage lane length were provided for the respective lanes. The lane which supports both direction traffic between two yellow lines were also input as shortage lane calculating the length from the google map.

Turning movements count inputs

By pressing “F4” function key a window for volume input appeared where we will input the volume foe each intersection. The volumes for each intersection were input in the window. Peak hour factors and percentage of heavy vehicles were modified from the default value as per the calculation. One data group did not have peak hour factor an another did not have heavy vehicle percentage so default values were taken for those intersections.

Signal design and signal optimization

Next we click the “Timing window” and almost all of the parameters in this window was set as default. The turn movements all were selected as default permitted movements. Next selecting each individual intersection from the optimize window we will optimize green split and cycle length of the signal by choosing “Optimize → Intersection Splits” and “Optimize → Intersection Cycle Length”. Next we create report to generate the report for signal optimization of each individual intersection. The report for signal optimization of four intersections are listed below in Appendix-A to Appendix D.

Coordinated signal (Network optimization) performance

In this step we selected all the intersections in the corridor and from then optimize the whole network by selecting “Optimize→ Network Cycle Length” and “Optimize →Network Offsets”. Then report was created which are attached in Appendix E. Furthermore, the following table (table 1) shows the comparison between isolated signal performance and coordinated signal performance. We can see from the table 1 for coordinated signal performance the cycle length for all the intersection increases whereas the delay decreases. The overall signal level of service remains the same in both the scenarios.

Table 1: table showing the comparison between isolated signal performance and coordinated signal performance.

Intersection location 400N &	Isolated Signal performance			Optimized signal performance		
	Cycle Length	Delay	Overall LOS	Cycle Length	Delay	Overall LOS
100 W	50	16	B	55	15.8	B
Main street	45	10.8	B	55	10.3	B
100 E	40	8.2	A	55	7.7	A
200 E	40	8.1	A	55	6.5	A

APPENDIX A: Isolated intersection design and performance at 400N and 100W

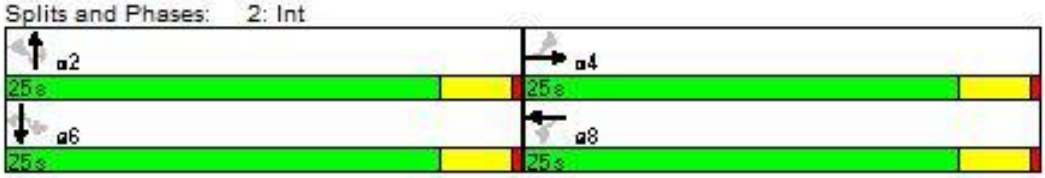
Lanes, Volumes, Timings
2: Int 12/12/2019

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.992			0.994				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3511	0	1770	3518	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.190			0.190			0.330			0.437		
Satd. Flow (perm)	354	3511	0	354	3518	0	615	1863	1583	814	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		14			10				38			24
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		40			40			25			25	
Link Distance (ft)		724			939			5610			4598	
Travel Time (s)		12.3			16.0			153.0			125.4	
Volume (vph)	84	960	52	104	1088	44	56	352	68	68	448	560
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	91	1043	57	113	1183	48	61	383	74	74	487	609
Lane Group Flow (vph)	91	1100	0	113	1231	0	61	383	74	74	487	609
Turn Type	Perm			Perm			Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Minimum Split (s)	20.0	20.0		20.0	20.0		20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	25.0	25.0	0.0	25.0	25.0	0.0	25.0	25.0	25.0	25.0	25.0	25.0
Total Split (%)	50%	50%	0%	50%	50%	0%	50%	50%	50%	50%	50%	50%
Maximum Green (s)	21.0	21.0		21.0	21.0		21.0	21.0	21.0	21.0	21.0	21.0
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0		11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0		0	0	0	0	0	0
Act Effct Green (s)	21.0	21.0		21.0	21.0		21.0	21.0	21.0	21.0	21.0	21.0
Actuated g/C Ratio	0.42	0.42		0.42	0.42		0.42	0.42	0.42	0.42	0.42	0.42
v/c Ratio	0.61	0.74		0.76	0.83		0.24	0.49	0.11	0.22	0.62	0.90
Uniform Delay, d1	11.3	12.0		12.3	12.8		9.3	10.6	4.2	9.3	11.4	12.9
Delay	25.8	12.4		40.2	15.5		10.2	11.1	5.5	9.9	12.0	26.6
LOS	C	B		D	B		B	B	A	A	B	C
Approach Delay		13.5			17.6			10.2			19.5	
Approach LOS		B			B			B			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 50	
Offset: 23 (46%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	
Natural Cycle: 50	
Control Type: Pretimed	

Maximum v/c Ratio: 0.90
Intersection Signal Delay: 16.0 Intersection LOS: B
Intersection Capacity Utilization 85.3% ICU Level of Service D

Splits and Phases: 2: Int



APPENDIX B: Isolated intersection design and performance at 400N and Main street

Lanes, Volumes, Timings
3: Int 12/12/2019

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	320		0	326		305	0		0	0		0
Storage Lanes	1		0	1		1	1		1	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.97	0.95	0.95	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt		0.958				0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3391	0	3367	3406	1524	1770	3539	1583	1736	3505	1583
Flt Permitted	0.360			0.514			0.211			0.346		
Satd. Flow (perm)	1301	3391	0	1822	3406	1524	393	3539	1583	632	3505	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		22				133			427			112
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		25			40			25			25	
Link Distance (ft)		729			707			5533			4611	
Travel Time (s)		19.9			12.1			150.9			125.8	
Volume (vph)	114	268	80	524	587	191	58	613	289	140	1169	104
Peak Hour Factor	0.86	0.92	0.71	0.93	0.92	0.84	0.73	0.91	0.64	0.92	0.96	0.93
Heavy Vehicles (%)	2%	2%	2%	4%	6%	6%	2%	2%	2%	4%	3%	2%
Adj. Flow (vph)	133	291	113	563	638	227	79	674	452	152	1218	112
Lane Group Flow (vph)	133	404	0	563	638	227	79	674	452	152	1218	112
Turn Type	Perm			Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		6
Minimum Split (s)	20.0	20.0		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	22.0	22.0	0.0	22.0	22.0	22.0	23.0	23.0	23.0	23.0	23.0	23.0
Total Split (%)	49%	49%	0%	49%	49%	49%	51%	51%	51%	51%	51%	51%
Maximum Green (s)	18.0	18.0		18.0	18.0	18.0	19.0	19.0	19.0	19.0	19.0	19.0
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0	0	0	0	0
Act Effct Green (s)	18.0	18.0		18.0	18.0	18.0	19.0	19.0	19.0	19.0	19.0	19.0
Actuated g/C Ratio	0.40	0.40		0.40	0.40	0.40	0.42	0.42	0.42	0.42	0.42	0.42
v/c Ratio	0.26	0.29		0.77	0.47	0.33	0.48	0.45	0.49	0.57	0.82	0.15
Uniform Delay, d1	9.0	8.6		11.7	10.0	3.6	9.4	9.3	0.4	9.9	11.5	0.0
Delay	9.5	8.8		16.5	10.2	4.6	15.2	9.5	1.7	14.9	14.3	2.4
LOS	A	A		B	B	A	B	A	A	B	B	A
Approach Delay		9.0			11.8			7.0			13.5	
Approach LOS		A			B			A			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 45	

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 45
Control Type: Pretimed
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 10.8 Intersection LOS: B
Intersection Capacity Utilization 79.1% ICU Level of Service C

Splits and Phases: 3: Int

APPENDIX C: Isolated intersection design and performance at 400N and 100E

Lanes, Volumes, Timings
7: Int

12/12/2019

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	326		0	0		0	0		0	0		0
Storage Lanes	1		0	1		0	1		1	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.985			0.988				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3486	0	1770	3497	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.300			0.411			0.617			0.613		
Satd. Flow (perm)	559	3486	0	766	3497	0	1149	1863	1583	1142	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		34			27				198			96
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		40			40			25			25	
Link Distance (ft)		707			724			5611			4629	
Travel Time (s)		12.1			12.3			153.0			126.2	
Volume (vph)	101	479	50	139	627	35	66	215	151	65	208	76
Peak Hour Factor	0.97	0.92	0.89	0.85	0.90	0.58	0.83	0.92	0.70	0.86	0.92	0.79
Adj. Flow (vph)	104	521	56	164	697	60	80	234	216	76	226	96
Lane Group Flow (vph)	104	577	0	164	757	0	80	234	216	76	226	96
Turn Type	Perm			Perm			Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Minimum Split (s)	20.0	20.0		20.0	20.0		20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	20.0	20.0	0.0	20.0	20.0	0.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (%)	50%	50%	0%	50%	50%	0%	50%	50%	50%	50%	50%	50%
Maximum Green (s)	16.0	16.0		16.0	16.0		16.0	16.0	16.0	16.0	16.0	16.0
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0		11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0		0	0	0	0	0	0
Act Effct Green (s)	16.0	16.0		16.0	16.0		16.0	16.0	16.0	16.0	16.0	16.0
Actuated g/C Ratio	0.40	0.40		0.40	0.40		0.40	0.40	0.40	0.40	0.40	0.40
v/c Ratio	0.46	0.41		0.54	0.53		0.17	0.31	0.29	0.17	0.30	0.14
Uniform Delay, d1	8.8	8.0		9.2	8.8		7.7	8.2	0.6	7.7	8.2	0.0
Delay	11.2	8.3		12.0	9.1		8.2	8.6	2.3	8.2	8.6	2.6
LOS	B	A		B	A		A	A	A	A	A	A
Approach Delay		8.7			9.6			6.0			7.0	
Approach LOS		A			A			A			A	

Intersection Summary	
Area Type:	Other
Cycle Length: 40	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	

Natural Cycle: 40
Control Type: Pretimed
Maximum v/c Ratio: 0.54
Intersection Signal Delay: 8.2 Intersection LOS: A
Intersection Capacity Utilization 56.8% ICU Level of Service A

Splits and Phases: 7: Int

APPENDIX D: Isolated intersection design and performance at 400N and 200 E

Lanes, Volumes, Timings
12: Int

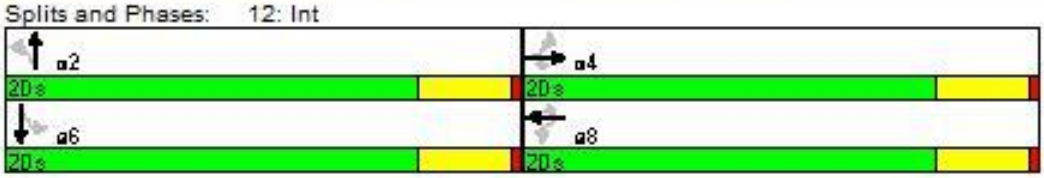
12/12/2019

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	185		0	320		0	0		0	0		0
Storage Lanes	1		1	1		1	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.948			0.982	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1810	1583	1770	1766	0	1770	1829	0
Flt Permitted	0.677			0.739			0.639			0.287		
Satd. Flow (perm)	1261	1863	1583	1377	1810	1583	1190	1766	0	535	1829	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			192			76		80			21	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		25			25			25			25	
Link Distance (ft)		1849			729			5519			4513	
Travel Time (s)		50.4			19.9			150.5			123.1	
Volume (vph)	14	26	177	175	114	70	32	321	170	38	152	21
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	2%	5%	2%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	15	28	192	190	124	76	35	349	185	41	165	23
Lane Group Flow (vph)	15	28	192	190	124	76	35	534	0	41	188	0
Turn Type	Perm		Perm	Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0		20.0	20.0	
Total Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	0.0	20.0	20.0	0.0
Total Split (%)	50%	50%	50%	50%	50%	50%	50%	50%	0%	50%	50%	0%
Maximum Green (s)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0		16.0	16.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0	0	0	0		0	0	
Act Effct Green (s)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0		16.0	16.0	
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40		0.40	0.40	
v/c Ratio	0.03	0.04	0.26	0.34	0.17	0.11	0.07	0.71		0.19	0.25	
Uniform Delay, d1	7.3	7.3	0.0	8.3	7.7	0.0	7.4	8.4		7.8	7.0	
Delay	7.5	7.5	2.0	8.9	8.0	2.8	7.7	11.1		8.6	7.4	
LOS	A	A	A	A	A	A	A	B		A	A	
Approach Delay		3.0			7.4			10.9			7.6	
Approach LOS		A			A			B			A	

Intersection Summary	
Area Type:	Other
Cycle Length: 40	

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 40
Control Type: Pretimed
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 8.1 Intersection LOS: A
Intersection Capacity Utilization 53.5% ICU Level of Service A

Splits and Phases: 12: Int



APPENDIX E: Coordinated intersection design and performance at all intersections (respectively).

Lanes, Volumes, Timings
2: Int

12/12/2019

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.992			0.994				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3511	0	1770	3518	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.167			0.167			0.320			0.427		
Satd. Flow (perm)	311	3511	0	311	3518	0	596	1863	1583	795	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		13			9				44			28
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		40			40			25			25	
Link Distance (ft)		724			939			5610			4598	
Travel Time (s)		12.3			16.0			153.0			125.4	
Volume (vph)	84	960	52	104	1088	44	56	352	68	68	448	560
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	91	1043	57	113	1183	48	61	383	74	74	487	609
Lane Group Flow (vph)	91	1100	0	113	1231	0	61	383	74	74	487	609
Turn Type	Perm			Perm			Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Minimum Split (s)	20.0	20.0		20.0	20.0		20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	28.0	28.0	0.0	28.0	28.0	0.0	27.0	27.0	27.0	27.0	27.0	27.0
Total Split (%)	51%	51%	0%	51%	51%	0%	49%	49%	49%	49%	49%	49%
Maximum Green (s)	24.0	24.0		24.0	24.0		23.0	23.0	23.0	23.0	23.0	23.0
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0		11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0		0	0	0	0	0	0
Act Effct Green (s)	24.0	24.0		24.0	24.0		23.0	23.0	23.0	23.0	23.0	23.0
Actuated g/C Ratio	0.44	0.44		0.44	0.44		0.42	0.42	0.42	0.42	0.42	0.42
v/c Ratio	0.67	0.71		0.83	0.80		0.24	0.49	0.11	0.22	0.63	0.90
Uniform Delay, d1	12.3	12.5		13.7	13.3		10.4	11.7	3.9	10.2	12.6	14.2
Delay	27.6	10.4		51.1	14.6		11.3	12.2	5.5	11.0	13.2	26.5
LOS	C	B		D	B		B	B	A	B	B	C
Approach Delay		11.7			17.7			11.1			20.0	
Approach LOS		B			B			B			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 55	
Offset: 23 (42%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	
Natural Cycle: 50	
Control Type: Pretimed	

Maximum v/c Ratio: 0.90
Intersection Signal Delay: 15.8 Intersection LOS: B
Intersection Capacity Utilization 85.3% ICU Level of Service D

Splits and Phases: 2: Int

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	320		0	326		305	0		0	0		0
Storage Lanes	1		0	1		1	1		1	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.97	0.95	0.95	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt		0.958				0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3391	0	3367	3406	1524	1770	3539	1583	1736	3505	1583
Flt Permitted	0.343			0.505			0.160			0.342		
Satd. Flow (perm)	1240	3391	0	1790	3406	1524	298	3539	1583	625	3505	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		29				155			427			112
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		25			40			25			25	
Link Distance (ft)		729			707			5533			4611	
Travel Time (s)		19.9			12.1			150.9			125.8	
Volume (vph)	114	268	80	524	587	191	58	613	289	140	1169	104
Peak Hour Factor	0.86	0.92	0.71	0.93	0.92	0.84	0.73	0.91	0.64	0.92	0.96	0.93
Heavy Vehicles (%)	2%	2%	2%	4%	6%	6%	2%	2%	2%	4%	3%	2%
Adj. Flow (vph)	133	291	113	563	638	227	79	674	452	152	1218	112
Lane Group Flow (vph)	133	404	0	563	638	227	79	674	452	152	1218	112
Turn Type	Perm			Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2		2	6		6
Minimum Split (s)	20.0	20.0		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	26.0	26.0	0.0	26.0	26.0	26.0	29.0	29.0	29.0	29.0	29.0	29.0
Total Split (%)	47%	47%	0%	47%	47%	47%	53%	53%	53%	53%	53%	53%
Maximum Green (s)	22.0	22.0		22.0	22.0	22.0	25.0	25.0	25.0	25.0	25.0	25.0
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0	0	0	0	0	0	0	0
Act Effct Green (s)	22.0	22.0		22.0	22.0	22.0	25.0	25.0	25.0	25.0	25.0	25.0
Actuated g/C Ratio	0.40	0.40		0.40	0.40	0.40	0.45	0.45	0.45	0.45	0.45	0.45
v/c Ratio	0.27	0.29		0.79	0.47	0.32	0.59	0.42	0.47	0.54	0.76	0.14
Uniform Delay, d1	11.1	10.3		14.4	12.2	3.3	11.1	10.1	0.5	10.8	12.5	0.0
Delay	10.3	9.3		15.4	9.4	2.5	24.1	10.3	1.7	12.4	13.0	2.4
LOS	B	A		B	A	A	C	B	A	B	B	A
Approach Delay		9.6			10.7			8.0			12.1	
Approach LOS		A			B			A			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 55	

Offset: 39 (71%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 45
Control Type: Pretimed
Maximum v/c Ratio: 0.79
Intersection Signal Delay: 10.3 Intersection LOS: B
Intersection Capacity Utilization 79.1% ICU Level of Service C

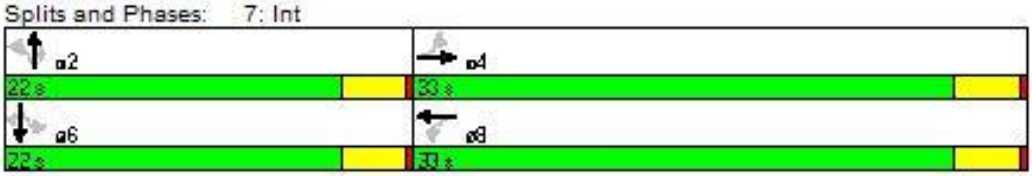
Splits and Phases: 3: Int

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	326		0	0		0	0		0	0		0
Storage Lanes	1		0	1		0	1		1	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.985			0.988				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3486	0	1770	3497	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.322			0.416			0.572			0.561		
Satd. Flow (perm)	600	3486	0	775	3497	0	1065	1863	1583	1045	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		31			25				216			96
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		40			40			25			25	
Link Distance (ft)		707			724			5611			4629	
Travel Time (s)		12.1			12.3			153.0			126.2	
Volume (vph)	101	479	50	139	627	35	66	215	151	65	208	76
Peak Hour Factor	0.97	0.92	0.89	0.85	0.90	0.58	0.83	0.92	0.70	0.86	0.92	0.79
Adj. Flow (vph)	104	521	56	164	697	60	80	234	216	76	226	96
Lane Group Flow (vph)	104	577	0	164	757	0	80	234	216	76	226	96
Turn Type	Perm			Perm			Perm		Perm	Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Minimum Split (s)	20.0	20.0		20.0	20.0		20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	33.0	33.0	0.0	33.0	33.0	0.0	22.0	22.0	22.0	22.0	22.0	22.0
Total Split (%)	60%	60%	0%	60%	60%	0%	40%	40%	40%	40%	40%	40%
Maximum Green (s)	29.0	29.0		29.0	29.0		18.0	18.0	18.0	18.0	18.0	18.0
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0		11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0		0	0	0	0	0	0
Act Effct Green (s)	29.0	29.0		29.0	29.0		18.0	18.0	18.0	18.0	18.0	18.0
Actuated g/C Ratio	0.53	0.53		0.53	0.53		0.33	0.33	0.33	0.33	0.33	0.33
v/c Ratio	0.33	0.31		0.40	0.41		0.23	0.38	0.33	0.22	0.37	0.16
Uniform Delay, d1	7.4	6.9		7.8	7.5		13.4	14.2	0.0	13.4	14.2	0.0
Delay	8.2	6.9		5.7	5.2		14.1	14.7	2.7	14.1	14.7	3.9
LOS	A	A		A	A		B	B	A	B	B	A
Approach Delay		7.1			5.3			9.7			12.0	
Approach LOS		A			A			A			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 55	
Offset: 32 (58%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	

Natural Cycle: 40
Control Type: Pretimed
Maximum v/c Ratio: 0.41
Intersection Signal Delay: 7.7 Intersection LOS: A
Intersection Capacity Utilization 56.8% ICU Level of Service A

Splits and Phases: 7: Int



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	185		0	320		0	0		0	0		0
Storage Lanes	1		1	1		1	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.948			0.982	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1810	1583	1770	1766	0	1770	1829	0
Flt Permitted	0.677			0.739			0.639			0.343		
Satd. Flow (perm)	1261	1863	1583	1377	1810	1583	1190	1766	0	639	1829	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			192			76		71			19	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		25			25			25			25	
Link Distance (ft)		1849			729			5519			4513	
Travel Time (s)		50.4			19.9			150.5			123.1	
Volume (vph)	14	26	177	175	114	70	32	321	170	38	152	21
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	2%	5%	2%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	15	28	192	190	124	76	35	349	185	41	165	23
Lane Group Flow (vph)	15	28	192	190	124	76	35	534	0	41	188	0
Turn Type	Perm		Perm	Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0		20.0	20.0	
Total Split (s)	23.0	23.0	23.0	23.0	23.0	23.0	32.0	32.0	0.0	32.0	32.0	0.0
Total Split (%)	42%	42%	42%	42%	42%	42%	58%	58%	0%	58%	58%	0%
Maximum Green (s)	19.0	19.0	19.0	19.0	19.0	19.0	28.0	28.0		28.0	28.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0	0	0	0		0	0	
Act Effct Green (s)	19.0	19.0	19.0	19.0	19.0	19.0	28.0	28.0		28.0	28.0	
Actuated g/C Ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.51	0.51		0.51	0.51	
v/c Ratio	0.03	0.04	0.29	0.40	0.20	0.13	0.06	0.57		0.13	0.20	
Uniform Delay, d1	11.9	11.9	0.0	13.6	12.6	0.0	6.8	7.9		7.1	6.6	
Delay	12.1	12.2	2.7	6.3	5.7	0.2	7.0	8.4		7.6	6.8	
LOS	B	B	A	A	A	A	A	A		A	A	
Approach Delay		4.4			4.9			8.3			6.9	
Approach LOS		A			A			A			A	

Intersection Summary	
Area Type:	Other
Cycle Length: 55	

Offset: 1 (2%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 40
Control Type: Pretimed
Maximum v/c Ratio: 0.57
Intersection Signal Delay: 6.5 Intersection LOS: A
Intersection Capacity Utilization 53.5% ICU Level of Service A

Splits and Phases: 12: Int