

VISSIM SIMULATION REPORT
FOR
DIVISION STREET



Submitted to: City of Traverse City
Date Prepared: December 17, 2010
URS Number: 12942514

URS Corporation - Great Lakes
TRAVERSE CITY, MICHIGAN

**VISSIM Modeling Report
Division Street
URS Project No. 12942514**

Scope for Traffic Modeling

URS' scope for the Division Street Roundabout Traffic Modeling called for developing VISSIM models for multiple different roundabout alternatives. The intended outcome of the model results was to determine the impact to traffic flow along the corridor. Typically VISSIM is not the model of choice for designing roundabouts, but was used for this analysis to assess traffic flow impacts along the corridor.

The model runs for the alternatives were created using 2009 (off season) morning and afternoon peak hour traffic data collected by MDOT and the City of Traverse City.

Division Corridor VISSIM Modeling

URS modeled six (6) roundabout alternatives as well as a VISSIM "base model" of existing conditions with the signalized intersections. The base model is for comparison of travel times and delays for the roundabout alternatives. The six modeled alternatives include the following:

- Alternative 1: Roundabouts at
 - 14th Street
 - 11th Street
 - 8 ½ Street,
 - Front Street
 - Grandview Parkway (no signalized intersections)
- Alternative 2: Roundabout at 11th Street
- Alternative 3: Roundabout at 14th Street
- Alternative 4: Roundabout at Front Street
- Alternative 5: Roundabouts at
 - 11th Street
 - 14th Street
- Alternative 6: Roundabouts at
 - 14th Street
 - 11th Street
 - Front Street
 - Grandview Parkway (signalized intersection at 7th Street)

The 2009 traffic volumes were adjusted to reflect the potential Franke Road connection to the Munson Medical Center. Based on traffic projections from the Munson Medical Center Access Study (Wade Trim, 1999), the traffic volumes accessing the hospital from the southwest were reduced by 11% which amounts to 32 vehicles in the morning peak hour and 21 vehicles in the afternoon peak hour. Ten simulations with different seed numbers were run to obtain average travel times and queues for the intersections along the corridor. The seed number is a VISSIM input which affects how traffic randomly enters the model based on the volume parameters. Seed numbers impact different simulation results; therefore an average from the multiple runs is used for the results.

The City of Traverse City provided pedestrian counts from May, 2008 at the Division Street intersections with Grandview Parkway, Front Street, 7th Street and 14th Street. These volumes were added to the models as the presence of pedestrians at a roundabout not only impacts traffic entering the roundabout, but also traffic exiting the roundabout and the overall operation of the roundabout. The pedestrian movements at the roundabout were modeled assuming unsignalized crossings at the roundabouts.

Division/14th Street Roundabout

During the creation of the models for the corridor, the VISSIM simulation showed significant queuing at the Division/14th Street roundabout. The model assumed that all legs of the roundabout would include two lanes. URS then performed a separate analysis on the Division/14th Street roundabout using RODEL software, which is modeling software specifically developed to measure traffic operations at a roundabout. According to RODEL, the westbound movement was over-capacity. RODEL showed that the southbound movement operated acceptably; however, the 85th percentile confidence level did show the southbound delay increasing at a higher rate than the other non-failing movements. The higher rate means that movement will reach capacity much quicker than the other movements.

URS contacted Ourston Roundabouts to provide assistance with designing the roundabout to operate more efficiently without adding lanes. Ourston recommended some adjustments that showed improvements in the RODEL analysis. Those modifications were made in the models and the roundabout simulation operates with less queuing and delay.

Ourston agreed with URS' assessment in that the intersection is close to maximizing its capacity as a two-lane roundabout. There is a concern that the volumes are from the fall of 2009 so the volumes do not take into account any future design year traffic growth or the increase in traffic during the summer months. Additionally, the growth of pedestrian traffic will potentially impact the operations of the intersection.

Simulation Results

A base model was created in VISSIM showing the existing conditions in the morning and afternoon peak hours. The base model was used in comparison to the alternatives to see what impacts the different roundabouts would have on the traffic operations in the corridor. The base model included signalized intersections at the following intersections with Division Street: Grandview Parkway, Front Street, 7th Street, and 14th Street. The signalized intersection of 14th Street/Veterans Drive was also included in all of the models. This intersection is approximately 1300-feet east of Division Street.

As part of the simulations for the alternatives, data was extracted to calculate travel times through the corridor, average and maximum intersection queue lengths, and average intersection delays. The average queue lengths are calculated per approach, not per lane.

Tables showing the average travel times, vehicle delays, and queue lengths can be seen in **Appendix A**. The tables show the results compared to the base model which was created without roundabouts. The travel times were calculated for traffic on Division Street from south of 14th Street to a point along Grandview Parkway.

The data from the VISSIM models show that the roundabouts typically improve travel times through the Division Street corridor from 14th Street to Grandview Parkway. The roundabouts eliminate time lost at a signalized intersection waiting for the phase for side-street traffic. Alternative 1 has the shortest travel times as it eliminates all of the traffic signals along the Division Street corridor. The roundabouts also typically decrease the average queues and average delays at the intersections.

The results of Alternative 2 show that this Alternative operates similarly to the Base Model but that is due to the fact that 11th Street is currently an unsignalized intersection with much lower volumes than the other signalized intersections. The existing intersection operates acceptably as an unsignalized intersection. For this reason, operating 11th Street as a roundabout intersection does not create substantial improvements to the average queues and delays. However, roundabouts can improve the intersection in other ways such as the potential for a decrease in accidents or lowering speeds through the corridor.

Findings

- The roundabout option at 14th Street (Alternative 3) does provide a significant reduction in the average queues and vehicle delays at the Division Street/14th Street intersection. The signalized intersections along the corridor do not appear to be affected by the presence of a roundabout at this intersection. Alternative 3 also results in shorter travel times through the Division Street corridor. Further analysis and study of the intersection as a roundabout would be needed as part of the Environmental Analysis (EA) process prior to the design of the roundabout.
- The roundabout option at Front Street (Alternative 4) provides a significant reduction in the average queues and vehicle delays at the Division Street/Front Street intersection. Due to the close proximity, it appeared that the roundabout at Front Street was impacting the operations of the Division Street/Grandview Parkway intersection. Northbound Division Street traffic was arriving at Grandview Parkway at a random rate, not like the platoon created by signalized intersections. It appeared as if the northbound movement at Grandview Parkway did not perform as efficiently as when Front Street was a signalized intersection.
- As mentioned before, the roundabout option at 11th Street (Alternative 2) does not show improvements in the average queues and vehicles delays. However, these improvements are minimal due to the fact that the intersection operated acceptably as an unsignalized intersection.
- The eastbound leg of the 8 ½ Street did experience some larger queue lengths in the afternoon peak hour. Further analysis of this intersection would potentially be necessary to determine if additional storage along 8 ½ Street would improve the capacity of the roundabout.
- Perform a complete roundabout analysis for all five of the roundabouts.

Potential Concerns

There are a few concerns with the operations of all of the roundabouts.

- The volumes are from the fall of 2009. These volumes do not take into account any future design year traffic growth or the increase in traffic during the summer months.
- The pedestrian volumes are from the spring of 2008. These pedestrian volumes do not take into account any future design year pedestrian traffic growth or the increase in pedestrian traffic during the summer months.
- When URS met with MDOT and the City at the MDOT Mt. Pleasant Transportation Service Center (TSC), MDOT Geometrics Unit expressed concerns regarding the roundabouts. For the most part the comments will have a minimal impact on the VISSIM models. However, MDOT did express the need to lower the speeds through the roundabouts, which could decrease the capacity at the roundabouts.
- The pedestrian crossings at the roundabouts were modeled as unsignalized crossings. The signalization of the crossing may potentially result in less delay for pedestrians attempting to cross the roundabout, while potentially increasing the delay to vehicles stopping at the crosswalk.

Appendix A – VISSIM Results

<u>Scenario</u>	AM		PM	
	<u>NB</u>	<u>SB</u>	<u>NB</u>	<u>SB</u>
Base	227.4	215.7	258.2	243.5
Alternative 1	186.3	194.3	188.5	221.5
Alternative 2	266.6	226.4	261.8	250.3
Alternative 3	215.8	213.4	231.4	214.4
Alternative 4	229.2	183.5	224.9	209.5
Alternative 5	215.4	228.7	229.1	229.6
Alternative 6	189.9	194.5	187.6	220.2

Source: URS Corporation, December 2010

Table 1. Average Travel Times (seconds)

<u>Scenario</u>	AM		PM	
	<u>NB</u>	<u>SB</u>	<u>NB</u>	<u>SB</u>
Base	20.3	22.0	17.8	19.5
Alternative 1	25.0	24.8	24.7	21.8
Alternative 2	18.5	21.1	17.7	19.3
Alternative 3	21.3	22.3	19.9	22.2
Alternative 4	20.1	25.8	20.5	22.6
Alternative 5	21.4	21.0	20.1	20.9
Alternative 6	24.4	24.6	24.7	21.7

Source: URS Corporation, December 2010

Table 2. Average Travel Time Speeds (mph)

Base	<i>Intersection:</i>	<u>AM</u>	<u>PM</u>
	Grandview	22.3	26.7
	Front	32.4	35.9
	7th Street	11.9	8.1
	11th Street	2.8	4.0
	14th/Silver Lk Rd	30.2	38.5
Alternative 1	<i>Intersection:</i>	<u>AM</u>	<u>PM</u>
	Grandview	10.8	18.5
	Front	3.5	7.1
	7th Street	1.9	6.2
	8 1/2 Street	1.4	12.7
	11th Street	1.5	2.7
	14th/Silver Lk Rd	5.1	10.0
Alternative 2	<i>Intersection:</i>	<u>AM</u>	<u>PM</u>
	Grandview	24.7	26.9
	Front	33.7	37.3
	7th Street	12.5	7.6
	11th Street	3.3	4.3
	14th/Silver Lk Rd	30.1	27.6
Alternative 3	<i>Intersection:</i>	<u>AM</u>	<u>PM</u>
	Grandview	23.7	26.8
	Front	33.0	34.9
	7th Street	12.3	9.1
	11th Street	1.8	2.9
	14th/Silver Lk Rd	5.4	9.9
Alternative 4	<i>Intersection:</i>	<u>AM</u>	<u>PM</u>
	Grandview	25.0	25.3
	Front	4.3	6.8
	7th Street	8.4	9.8
	11th Street	2.4	3.6
	14th/Silver Lk Rd	31.1	37.9
Alternative 5	<i>Intersection:</i>	<u>AM</u>	<u>PM</u>
	Grandview	22.9	26.1
	Front	32.6	34.6
	7th Street	12.2	9.2
	11th Street	2.4	3.4
	14th/Silver Lk Rd	5.2	10.4
Alternative 6	<i>Intersection:</i>	<u>AM</u>	<u>PM</u>
	Grandview	10.5	17.6
	Front	4.1	6.4
	7th Street	9.2	10.5
	11th Street	2.0	3.1
	14th/Silver Lk Rd	5.0	10.0

Source: URS Corporation, December 2010

Table 3. Average Vehicle Delays (seconds)
(Roundabout intersections highlighted in yellow)

<i>Base</i>	<i>Intersection:</i>	<i>AM</i>	<i>PM</i>
	Grandview	65.7	106.7
	Front	50.0	80.1
	7th Street	17.7	18.4
	11th Street	2.0	6.2
	14th/Silver Lk Rd	34.9	71.8
<i>Alternative 1</i>	<i>Intersection:</i>	<i>AM</i>	<i>PM</i>
	Grandview	25.4	100.7
	Front	4.9	25.6
	7th Street	1.6	23.8
	8 1/2 Street	0.1	140.6
	11th Street	0.7	2.8
	14th/Silver Lk Rd	6.0	47.4
<i>Alternative 2</i>	<i>Intersection:</i>	<i>AM</i>	<i>PM</i>
	Grandview	114.5	118.9
	Front	52.3	84.4
	7th Street	18.4	17.5
	11th Street	2.1	5.5
	14th/Silver Lk Rd	40.7	87.7
<i>Alternative 3</i>	<i>Intersection:</i>	<i>AM</i>	<i>PM</i>
	Grandview	94.6	121.5
	Front	51.5	74.9
	7th Street	18.2	19.4
	11th Street	0.8	4.4
	14th/Silver Lk Rd	7.2	27.8
<i>Alternative 4</i>	<i>Intersection:</i>	<i>AM</i>	<i>PM</i>
	Grandview	97.6	103.0
	Front	6.8	16.7
	7th Street	12.5	22.2
	11th Street	1.4	5.1
	14th/Silver Lk Rd	33.8	65.0
<i>Alternative 5</i>	<i>Intersection:</i>	<i>AM</i>	<i>PM</i>
	Grandview	88.0	110.4
	Front	50.3	73.6
	7th Street	17.9	19.1
	11th Street	1.5	3.9
	14th/Silver Lk Rd	6.5	31.9
<i>Alternative 6</i>	<i>Intersection:</i>	<i>AM</i>	<i>PM</i>
	Grandview	26.2	111.4
	Front	5.5	14.7
	7th Street	13.1	21.7
	11th Street	1.1	3.8
	14th/Silver Lk Rd	5.8	37.9

Source: URS Corporation, December 2010

Table 4. Average Queue Lengths (feet)
(Roundabout intersections highlighted in yellow)

		Base		Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6	
Intersection	Movement	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Grandview	NB	590	871	244	477	736	709	688	827	611	671	591	692	284	364
	EB	443	443	571	942	415	409	441	368	416	373	451	349	548	1011
	WB	454	682	247	846	485	791	501	621	496	629	463	621	244	909
Front Street	NB	262	470	184	260	302	380	341	443	218	283	352	389	203	243
	EB	455	598	131	284	476	598	535	557	223	307	499	555	145	248
	SB	390	512	101	130	425	544	431	498	155	203	377	520	130	231
	WB	355	537	133	374	338	538	305	529	153	303	333	533	152	270
7th Street	NB	176	149	0	0	210	112	176	212	172	136	175	203	178	187
	EB	77	204	56	372	71	161	68	223	70	211	67	174	70	154
	SB	310	172	0	9	290	166	262	177	134	258	283	169	142	215
	WB	170	202	86	153	172	196	194	188	187	192	176	203	171	191
8 1/2 Street	NB	--	--	67	108	--	--	--	--	--	--	--	--	--	--
	EB	--	--	44	965	--	--	--	--	--	--	--	--	--	--
	SB	--	--	86	129	--	--	--	--	--	--	--	--	--	--
11th Street	NB	201	314	42	46	76	214	115	115	216	276	77	82	52	104
	EB	93	183	76	153	87	226	91	196	90	181	88	190	79	171
	SB	50	52	124	194	227	214	32	40	10	26	160	256	129	225
	WB	43	22	21	8	20	6	34	23	40	32	26	0	19	0
14th Street	NB	436	499	158	115	449	508	159	108	450	510	170	124	147	110
	EB	344	351	107	181	367	372	122	177	342	338	117	169	105	208
	SB	265	690	95	425	233	667	118	454	290	745	116	448	123	443
	WB	240	859	280	1114	264	1005	286	711	241	742	251	848	253	784

Source: URS Corporation, December 2010

Table 5. Maximum Queue Lengths (feet)
(Roundabout intersections highlighted in yellow)