

High-Capacity Roundabout Intersection Analysis: Going Around in Circles

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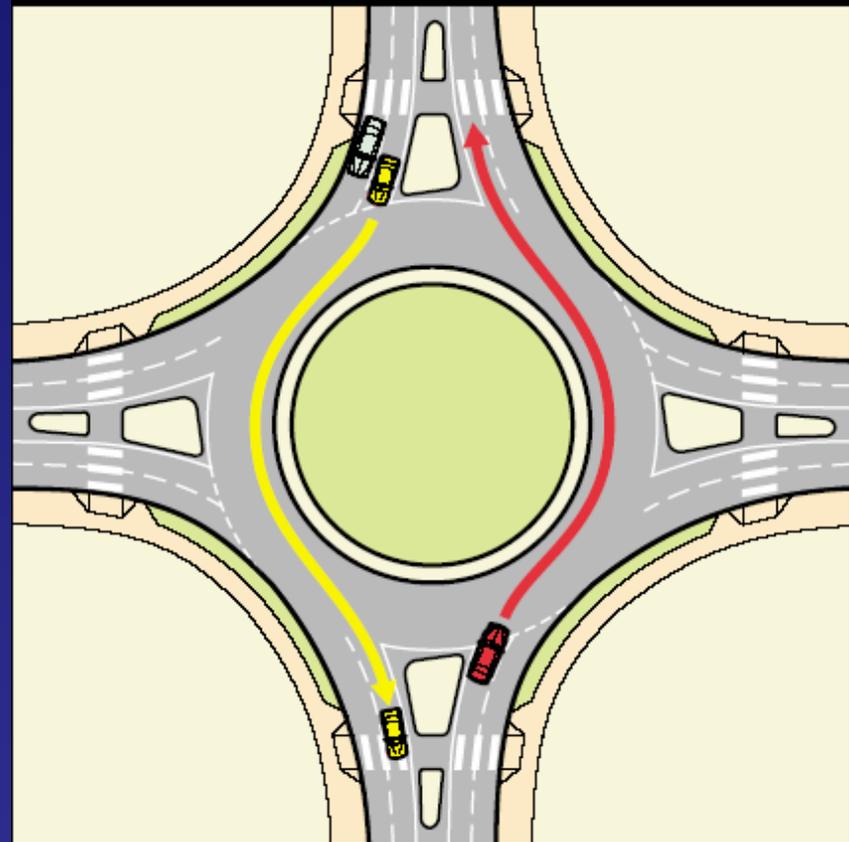
Vail, CO

Presentation Overview

- **What is a high-capacity roundabout?**
- **What methods are used to analyze traffic operations?**
- **How are these methods applied to real-world problems?**
- **What are the differences in analysis results between methods?**
- **Which method should be used for a given set of conditions?**

High-Capacity Roundabout

- **Modern roundabout with yield entry**
- **Approaches with 2 or more lanes**
- **An alternative to traffic signals for high-volume locations**



Roundabout Analysis Methods

- **Highway Capacity Manual (TRB, 2000)**
 - Only one-lane roundabouts
 - LOS thresholds are undefined
- **Roundabouts: An Informational Guide (FHWA, 2000)**
 - Equations for two-lane roundabouts
 - Design to v/c of 0.85
 - List of analysis software

Roundabout Analysis Methods

- **Macroscopic Models (Isolated)**
 - Analyze vehicle flows
 - Methods: **RODEL & SIDRA**
- **Microscopic Models (System)**
 - Analyze individual vehicles & drivers
 - Methods: **SimTraffic, Paramics, & VISSIM**

RODEL

- **Barry Crown, UK**
- **Regression equations based on observations of UK intersections**
- **Design elements determine approach capacity (diameter, entry width, etc.)**
- **Interactive design / operations analysis**

RODEL

RODEL											
12:0:03 NB SR 99/EAST FIRST AVE 1											
E (m)	5.00	10.00	10.00	10.00	TIME PERIOD	min	90				
L' (m)	10.00	10.00	10.00	10.00	TIME SLICE	min	15				
U (m)	3.00	7.00	7.00	7.00	RESULTS PERIOD	min	0 60				
RAD (m)	30.00	30.00	30.00	30.00	TIME COST	\$/hr	15.00				
PHI (d)	40.00	40.00	40.00	40.00	FLOW PERIOD	min	0 60				
DIA (m)	45.00	45.00	45.00	45.00	FLOW TYPE	pcu/veh	VEH				
GRAB SEP	0	0	0	0	FLOW PEAK	am/op/pm	PM				
LEG NAME	PCU	FLOWS (1st exit 2nd etc...0)				FLDF	CL	FLOW RATIO			FLOW TIME
NB 99 ON	1.02	0	0	0	0	1.11	50	1.11	1.111	1.11	0 30 60
WB E 1ST	1.02	185	745	0	20	1.11	50	1.11	1.111	1.11	0 30 60
NB 99 OFF	1.02	0	5	950	0	1.11	50	1.11	1.111	1.11	0 30 60
EB E 1ST	1.02	0	625	215	0	1.11	50	1.11	1.111	1.11	0 30 60
MODE 2											
FLOW	veh	0	1055	1060	932						
CAPACITY	veh	156	2300	1821	1638	AVDEL	s	3.7			
AVE DELAY	mins	0.00	0.04	0.07	0.07	L O S	A				
MAX DELAY	mins	0.00	0.05	0.08	0.08	VEH HAS	3.1				
AVE QUEUE	veh	0	1	1	1	COST	\$	46.4			
MAX QUEUE	veh	0	1	1	1						
Fmode	F2direct	F3peak	GTRFSkev	F5fact	F6stats	F8econ	E9prnt	F10run	Esc		

SIDRA

- **Akcelik & Associates, Australia**
- **Intersection analysis similar to HCM**
- **Uses gap acceptance and lane utilization to determine capacity**
- **Can change headway values to calibrate to local conditions**

SIDRA

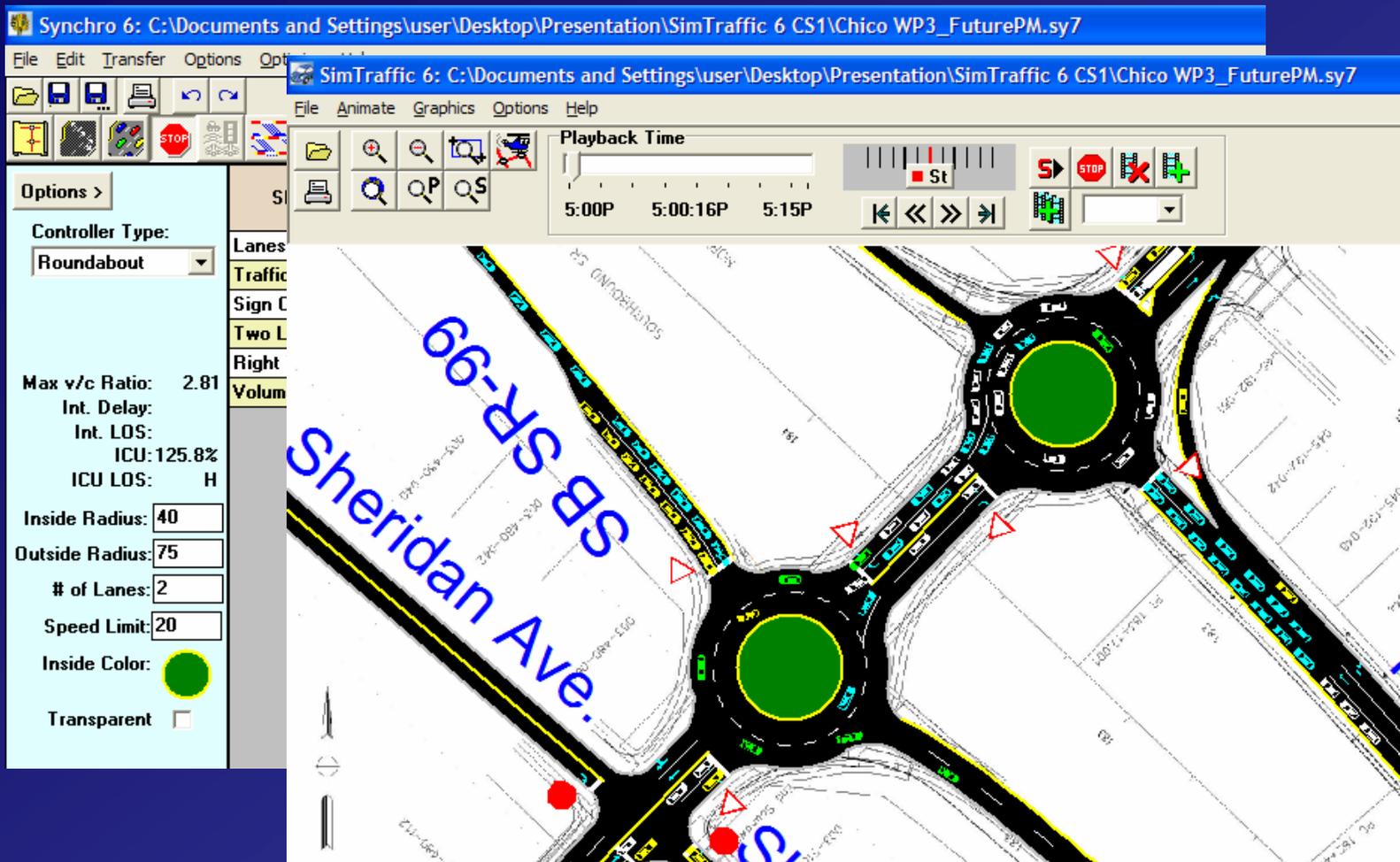
The screenshot displays the aaSIDRA 2.0 software interface. On the left is a project tree for 'AIE127PM2' with folders for Geometry, Input, RIDES, Data Listing, Output, and Output Tables. The main window shows a 'Movement Summary' report for a roundabout. The report includes a diagram of the roundabout geometry with four approaches: EB E First Ave, WB E First Ave, SB Off-r, and NB On-r. The table below the diagram provides movement counts for each approach.

File	Roundab	Vehicle	Mov No
E Fir			
Roundab			
Alte			
Inte			
aaTr			
RUN			
* Ba			
WB E Fir	22		
	21		
Approa			
SB Off-r	42		

SimTraffic

- **Trafficware, USA**
- **Stochastic simulation model**
- **Uses Synchro for data input**
- **Driver behavior and vehicle characteristics**
- **Can change headway factors to calibrate to local conditions**

SimTraffic



Paramics

- **Quadstone, UK**
- **Stochastic simulation model**
- **Driver behavior and vehicle characteristics**
- **Link/node network structure**
- **Automatically creates roundabout**

Paramics



VISSIM

- **PTV, Germany**
- **Stochastic simulation model**
- **3D animation features**
- **Link/connector network structure**
- **Specify gap acceptance parameters by lane for each approach**

VISSIM



Review of Methods

- **FHWA & RODEL**
 - Based on British regression equations
 - Gap acceptance & lane configuration are not factors
- **SIDRA & SimTraffic**
 - Allow calibration of gap acceptance parameters to local conditions
- **Paramics & VISSIM**
 - Most flexible in modeling behavior

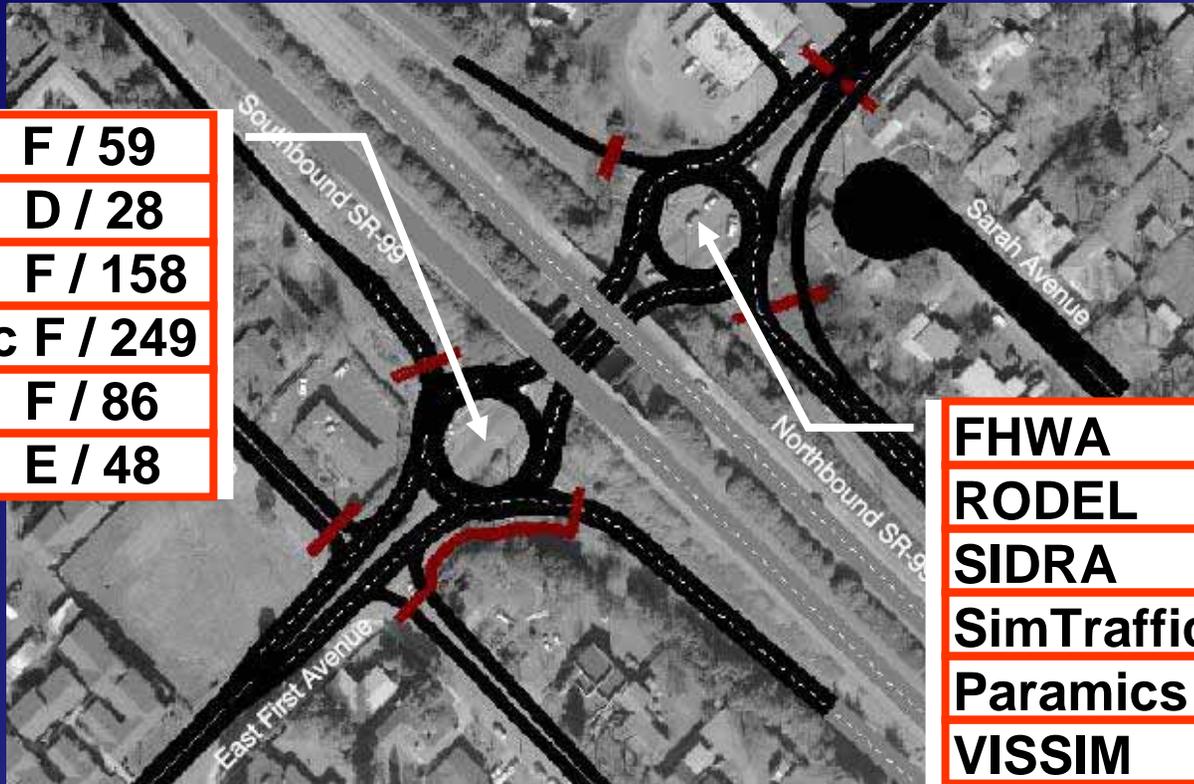
Case Study #1 - Description

- **SR-99/East First Avenue in Chico, CA**
- **Design Year (2027) PM Peak Hour**
- **Other alternatives with signals analyzed with CORSIM**
- **Diamond interchange with roundabout ramp terminal intersections**

Case Study #1 - Description



Case Study #1 - Results



FHWA	F / 59
RODEL	D / 28
SIDRA	F / 158
SimTraffic	F / 249
Paramics	F / 86
VISSIM	E / 48

FHWA	A / 5
RODEL	A / 4
SIDRA	D / 28
SimTraffic	F / 353
Paramics	C / 24
VISSIM	B / 11

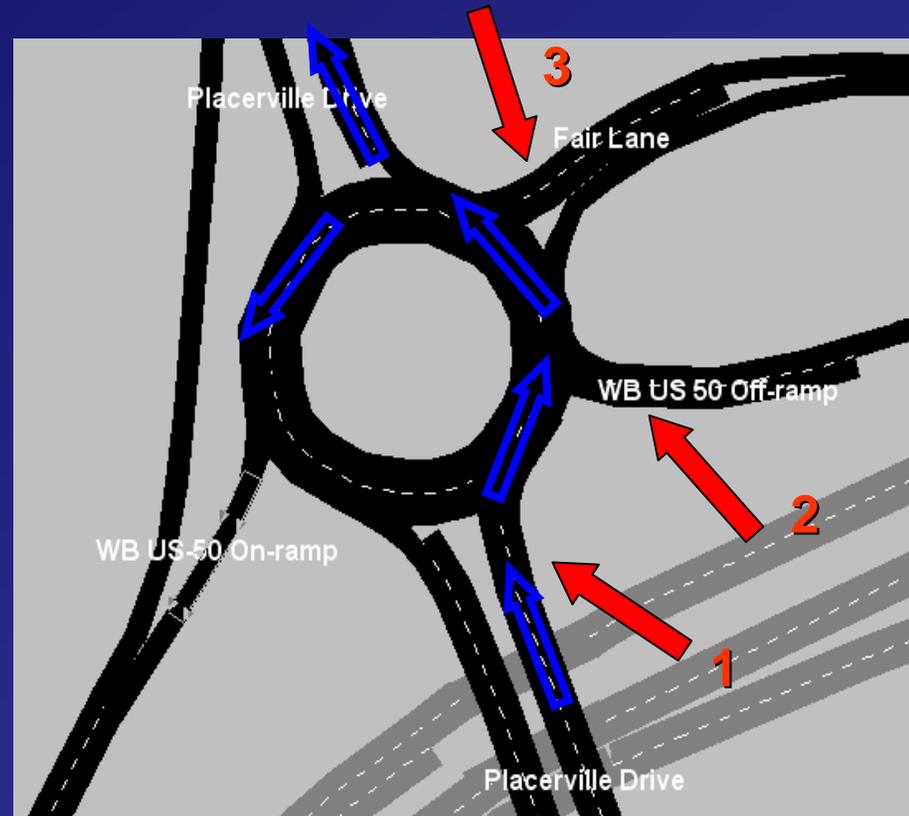
- **VISSIM** predicted the lowest delay for the roundabout, about 11% less than the next best performer, **Paramics**.





Case Study #2 - Description

- **US-50/Placerville Dr. in Placerville, CA**
- **Design Year (2030) PM Peak Hour**
- **5-leg roundabout at westbound ramp terminal intersection**



Case Study #2 - Results

- **RODEL & SIDRA report good LOS**
- **Difficult to model the geometry accurately**

Method	LOS / Delay
RODEL	B / 11
SIDRA	B / 15
VISSIM	F / 99

- **VISSIM can model one-lane exits, lane restrictions, & gap acceptance factors**
- **Shows insufficient gaps for 3rd approach**



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Recommendations

- **FHWA, RODEL, & SIDRA**
 - For uncongested conditions
 - For isolated locations
- **SimTraffic**
 - For congested conditions
 - For system-wide analysis
 - For restricted geometry (one-lane exits or forced right two-lane exits)

Recommendations

- **Paramics & VISSIM**
 - For congestion conditions
 - For system-wide analysis
 - For complex geometry, such as:
 - Weaving within the roundabout
 - Signalized intersections
 - Right-of-way constraints
 - Freeway ramps
 - Driveways

Questions?

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