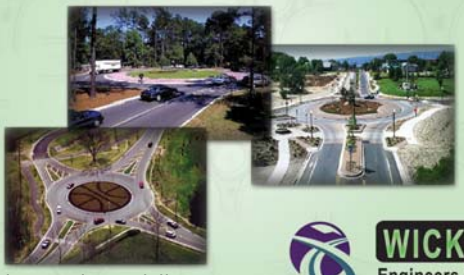
Introduction to Roundabouts: The In's & Out's



Planning & Delay Modeling

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Planning Roundabouts

- Similar to other controlled intersections
- Performance and design measures
- Planning level studies
- Preliminary designs
- Delay modeling
- Comparison of alternatives

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Performance Measures

- Same as a other intersections
  - Degree of saturation (v/c)
  - Amount of Delay
  - Queue Lengths

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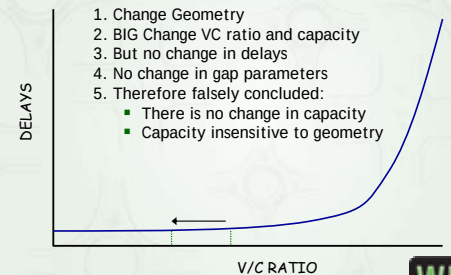
Planning Level Studies

- Two Planning Level Studies
  - Roundabout Feasibility Study (Implies a "Done Deal")
  - Intersection Alternatives Analysis
- Preliminary Size
  - Number of Entry and Exit Lanes
  - Number of Circulatory Lanes
  - Approximate Inscribed Diameter

Planning Level Capacity Number of Entry and Exit Lanes

- Simple Spreadsheet using traffic volumes, bus and truck percentages
- Equations are based on FHWA equations (Appendix A)
- If v/c ratio is .85 or greater should add another lane. Allows a reserve capacity. (At capacity flows and queue lengths can vary significantly.)

Gap Capacity is Insensitive to Geometry



FHWA Spreadsheet Sample

Row			a Raw Traffic Volumes	b Adjusted Volumes	c Total Entering Volume by Approach	d Total Circulating Volume, Q	e Single Lane Entry Capacity, C_1	f Double Lane Entry Capacity, C_2	g v/c Single Lane	h v/c Double Lane
				$a*f_{HV}$ / PHF	1+2+3+4	5+8+9+10+12 +16	C = 1212-0.5447 * Q	C = 2424 - 0.7159 * Q	v/c = c / e	v/c = c / f
1		SB LT	100	116						
2	North	SB TH	350	406	668	958	690	1738	0.97	0.38
3	Approach	SB RT	100	116						
4		SB UT	25	29						
5		NB LT	100	116						
6	South	NB TH	350	406	668	726	817	1904	0.82	0.35
7	Approach	NB RT	100	116						
8		NB UT	25	29						
9		WB LT	300	348						
10	East	WB TH	350	406	900	726	817	1904	1.10	0.47
11	Approach	WB RT	100	116						
12		WB UT	25	29						
13		EB LT	100	116						
14	West	EB TH	350	406	668	958	690	1738	0.97	0.38
15	Approach	EB RT	100	116						
16		EB UT	25	29						

PHF = 0.9, trucks = 4% (all approaches), buses = 1% (all approaches)
f_{HV} = 1.0 *.95+1.5*.01+2*.04

f_{HV} = 1.045 PHF = 0.9

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Circulating Roadway Width Inscribed Circle Diameter

Inscribed Circle Diameter	Minimum Circulatory Lane Width*	Central Island Diameter
45 m (150 ft)	9.8 m (32 ft)	25.4 m (86 ft)
50 m (165 ft)	9.3 m (31 ft)	31.4 m (103 ft)
55 m (180 ft)	9.1 m (30 ft)	36.8 m (120 ft)
60 m (200 ft)	9.1 m (30 ft)	41.8 m (140 ft)
65 m (215 ft)	8.7 m (29 ft)	476 m (157 ft)
70 m (230 ft)	8.7 m (29 ft)	52.6 m (172 ft)

Recommendations from the FHWA Roundabout Guidelines, Exhibit 6-22

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Delay Modeling

Two Main Analysis Theories

- Empirical (ADOT Preferred)
  - British
  - Models = RODEL (ADOT Preferred) & ARCADY
- Gap Acceptance
  - Australian
  - Model = SIDRA

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Analysis Methodology

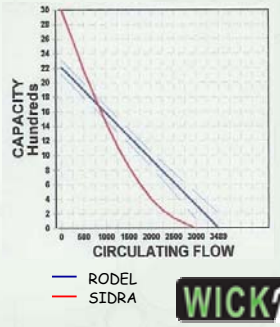
- RODEL – Empirical Equations
  - Transportation Research Laboratory (TRL) derived linear regression equations from measured entry capacities and circulating flows.
  - Surveyed over 0.5M vehicles and 11,000 capacity measurements at 86 roundabouts.
  - Range of measured data at ± 14% of equation (95% confidence).
  - Model uses total circulating flow rate to determine the total entry capacity per approach. Individual lane details are not accounted for.

Analysis Methodology

- SIDRA – Gap Acceptance
  - Capacity based on size of time gaps between vehicles that motorists choose when entering the roundabout.
  - Gap-acceptance parameters calibrated to Australian roundabouts.
  - Capacity sensitive to total circulating flows as well as variations in lane use, approach demand flow pattern, queuing and bunching.

Analysis Methodology

- For saturated roundabout conditions, Sidra predicts higher capacities at low circulating flows and lower capacities at high circulating flows compared to Rodel.



Questions????

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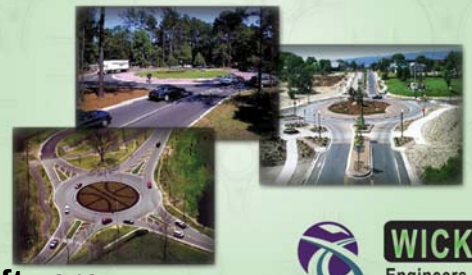
Introduction to Roundabouts: The In's & Out's



Software

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Software

- Why use it?
  - Fast
  - Allows iterative process (dynamic design)
- Types of software
  - Analytical and empirical software
  - Simulation

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Analytical and Empirical Software

- HCS 2000 (and others)
- ARCADY
- RODEL
- SIDRA
- KREISEL
- GIRABASE

HCS 2000 (and others)

- Developer: McTrans (Univ. of Florida)
- Model basis: HCM (Analytical)
- Cost: $500
- Distributor: McTrans

McTrans Center
University of Florida
512 Weil Hall
P.O. Box 116585
Gainesville, FL 32611-6585
(352) 392-0378, fax (352) 392-3224
Web site: mctrans.ce.ufl.edu

HCS 2000 (and others)

- Advantages
  - Implements HCM 2000 (same as 1997 HCM)
  - Also has signalized, TWSC, AWSC procedures
- Disadvantages
  - Single-lane roundabouts only
  - No delay, queuing estimates

ARCADY

- Developer: Transport Research Laboratory (TRL), United Kingdom
- Model basis: UK empirical equations
- Cost: ~$1,250
- Distributor: Systematica North America

Systematica North America
P.O. Box 313
Mt. Vernon, VA 22121
(800) 874-7710, fax (703) 780-7874

ARCADY

- Advantages
  - Addresses all roundabout configurations
  - Includes crash prediction model (UK equations)
  - Backed by TRL
- Disadvantages
  - Requires detailed knowledge of geometrics
  - Restricted to 50% confidence limits
  - Calibration to U.S. capacity unknown at this time

RODEL (ADOT Preferred)

- Developer: Barry Crown, United Kingdom
- Model basis: UK empirical equations
- Cost: $800
- Distributor: Rodel Software Ltd., UK

Rodel Software Ltd.
Staffordshire County Council
11, Carlton Close
Cheadle
Stoke-on-Trent ST10 1LB
United Kingdom
011-44-78-527-6582, fax 011-44-78-521-1279
e-mail: RSLcrown@aol.com

RODEL

- Advantages:
  - Includes design mode (performance targets specified) and evaluation mode (geometric parameters specified)
  - Allows user-specified confidence limits
  - Spreadsheet-style format
- Disadvantages:
  - Requires detailed knowledge of geometrics
  - Calibration to U.S. capacity unknown at this time

SIDRA

- Developer: Akçelik & Associates Pty Ltd
- Model basis: Australian analytical (gap)
- Cost: ~$850

Developer:
Akçelik & Associates Pty Ltd.
P.O. Box 1075G
Greythorn, Vic 3104
Australia
011-61-3-9857-9351
fax 011-61-3-9857-5397
e-mail: info@akcelik.com.au
www.akcelik.com.au/sidra

U.S. Distributor:
McTrans Center
University of Florida
512 Weil Hall
P.O. Box 116585
Gainesville, FL 32611-6585
(352) 392-0378, fax (352) 392-3224
Web site: mctrans.ce.ufl.edu

SIDRA

- Advantages:
  - Commonly used in U.S.
  - Can also evaluates TWSC, AWSC, and signals: good for comparative analysis
  - Also provides HCM 97 and German procedures
- Disadvantages:
  - Not statistically validated against measured capacities

KREISEL

- Developer: Ruhr-University Bochum
- Model basis: All methods
- Cost: TBD for English version
- Distributor:

Ruhr University Bochum
Institute for Transportation and Traffic Engineering
Universitaesstrasse, 150
Building 1A, Room 2/126
D-44780 Bochum
Germany
011-49-234-700-5936, fax 011-49-234-7094-151

KREISEL

- Advantages:
  - Implements models from many countries, including Germany, UK, France, Australia, U.S.
  - Provides comparison of procedures
- Disadvantages:
  - Currently has very limited use in U.S.

GIRABASE

- Developer: Bernard Guichet, France
- Model basis: French empirical equations
- Cost: 5,000 FF (~ $800)
- Distributor: CERTU, France

MINISTERE DE L'EQUIPMENT
CERTU / Bureau de vente
9, rue Juliette Récamier
69456 Lyon Cedex 06
France
www.certu.fr

GIRABASE

- Advantages:
  - Gives capacity, delay, queuing
  - Gives recommendations for design modifications
- Disadvantages:
  - Currently has very limited use in U.S.

Simulation

- Why consider simulation?
- How to use simulation
- Examples of available models

Why Consider Simulation?

- Microscopic modeling of roundabouts
- Based on car-following theory and lane-changing logic
- Requires greatest level of care in application
- Research needed on effectiveness of models

Questions to Ask

- Is simulation appropriate?
- Can the model's input requirements be met?
- What style of output is required?
- What special features of the model apply to my problem?
- How sensitive is the model to geometry?
- Is the model validated for roundabouts?

Sample of Available Simulation Models

- CORSIM
- Integration
- Simtraffic
- VISSIM
- Paramics

CORSIM

- Developer: FHWA
- Cost: $500
- Distributor: McTrans

McTrans Center
University of Florida
512 Weil Hall
P.O. Box 116585
Gainesville, FL 32611-6585
(352) 392-0378, fax (352) 392-3224
Web site: mctrans.ce.ufl.edu

CORSIM

- Advantages:
  - Model is commonly used in U.S.
- Disadvantages:
  - No roundabout-specific features
  - Known flaws in current modeling of roundabouts

Integration

- Developer: Michel Van Aerde
- Cost: $400
- Distributor: McTrans

McTrans Center
University of Florida
512 Weil Hall
P.O. Box 116585
Gainesville, FL 32611-6585
(352) 392-0378, fax (352) 392-3224
Web site: mctrans.ce.ufl.edu

Integration

- Advantages:
  - Model is commonly used in U.S.
  - Good for large-scale planning-level applications
- Disadvantages:
  - No roundabout-specific features

Simtraffic

- Developer: David Husch
- Cost: ~$900
- Distributor: Trafficware

Trafficware
1442A Walnut Street #210
Berkeley, CA 94709
(510) 526-5891, fax (510) 526-5199
Web site: www.trafficware.com

Simtraffic

- Advantages:
  - Direct interface with Synchro
- Disadvantages:
  - No roundabout-specific features
  - Has not been validated for roundabouts

VISSIM

- Developer: PTV system Software and Consulting GmbH, Germany
- Cost: ~$12,000; also lower cost versions
- Distributor: Innovative Transportation Concepts

Innovative Transportation Concepts, LLC
1128 NE Second Street, Suite 204
Corvallis, OR 97330
(541) 754-8836, fax (541) 754-6837

VISSIM

- Advantages:
  - Good graphical interface
  - Can model interaction with transit, complex signal systems
- Disadvantages:
  - No roundabout-specific features
  - Limited use in U.S. to date

Paramics

- Developer: Quadstone, Ltd., Scotland
- Cost: ~$11,000
- Distributor: Quadstone, Ltd.

Quadstone Ltd.
16 Chester Street
Edinburgh EH3 7RA
Scotland
011-44-131-220-4491, fax 011-44-131-220-4492
Web site: www.paramics-online.com

Paramics

- Advantages:
  - Good graphical interface, including 3-D animation
  - Explicitly models roundabouts
  - Models vehicles in two dimensions (vectors)
- Disadvantages:
  - Limited use in U.S. to date

References

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- Designing and Implementing Roundabouts –Scott Ritchie & Barry Crown Course 4/04

Website References

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- http://www.hwysafety.org/
- http://www.roundabouts.net/
- http://www.ourston.com/
- http://www.dot.state.az.us/
- http://www.ksu.edu/roundabouts/ada/photos.htm - Great Pictures for roundabouts!
- http://www.trans.ci.portland.or.us/trafficcalming/devices/roundaboutphotos.htm
- http://roundabout.kittelson.com/

Questions????