SIDRA SOLUTIONS

Akcelik & Associates Pty Ltd
PO Box 1075G, Greythorn, Vic 3104 AUSTRALIA
info@sidrasolutions.com

Management Systems Registered to ISO 9001
ABN 79 088 889 687

ROUNDABOUT MODEL COMPARISON TABLE

Prepared by
Rahmi Akçelik

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The table given in the following pages presents a brief comparison of main features of three roundabout capacity models, namely the Australian model as implemented in the SIDRA INTERSECTION software (1-12), the HCM 2010 model described in the 2010 Highway Capacity Manual (13-15), and the UK (TRL) model implemented in the RODEL and ARCADY software packages (16-21).

The HCM 2010 model has been implemented in the SIDRA INTERSECTION software. The terms *SIDRA Standard* and *HCM 2010* models are used to distinguish between the two model options in SIDRA INTERSECTION.

In order to avoid misleading statements about particular software packages, the third model will be referred to as the *UK TRL* model to distinguish it as the original published model as opposed to the ARCADY and RODEL software packages which have implemented it since the software may include some differences from the original model.

The features compared include methodology, model level of detail (lane-based or approach-based), parameters used in the model to represent driver behavior and roundabout geometry, and model calibration methods. The comparison focuses on the capacity model and makes only a brief reference to modeling of performance (delay, queue length, fuel consumption and emissions, etc.) and level of service methods used.

For detailed discussions and case studies on this subject, refer to many technical papers (including many of those listed in the REFERENCES section of this document) available for download from our web pages shown below:

http://www.sidrasolutions.com/**Resources/Articles**

http://www.sidrasolutions.com/**Resources/Roundabouts/SIDRA_For_Roundabouts**

Comparison of the main features of SIDRA Standard, HCM 2010 and UK TRL models

Model Feature	*SIDRA Standard* Model	*HCM 2010* Model	*UK TRL* model
Methodology	Based-on gap-acceptance theory with empirical (regression) equations to model gap-acceptance parameters including the effect of roundabout geometry.	Empirical (exponential regression) capacity model with clear basis in gap-acceptance theory.	Empirical (linear regression) capacity model with no stated basis in traffic theory.
	Lane-based model: capacity and performance of individual entry lanes modeled.	***Lane-based*** model: capacity and performance of individual entry lanes modeled.	***Approach-based*** model: all lanes aggregated. Lane capacity and performance not available.
Model Level of Detail - Entry and Circulating Lanes	Variations in lane disciplines (exclusive and shared lanes, slip and continuous lanes) can be modeled.	Variations in lane disciplines (exclusive and shared lanes, slip and continuous lanes) can be modeled.	Variations in lane disciplines (exclusive and shared lanes, slip and continuous lanes) cannot be modeled.
	Dominant and subdominant entry lanes identified.	Dominant and subdominant entry lanes identified.	Entry lanes not identified.
	Number of circulating lanes affects capacity.	Number of circulating lanes affects capacity.	Number of circulating lanes does not affect capacity.
	Circulating lane flow rates used allowing for unbalanced flows. Amount of queuing before entering circulating stream affects capacity.	Total circulating flow rate used. Circulating lane flows not used.	Total circulating flow used. Circulating lane flows not used.
	Uses a bunched arrival headway model for the circulating stream. Proportion bunched modeled.	Uses a random arrival headway model for the circulating stream.	No explicit assumptions about circulating stream headways.
	Extra bunching to model upstream signal effects allowed.	Effect of upstream signals modeled as an extension to the HCM 2010 model in SIDRA INTERSECTION.	Not used.
	A proportion of exiting flow can be added to circulating flow as opposing flow.	Not applicable.	*Not known to the author.*
Lane Utilization for Multilane Approaches	Entry lane flow rates are calculated.	Entry lane flow rates are calculated.	No lane flow details.
	De facto exclusive lanes are identified.	De facto exclusive lanes are identified.	De facto exclusive lanes cannot be identified.
	Unequal lane use can be modeled by specifying lane utilization ratios.	Unequal lane use can be modeled by specifying lane volume percentages.	Unequal lane use cannot be modeled.
	Critical lane v/c ratio (degree of saturation) for a multilane approach is determined.	Critical lane v/c ratio (degree of saturation) for a multilane approach is determined.	Critical lane v/c ratio cannot be determined (only the average v/c ratio for the approach is available). This will underestimate the higher v/c ratio of the critical lane unless equal lane use exists.

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Comparison of the main features of SIDRA Standard, HCM 2010 and UK TRL models *(continued)*

Model Feature	*SIDRA Standard* Model	*HCM 2010* Model	*UK TRL* model
Driver Behavior Parameters	Gap-acceptance parameters (Follow-up Headway, Critical Gap), entry lane-use model and circulating stream bunching represent driver behavior. Driver response times determined.	Gap-acceptance parameters (Follow-up Headway, Critical Gap) and entry lane-use model represent driver behavior.	No direct representation of driver behavior. Capacity is sensitive to the circulating flow rate only.
	Follow-up Headway and Critical Gap depend on roundabout geometry.	Follow-up Headway, Critical Gap values are constant.	Not used.
	Follow-up Headway and Critical Gap values are reduced (more aggressive driver behavior) with increased circulating flow rate.	Follow-up Headway, Critical Gap values are constant.	Not used.
	Priority sharing and priority emphasis effects are included in the model.	Not applicable.	Not used.
Roundabout Geometry Parameters (list of geometry parameters affecting capacity) Differences in sensitivities indicated.	Average entry lane width	Not used	Total entry width
	Number of entry lanes	Number of entry lanes	Not used
	Approach lane disciplines and configuration including bypass lanes	Approach lane disciplines and bypass lanes	Not used
	Number of circulating (conflicting) lanes	Number of circulating (conflicting) lanes	Not used
	Inscribed diameter With increased inscribed diameter: capacity increases and then decreases for very large roundabouts.	Not used	Inscribed diameter With increased inscribed diameter: capacity increases with increasing inscribed diameter; capacity does not decrease for very large roundabouts.
	Entry radius With increased entry radius: the capacity at zero circulating flow increases (more capacity), and the slope of the capacity curve decreases (more capacity); capacity remains same if the capacity at zero circulating flow is user-specified.	Not used	Entry radius With increased entry radius: the capacity at zero circulating flow increases (more capacity), and the slope of the capacity curve also increases (less capacity); capacity decreases if the capacity at zero circulating flow is user-specified.
	Entry angle With decreased entry angle: the capacity at zero circulating flow increases (more capacity), and the slope of the capacity curve decreases (more capacity); capacity remains same if the capacity at zero circulating flow is user-specified.	Not used	Entry angle With decreased entry angle: the capacity at zero circulating flow increases (more capacity), and the slope of the capacity curve also increases (less capacity); capacity decreases if the capacity at zero circulating flow is user-specified.
	Approach short lanes: capacity and overflow into adjacent lane modeled using gap-acceptance cycles and back of queue modeling.	Short lanes modeled as an extension to the HCM 2010 model in SIDRA INTERSECTION.	Approach flaring (Approach half width and Flare length) Interpolation for lane width between single and multilane approach values problematic.
	Number of exit lanes (can affect upstream approach lane use)	Not used.	Not used.
	Exit short lanes (merge lanes): effect on upstream approach lane use modeled (increased v/c ratio due to lane underutilisation).	Not used.	Not used.

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Comparison of the main features of SIDRA Standard, HCM 2010 and UK TRL models *(continued)*

Model Feature	*SIDRA Standard* Model	*HCM 2010* Model	*UK TRL* model
Unbalanced Flows	Capacity is sensitive to Origin-Destination demand flow pattern, lane use and level of queuing on entry lanes. Roundabout modeled with high level of interaction between traffic using all intersection approaches (O-D Factor method used).	Not used. O-D Factor method available as an option for the HCM 2010 method in SIDRA INTERSECTION.	Not used (roundabout modeled as a series of T-intersections with no sensitivity to Origin-Destination flow patterns).
	Adjustment options exist for high Entry Flow / Circulating Flow ratio (increased entry capacity at very low circulating flow rates due to increased driver aggressiveness level).	Not used. Adjustment options for high Entry Flow / Circulating Flow ratio available in SIDRA INTERSECTION.	Not used.
Heavy Vehicles	Circulating flow rate is increased for heavy vehicles in the circulating stream. Follow-up Headway and Critical Gap values are increased for heavy vehicles in the entry lane.	Capacity is decreased for heavy vehicles directly.	*Not known to the author.*
Model Calibration	Intersection-level or approach-level calibration using Environment Factor. A general value of 1.2 used for US conditions. Movement-level calibration using Follow-up Headway and Critical Gap parameters.	Method described to calibrate the model parameters using known Follow-up Headway and Critical Gap values.	The capacity at zero circulating flow (y-intercept) value of the linear regression capacity function can be adjusted. *(16,21)* Problematic since the capacity decreases with improved geometry (increased entry radius, decreased entry angle, increase entry width, increased flare length) if the capacity at zero circulating flow is user-specified.
	Sensitivity analysis facility is available for driver behavior and roundabout geometry parameters.	Offered as an extension in SIDRA INTERSECTION software.	*Not known to the author.*
Level of Service	Uses HCM and additional level of service methods (options for alternative LOS methods including HCM 2010 and HCM 2000 methods, ICU method, etc.); the *LOS Target* parameter to specify acceptable LOS levels for different intersection types.	HCM 2010 LOS methods define different LOS thresholds for signalized intersections and all unsignalized intersections.	*Not known to the author.*
	Roundabout LOS options ("Same as Sign Control", "Same as Signalised Intersections" and "SIDRA Roundabout LOS") available; uses "Same as Signalised Intersections" as default.	Same LOS thresholds for roundabouts and sign-controlled intersections.	

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Comparison of the main features of SIDRA Standard, HCM 2010 and UK TRL models *(continued)*

Model Feature	*SIDRA Standard* Model	*HCM 2010* Model	*UK TRL* model
Drive Cycles	Detailed drive-cycle model (cruise, decelerate, idle, accelerate) of movements through the intersection. determined for queued and unqueued vehicles (light and heavy vehicles separately) for each lane. Negotiation radius, speed and distance calculated (used for geometric delay, fuel consumption, emissions and operating cost).	Aggregate model.	Aggregate model.
Delay, Queue and Stops	The gap-acceptance cycles are identified for modelling delay, back of queue, stop rate, proportion queued, etc. for each lane (as well as capacity). *Geometric delay* determined. *Back of queue* is important for modeling short lane capacities and blocking of upstream intersections. *Percentile queue* values (not a single value) and *probability of blockage* of upstream lanes calculated.	Simple queuing theory for delay *and cycle-average queue*. *Geometric delay* not determined. 95th percentile queue only for unsignalized intersections. No back of queue model for unsignalized intersections.	Simple queuing theory for delay and cycle-average queue. *Geometric delay* ?. No back of queue model.
Fuel Consumption, Emissions and Operating Cost	Detailed vehicle power-based model using drive cycle information derived for queued and unqueued vehicles in each lane. Light and heavy vehicles modelled separately. Drive cycle model incorporating acceleration - deceleration models are important for geometric delay, fuel consumption, emissions and operating cost.	Not available.	Not available.

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