

# ROUNABOUT MODEL COMPARISON TABLE

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August 2011

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 from the ARCADY and RODEL software which have implemented it.

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.

## 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
<b>Methodology</b>	Based-on gap-acceptance theory with empirical (regression) equations to model gap-acceptance parameters.	Empirical (exponential regression) capacity model with clear basis in gap-acceptance theory.	Empirical (linear regression) capacity model with no stated theoretical basis.
<b>Individual Entry and Circulating Lanes</b>	<b>Lane-based</b> model: Capacity and performance of individual entry lanes are modeled.	<b>Lane-based</b> model: Capacity and performance of individual entry lanes are modeled.	<b>Approach-based</b> model: All lanes aggregated and capacity and performance modeled for the approach as whole.
	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.
	Assumes bunched arrival headways for the circulating stream. Proportion bunched modeled.	Assumes random arrival headways 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 in SIDRA INTERSECTION software.	Not applicable.
	A proportion of exiting flow can be added to circulating flow as opposing flow.	Not applicable.	<i>Not known to the author.</i>
<b>Lane Utilization for Multilane Approaches</b>	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.
<b>Volume / Capacity Ratio</b>	v/c ratio (degree of saturation) for a multilane approach represents the <i>critical lane</i> value.	v/c ratio for a multilane approach represents the <i>critical lane</i> value.	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
<b>Driver Behavior Parameters</b>	Gap-acceptance parameters (Follow-up Headway, Critical Gap), entry lane-use model, circulating stream bunching represent driver behavior.  Driver response times determined.	Gap-acceptance parameters (Follow-up Headway, Critical Gap), entry lane-use model, circulating stream bunching represent driver behavior.	No direct representation of any aspect 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 applicable.
	Follow-up Headway and Critical Gap values are reduced (more aggressive driver behavior) with increased circulating flow rates.	Follow-up Headway, Critical Gap values are constant.	Not applicable.
	Priority sharing and priority emphasis effects are included in the model.	Not applicable.	Not applicable.
<b>Roundabout Geometry Parameters</b>  (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
	Number of circulating lanes	Number of circulating 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 lane capacity and overflow into adjacent lane modeled using gap-acceptance cycles and back of queue modeling.	Short lanes modeled as an extension in SIDRA INTERSECTION software.	Approach flaring (Approach half width and Flare length).  Interpolation for lane width between single and multilane approach values problematic.

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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
<b>Roundabout Geometry Parameters</b>	Number of exit lanes and exit short lanes (merge lanes) modeled through effect on upstream approach lane use (increased v/c ratio due to lane underutilisation).	Not applicable.	Not applicable.
<b>Unbalanced Flows</b>	Capacity is sensitive to Origin-Destination demand flow pattern, lane use and level of queuing on approaches. Roundabout modeled with high level of interaction between traffic using all intersection approaches (O-D Factor method used).	No sensitivity to Origin-Destination flow patterns. Roundabout modeled as a series of T-intersections. O-D Factor method offered as an extension in SIDRA INTERSECTION software.	No sensitivity to Origin-Destination flow patterns. Roundabout modeled as a series of T- intersections.
	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).	Adjustment options for high Entry Flow / Circulating Flow ratio offered as an extension in SIDRA INTERSECTION software.	Not applicable.
<b>Heavy Vehicles</b>	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.	<i>Not known to the author.</i>
<b>Model Calibration</b>	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. <i>(16,21)</i>  <small>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.</small>
	Sensitivity analysis facility is available for driver behavior and roundabout geometry parameters.	Offered as an extension in SIDRA INTERSECTION software.	<i>Not known to the author.</i>
<b>Level of Service</b>	Uses HCM and additional level of service methods (options for alternative LOS methods including HCM 2010 and HCM 2000 methods, ICU method, etc.); the <i>LOS Target</i> 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.	<i>Not known to the author.</i>
	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
<b>Drive Cycles</b>	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.
<b>Delay, Queue and Stops</b>	The gap-acceptance cycles are identified for modelling delay, back of queue, stop rate, proportion queued, etc. for each lane (as well as capacity). <i>Geometric delay</i> determined. <i>Back of queue</i> is important for modeling short lane capacities and blocking of upstream intersections. <i>Percentile queue</i> values (not a single value) and <i>probability of blockage</i> of upstream lanes calculated.	Simple queuing theory for delay <i>and cycle-average queue</i> .  <i>Geometric delay</i> 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.  <i>Geometric delay</i> ?.  No back of queue model.
<b>Fuel Consumption, Emissions and Operating Cost</b>	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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