Alternative Intersection Analysis Using SIDRA INTERSECTION

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Alternative Intersection Analysis
Using SIDRA INTERSECTION

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1. **Resources** on Alternative Intersections
Useful Sources on Alternative Intersections


- WIKIPEDIA: Continuous-Flow Intersection and Diverging Diamond Interchange topics. [Useful references]
Selected alternative intersection and interchange treatments in the United States and other countries:

- Displaced left-turn (DLT) intersection
- Median U-turn (MUT) intersection
- Restricted crossing U-turn (RCUT) intersection
- Quadrant roadway (QR) intersection
- Double crossover diamond (DCD) interchange
  [Diverging Diamond Interchange (DDI)]
- DLT interchange
Alternative intersection types:

- Diverging Diamond Interchanges (DDI)
- Median U-turn (MUT) intersections
- Displaced left-turn (DLT) intersections
- Restricted crossing U-turn (RCUT) intersections

Converted to left side driving
“The design of the conversion of the KwaMashu interchange (on National Route 2 north of Durban) from a standard diamond to a diverging diamond layout is complete and construction of the conversion commenced in June 2012 and is due for completion in May 2013. This will be the very first diverging diamond interchange to be implemented in the Southern Hemisphere.”

Also see: www.civildesigner.com/press/kwamashu.pdf
Continuous Flow Intersection (CFI) and other types


Alternative Intersection Analysis Using SIDRA INTERSECTION

2. SIDRA INTERSECTION Network Model
SIDRA NETWORK Model

Unique lane-based NETWORK model

All intersection types (signals, roundabouts, sign control)

PAIRED INTERSECTIONS (detailed lane-based analysis)
SIDRA INTERSECTION features enabling analysis of Alternative Intersections

- **LANE-BASED** network model
- **QUEUE SPILLBACK** and Capacity Constraint
- **Movement Classes** (special use for downstream turning movements)
- **Second-by-second lane-based** **platoon** model
- **Lane Movements** at intersections
- **Implied midblock lane changes**
- **Common Control Group** for signal phasing and timing with one signal controller unit (Version 7)
Lane Utilization at Alternative Intersections

HCM 2015 / 2016, page 23-7:

**Lane Utilization Effects**

Lane utilization is the extent to which lanes are used equally (or unequally) by drivers. The presence of multiple intersections operating as a single unit can strongly influence drivers’ choice of lanes when approaching an upstream intersection. At interchanges, this can mean through-lane utilization at the upstream intersection reflects desired turn movements at the downstream intersection. Likewise, at MUT and RCUT intersections, this can mean dual right-turn lane utilisations reflect downstream movements with drivers headed for the U-turn crossover using the leftmost of the side-street, right-turn lanes.

This applies to all “paired intersections”
**SIDRA Lane-based model for intersections since 1984**

**LANE-BASED MODEL**

More realistic and reliable analysis compared with approach-based and lane group (link) - based methods (various UK models and US HCM).

- **General**: Unequal lane flows, de facto exclusive lanes, short lanes, slip/bypass lanes (give-way/yield, continuous, signals).
- **Roundabouts**: Circulating lane use; Dominant and subdominant lanes.
- **NETWORK Model**: (lane queues, lane blockage, signal platoon arrival and departure patterns).

Try defining “links” and “lane groups”!

Individual lanes have different characteristics

Short lane analysis (flaring)

Slip / Bypass lanes
Iterative method for LANE BLOCKAGE and CAPACITY CONSTRAINT

- The two basic elements of the model are highly interactive with opposing effects.
- SIDRA INTERSECTION 6 uses a network-wide iterative process to find a solution that balances these opposing effects.
- Backward spread of congestion and capacity constraint are common to all intersection types.
Importance of Back of Queue Model and Lane-Based Probability of Blockage

Back of Queue Percentile and Probability of Blockage values are based on back of queue estimates for individual lanes.
Movement Classes

Light Vehicles
Heavy Vehicles
Buses
Bicycles
Large Trucks
Light Rail / Trams
Two User Classes
for special treatment

Combined with the lane-based method, new Movement Classes allow modelling of Bus Priority Lanes, Bicycle Lanes, and so on ...

Site Origin-Destination Movements by Movement Class as a basis of all data and modelling
3. Interchanges and Alternative Intersections Using SIDRA INTERSECTION
Signalised Diamond Interchange (SDI)

Through traffic in different lanes have different destinations downstream.

Lane allocation by SPECIAL MOVEMENT CLASSES for turning movements.

Common Control Group (single controller)

Doncaster Road - Eastern Freeway, Melbourne
Diverging Diamond Interchange (DDI)

Lane allocation by SPECIAL MOVEMENT CLASSES for turning movements

Through traffic in different lanes have different destinations downstream

Templates will be available

Common Control Group
Roundabout Interchange

Through traffic in different lanes have different destinations downstream

Lane allocation by SPECIAL MOVEMENT CLASSES for turning movements
Continuous Flow Intersection (CFI)

Through traffic in different lanes have different destinations downstream.

Lane allocation by SPECIAL MOVEMENT CLASSES for turning movements.
Continuous Flow Intersection (CFI) West Site

SPECIAL MOVEMENT CLASSES for Through traffic with different downstream destinations in different lanes

CONTRAFLOW lanes help to configure complex layouts

Lane Movements in SIDRA INTERSECTION Lane Data input dialog
Continuous Flow Intersection (CFI) Main Intersection

SPECIAL MOVEMENT CLASSES for Through traffic with different downstream destinations in different lanes

CONTRA FLOW lanes help to configure complex layouts

Lane Movements in SIDRA INTERSECTION Lane Data input dialog
4. An Interchange Comparison Example
An Interchange Comparison: Results with Cycle Time = 100 s specified for both SDI and DDI
An Interchange Comparison: Results with Cycle Time = 100 s specified for both SDI and DDI

<table>
<thead>
<tr>
<th>Interchange Type</th>
<th>Degree of Saturation Worst Lane (v/c)</th>
<th>Average Delay (Worst Lane) (sec)</th>
<th>Largest Probability of Blockage (%)</th>
<th>Average Network Speed (km/h)</th>
<th>Network LOS (Based on Speed Efficiency)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signalized Diamond Interchange</td>
<td>1.19</td>
<td>239</td>
<td>37%</td>
<td>28.7</td>
<td>LOS E</td>
</tr>
<tr>
<td>Diverging Diamond Interchange</td>
<td>0.77</td>
<td>30</td>
<td>29%</td>
<td>44.3</td>
<td>LOS D</td>
</tr>
<tr>
<td>Roundabout Interchange</td>
<td>0.56</td>
<td>14</td>
<td>0%</td>
<td>56.4</td>
<td>LOS B</td>
</tr>
</tbody>
</table>
Thank you!

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