

# Modelling Roundabout Capacity

Mike Hutt – Traffic, Transportation



# Capacity Research

- 11,000 minutes “at capacity” operation recorded
- 500,000 vehicles observed
- 5 years accident data studied
- US\$20,000,000 current equivalent cost
- 1427 injury accidents studied
- 431 junction years of data collected
- 12 year duration of study
- Accuracy last revisited in **2011**

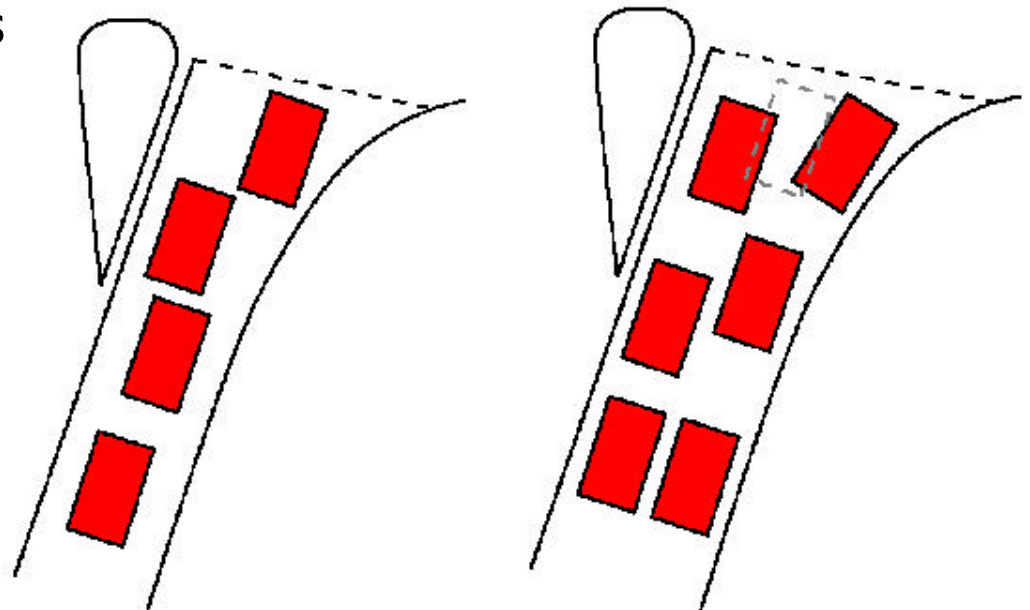


# Capacity Research

- The UK approach is focused more on design and operational performance than academic exploration
- Gap acceptance methods refected as they give a weak link between geometry and performance
- Geometry is a key factor for roundabout designers; this is a real weakness of gap acceptance methodologies
- Research conducted to understand the *root cause of gap acceptance and what initial factors influence it*

# Unbalanced Lane Use

- Capacity is related to entry width
- Queue formation changes with entry width
- This is ***independent*** to lane distribution



# Unbalanced Lane Use



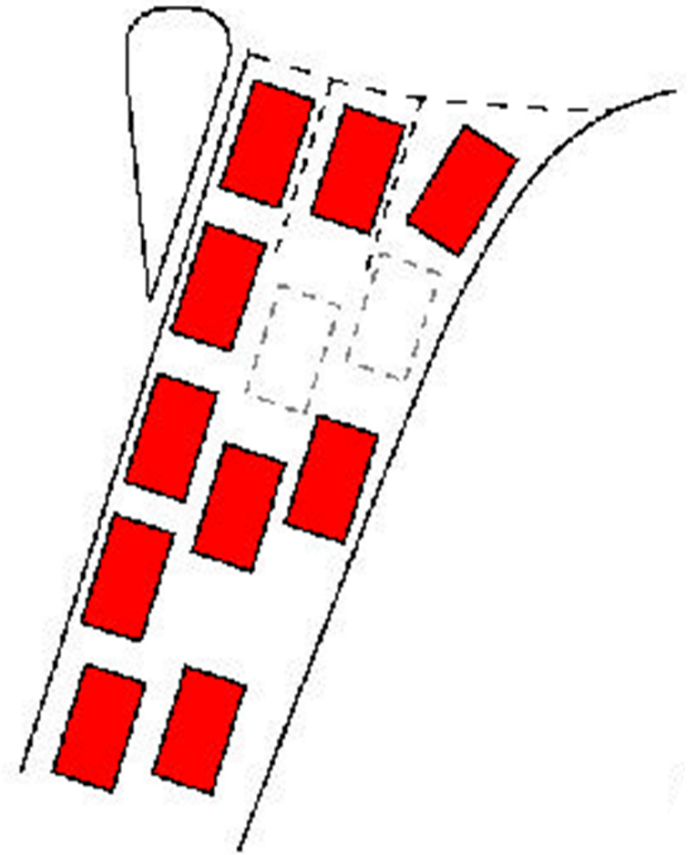
# Incomplete Lane Use

Possible reasons:

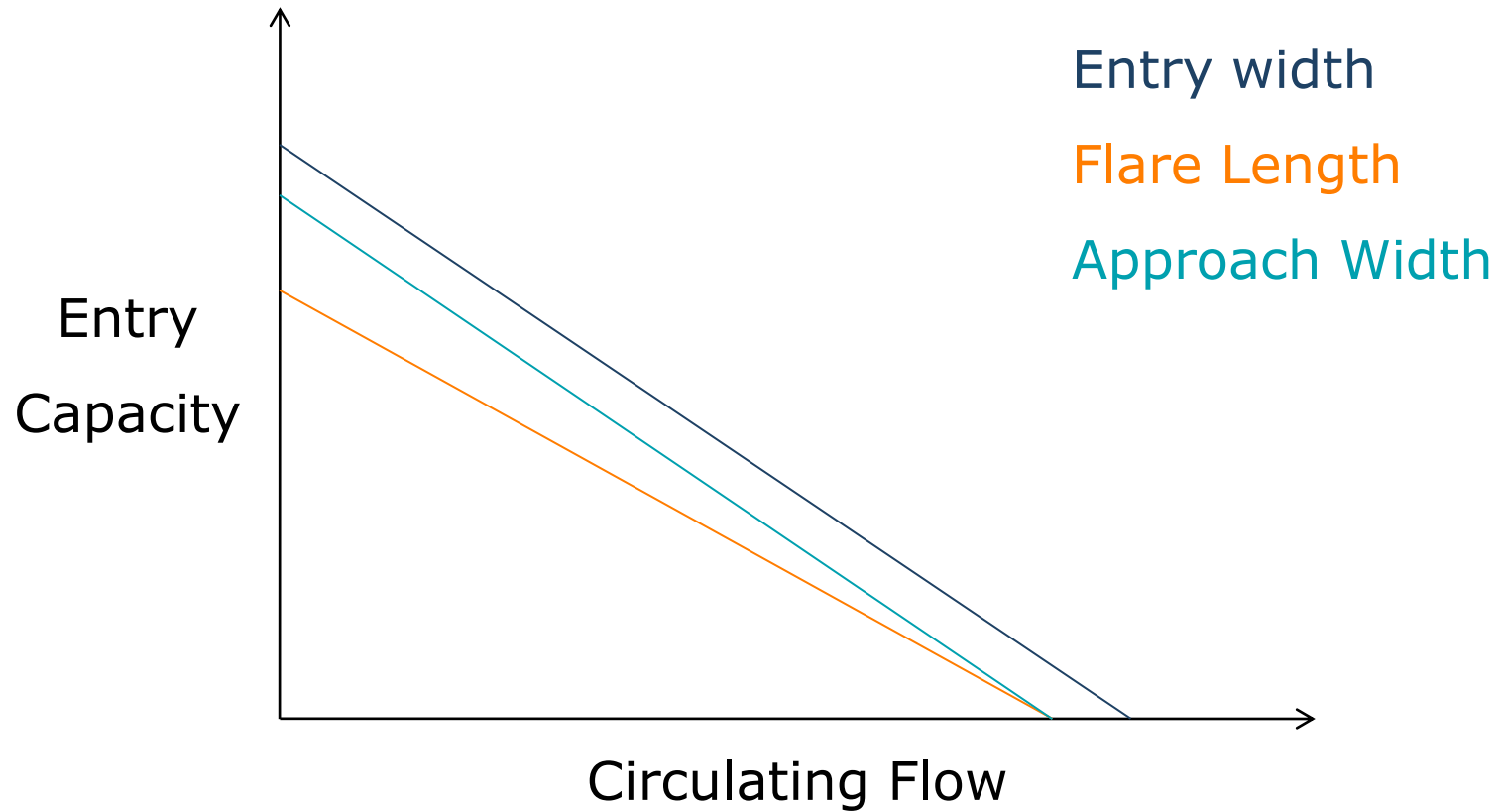
- Path overlap
- Poor design/ geometry
- Poor marking/ signage
- Exit restrictions

...all accounted for in research and mode

...highly applicable



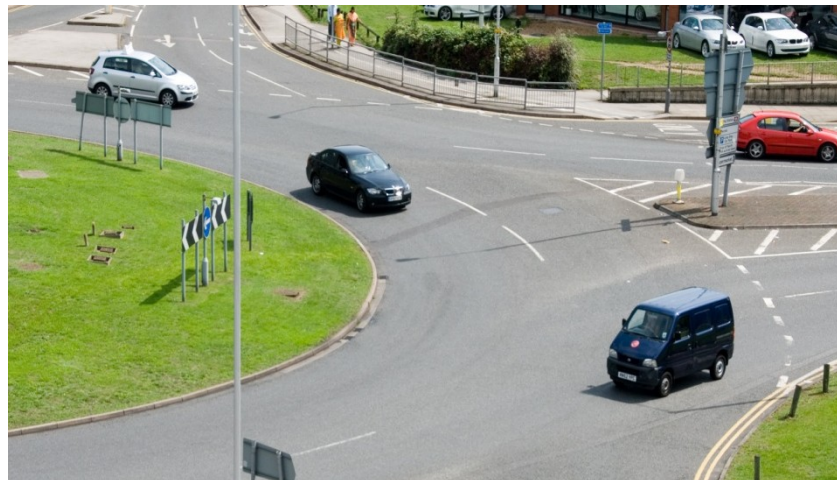
# Still Linear Relationships



# Multiple Lanes

- Traffic distributed **automatically** as per researched evidence
- If applicable manually distributed among:
  - Lanes
  - Streams
  - Links

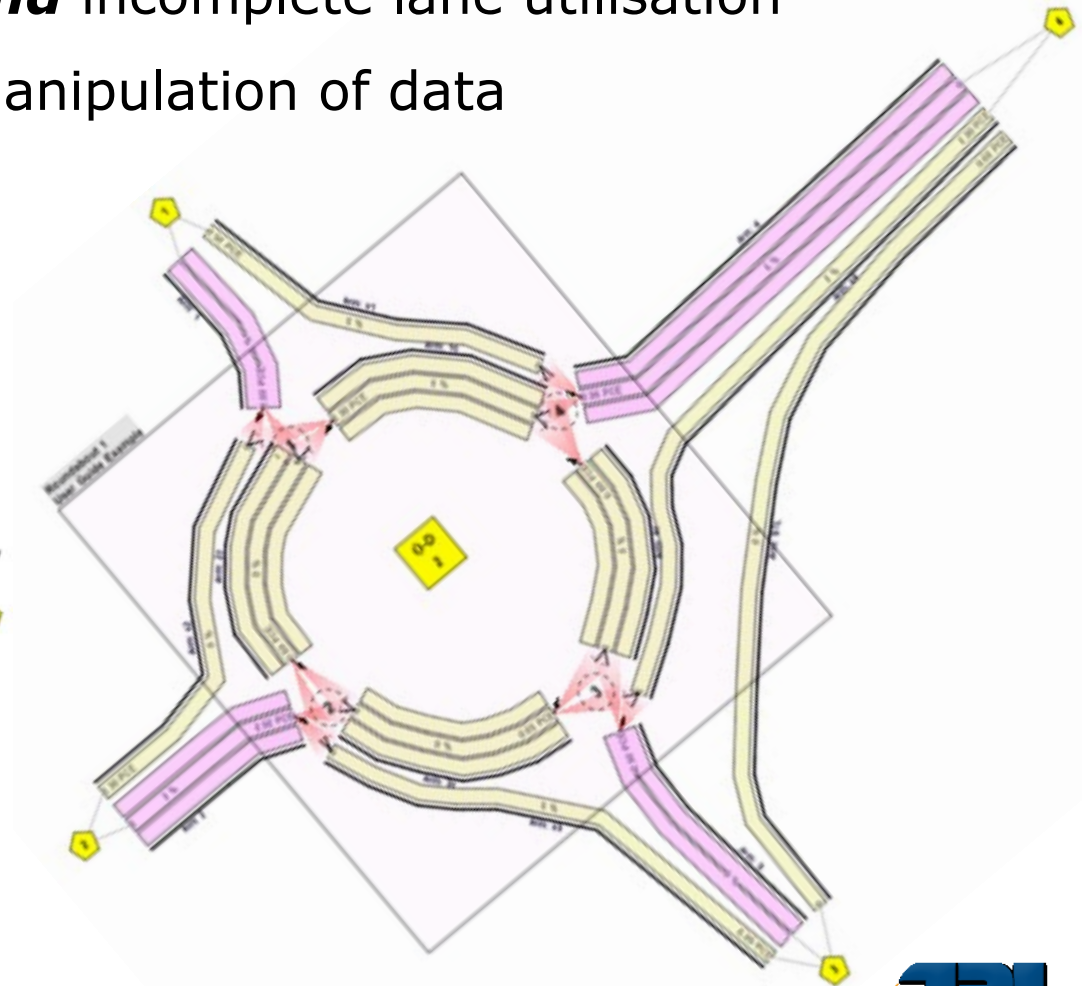
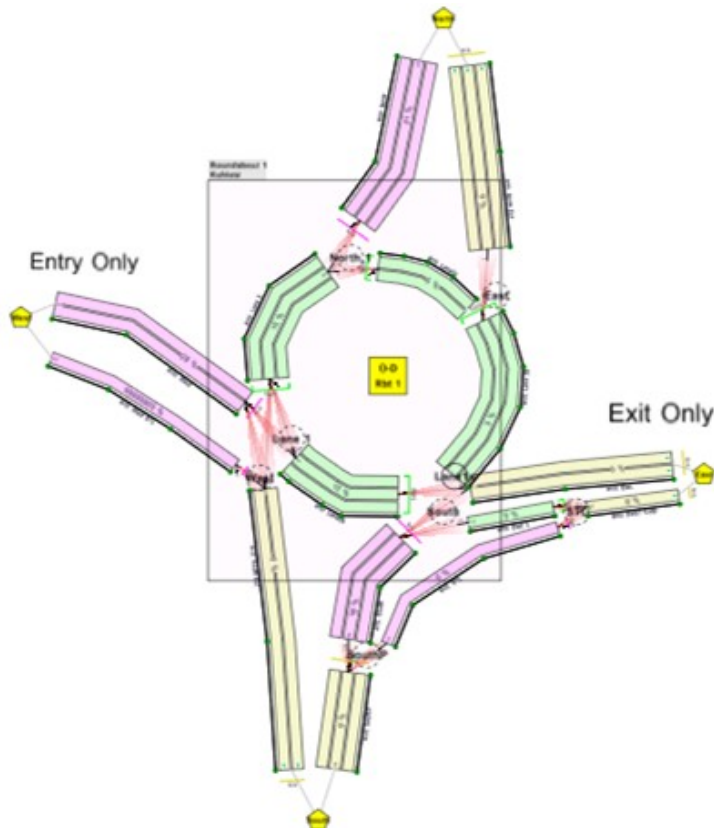
...following traffic engineering principles



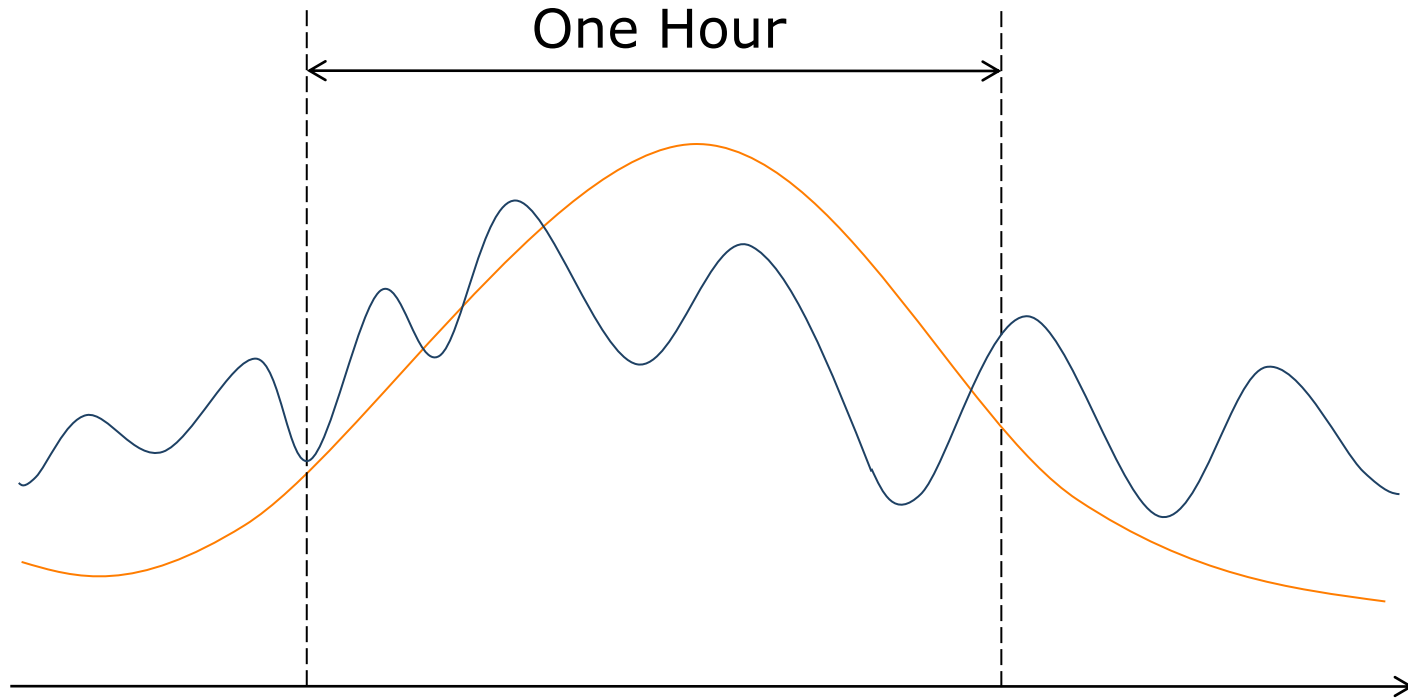


# Multiple Lanes

- This considers unequal **and** incomplete lane utilisation  
...but allows manual manipulation of data



# Traffic Profile Consideration



# Geometric Delay Calculation

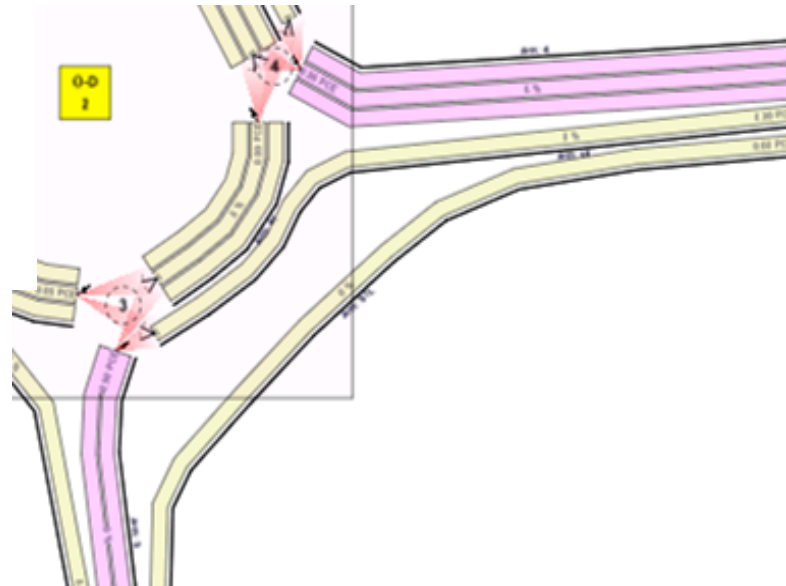
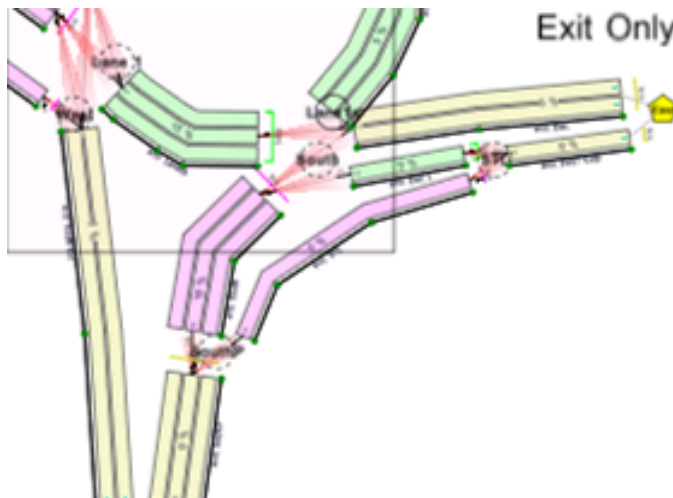
Point to point journey time and distance through intersection

- Additional data required:
  - Speeds
  - Angles
  - Radii
  - Distances



# Seperated Turn/ Bypass Lanes

Different to yield controlled intersections...



# Mini Roundabouts

- Seven geometries for capacity design
- Potential for larger capacity
- Less space





# Grade-Separated Roundabouts

- Different capacity relationships
  - Defined as grade-separated if connected with a motorway/ interstate passing either overhead or underneath
  - ...or if connected directly with a motorway/ interstate



# Large Scale Roundabouts

- Roundabouts with a diameter of over 130m also use different capacity relationships
- NB. grade-separated and large roundabouts are versions of standard roundabouts  
...not mini roundabouts



# Signalised Roundabouts

- Traffic Signals "move" traffic around a network in platoons
- Very different to yield control
- Need to understand the interaction
- A specialised traffic network





# Part Time Signal Control at Roundabouts

- Caters for peak periods
- Events or seasonal demand:
  - Sports grounds
  - Universities
  - Convention Centres...



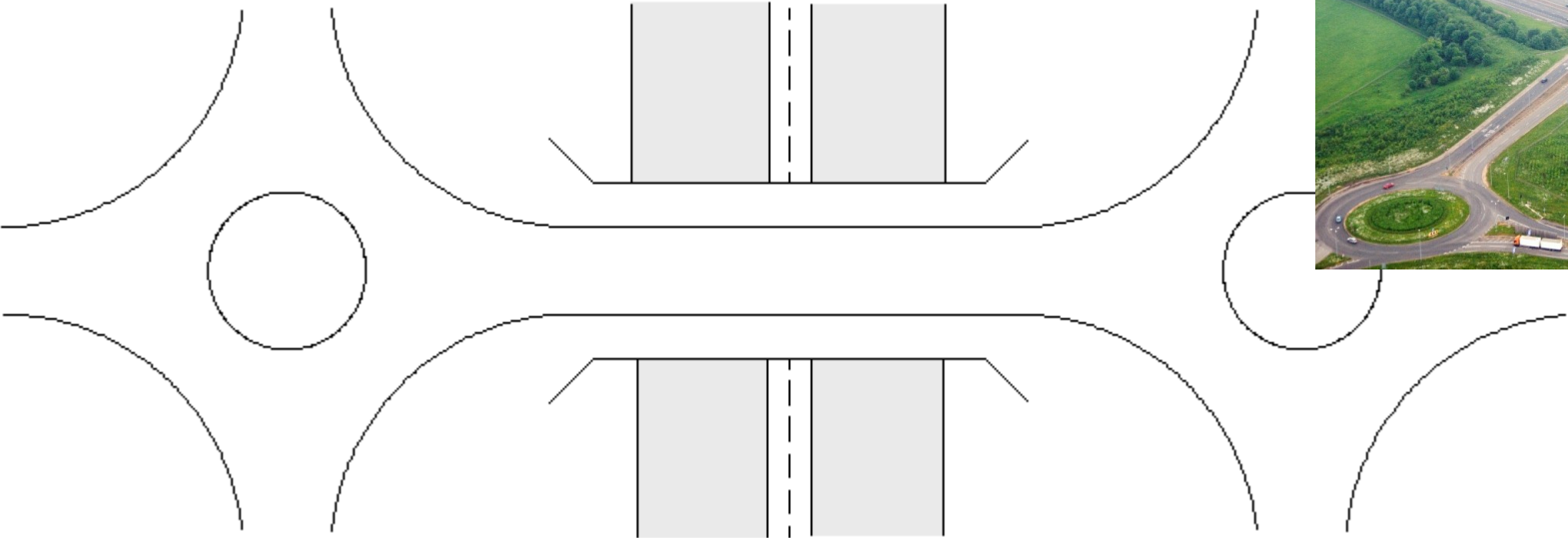
# Partially Signalised Roundabouts

- Allows free flow **with** strategic placement of queues
- Efficient along arterial corridors



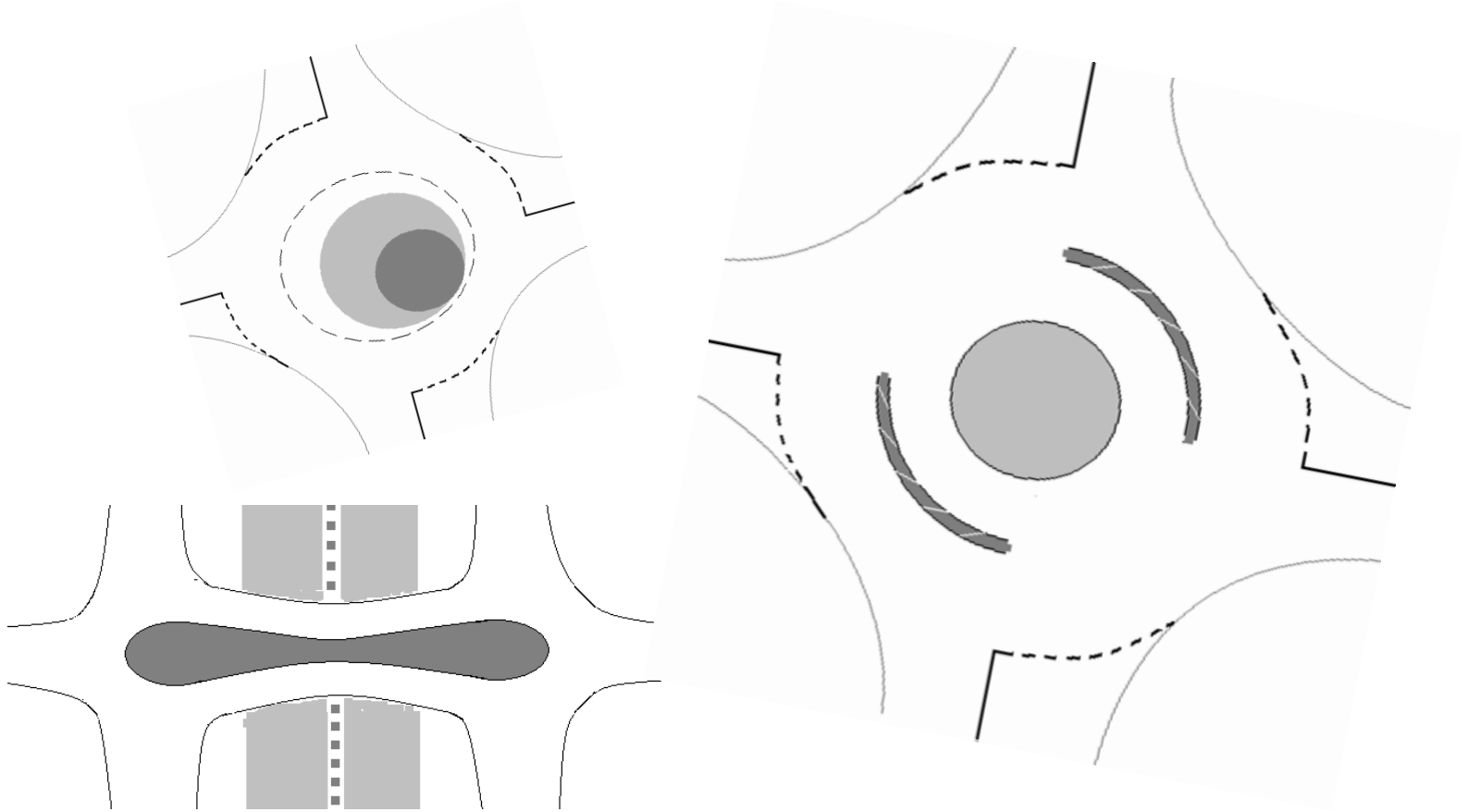
# Roundabout Corridors

Understanding of roundabout network interaction essential



# Roundabout Modelling

- Various priority roundabout configurations



# Pedestrian Crossings

- The effect pedestrian crossings have on intersection capacity
- RFID street trials
- Visually, Hearing and Physically impaired Ped trials
- Pedestrian Countdown
- Emerging Technologies
- Cyclists at crossings
- Specific effects on roundabout vehicle capacity

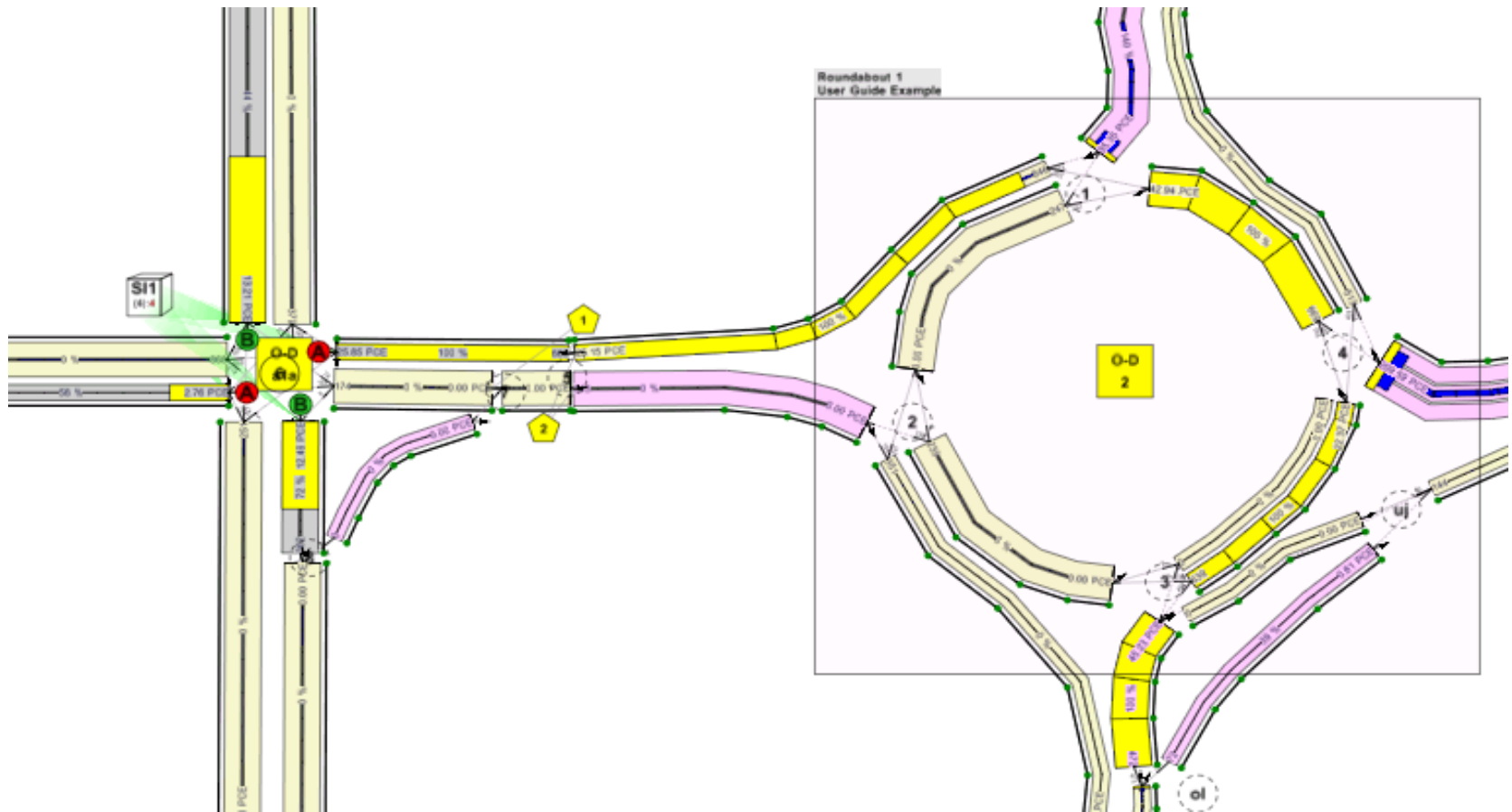
...signalising the roundabout?

# Roundabouts in Traffic Networks

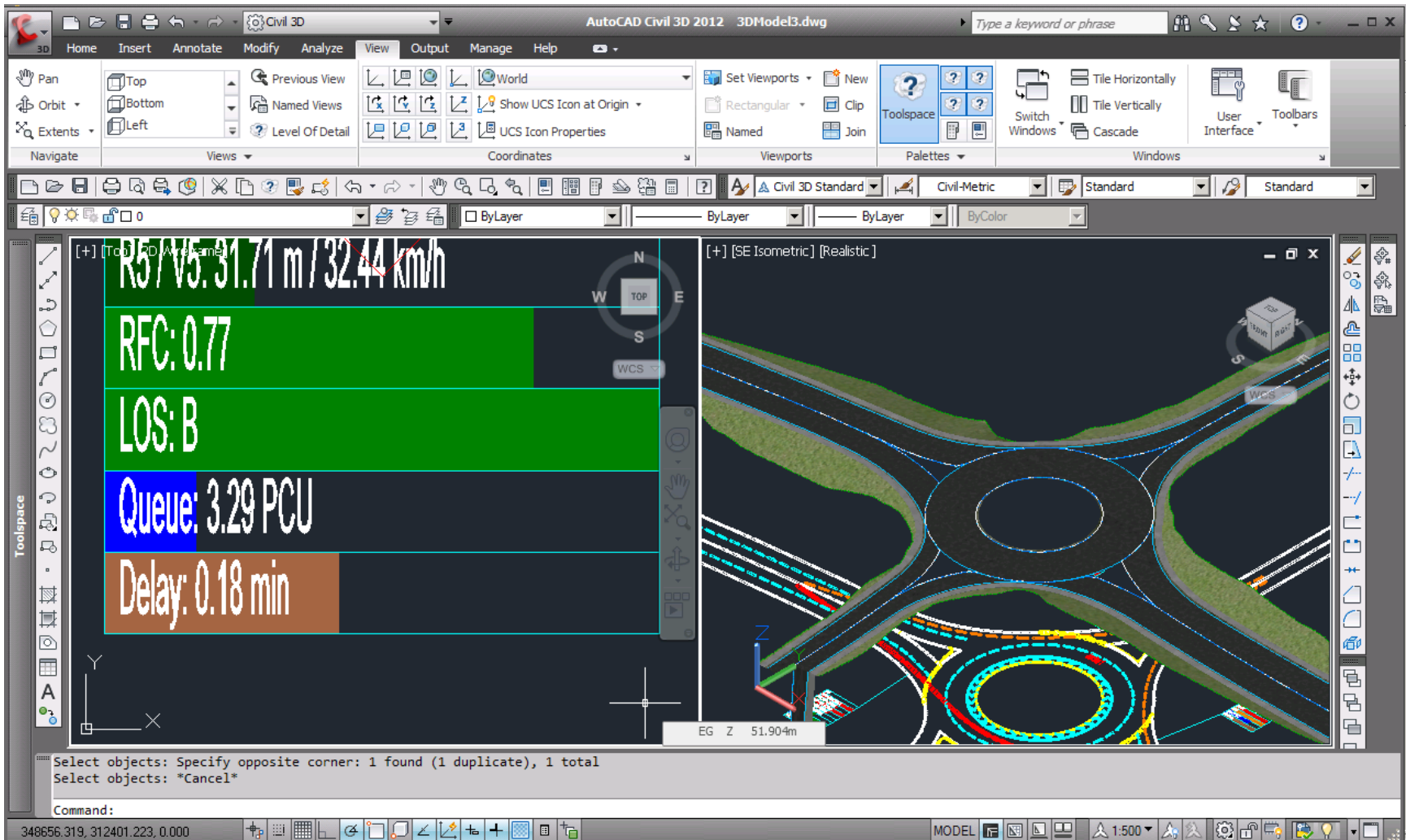
- Traffic Signals create platoons; whether fixed time signals or adaptive ITS.
- Understanding interaction and the effect imposed on the "next" intersection is imperative in delivering a safe and efficient infrastructure
  - ...and realising the full benefits of the individual components
- Signal and yield control display different traffic profiles



# Roundabouts in Traffic Networks



# 3D Surface Consideration





# Automatic Traffic Count Integration



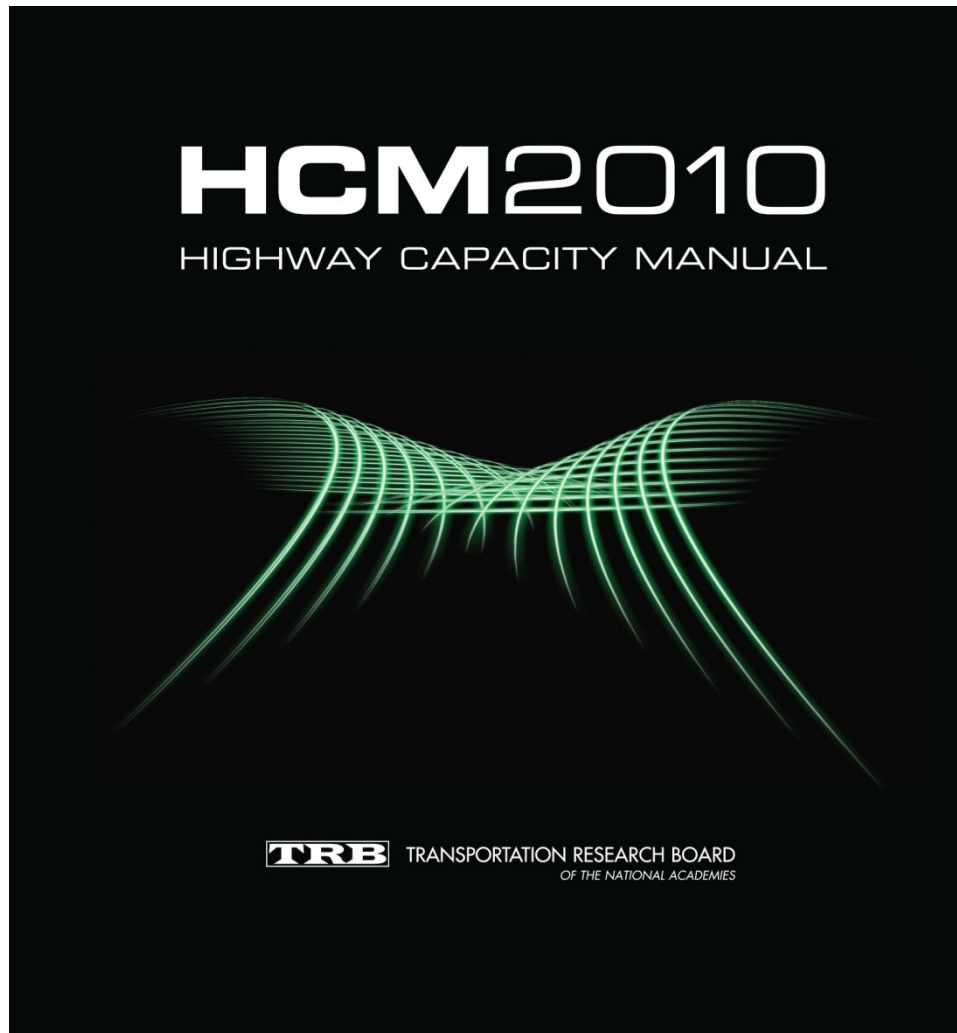
Turning Proportions/Counts - William/ I45 Intersection Modification - ...

Counts (PCE/hr) Proportions (PCE) Options

| From \ To      | William Street | I-45 East | Antonio Drive | I-45 West | Total   |
|----------------|----------------|-----------|---------------|-----------|---------|
| William Street | 0.000          | 334.000   | 0.000         | 160.000   | 494.00  |
| I-45 East      | 239.000        | 0.000     | 104.000       | 716.000   | 1059.00 |
| Antonio Drive  | 0.000          | 518.000   | 0.000         | 1044.000  | 1562.00 |
| I-45 West      | 74.000         | 422.000   | 347.000       | 0.000     | 843.00  |
| Total          | 313.00         | 1274.00   | 451.00        | 1920.00   | -       |

Enter Turning Counts OR Proportions.

# Further Internationalism



Courtesy of the  
Transportation  
Research Board

# Recent Major International Case Studies

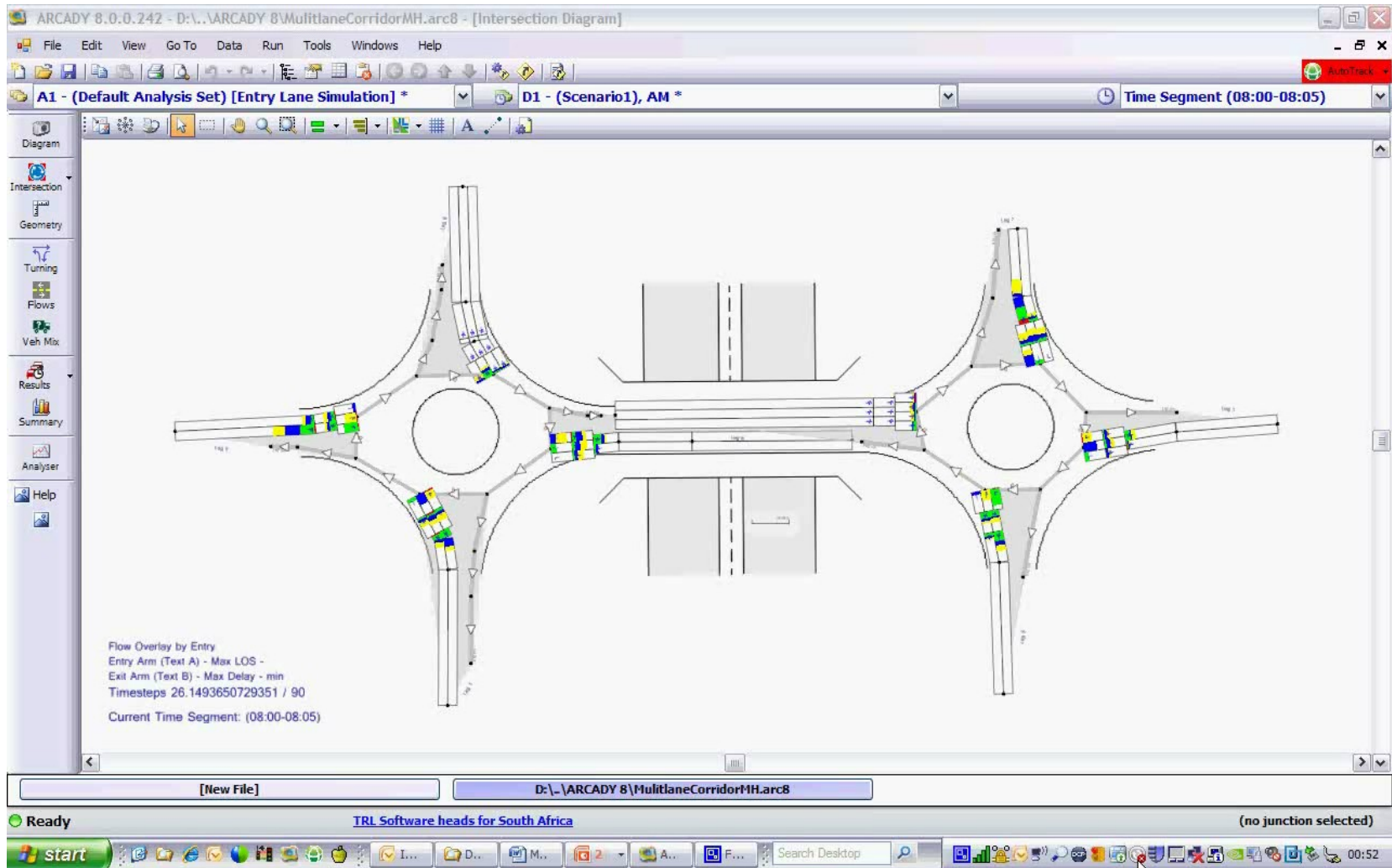
- **US31 and 106th St and US 31 and 116th St, Carmel, Indiana, USA**  
Six roundabouts on and close to interstate highway US31. Considered the geometry proposed originally and alternatives to illustrate what would be required operate within pre-defined limits and level of service
- **Hoddle Street, Melbourne, Australia**  
Part of the Victorian Transport Plan, \$5 million two-year study to investigate ways to improve the efficiency and reliability of all modes of transport . Critical to north-south and east-west transport movements in inner Melbourne and the flow of the Eastern freeway
- **Armdale Rotary Conversion and St. Peters Corner, Canada**  
Conversion of a rotary with excessive flows and designing a roundabout corridor to operate with Traffic Signals
- **Peninsula Link / Cranbourne / Frankston Road, Melbourne, Australia**  
High profile scheme part of much wider \$759 million development project comprising 27 kilometres of road link

# Mathematical Validation

## Probabilistic modelling

- 1000's iterations
- Entire period modelled to build profile
- The traffic profile is visualised and animated
- Independently researched
- Agreeable with the Empirical Model

# Mathematical Validation



# Thank you, any questions?

**Obrigado  
Gracias  
Dank U  
Merci  
Danke  
Grazie  
Tack**

**Kiitos  
dziękuję  
Takk...**

**Mike Hutt**  
mhutt@trl.co.uk  
www.trl.co.uk

