Using Rodel Software for Capacity Analysis: Minimizing Risk and Uncertainty

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Overview

- How to reduce risk when using Rodel version 1
- Practical advice for practitioners
- Common challenges and situations
- Dispels misperceptions about risk

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In Perspective

- All software ⟶ underlying assumptions
- Underlying assumptions = risk
- **Designer** must understand risks
- **Designer** must use software correctly
- Personal responsibility
- Real vs. perceived risks: both exist
- Issues not unique to Rodel
- Gap vs. empirical – not focus of paper
- Opinion: risks greater with gap models

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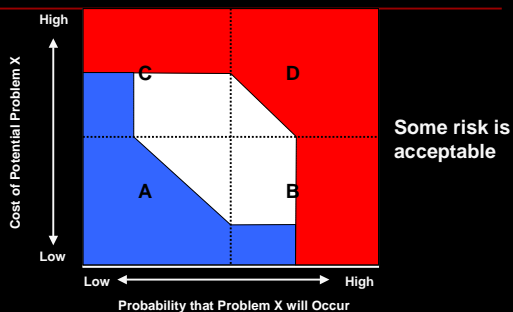

Framework

- Risk – two elements:
  - Probability of problem occurring
  - "Cost" if problem does arise
- Risks arising from capacity analysis
  - Unacceptable delay
  - Long queues
  - Related fallout
- Designer's goal – manage risk so that:
  - Low probability
  - Low "cost"

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Risk Quadrant Matrix

Cost of Potential Problem X (High / Low)
Probability that Problem X will Occur (Low / High)

C   D
A   B

Some risk is acceptable

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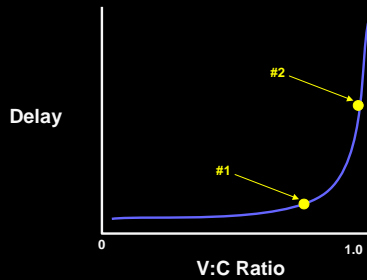

Driver Behavior

- What if behavior causes below avg capacity?
- Capacity is lower, V:C ratio increases
- Mean value capacity distribution = 50% CL
- If distribution correct, below mean half of time
- If distribution correct, above mean half of time
- Determine geometry using 50% CL (default)
- Test geometry at 85% CL (pessimistic capacity)
- Adjust 6 parameters for a robust design
- Report results at 50% CL

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Driver Behavior

Delay vs V:C Ratio graph with points #1 and #2
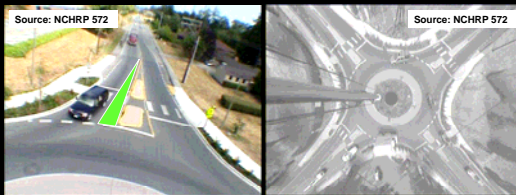
U.S. Capacity vs U.K. Capacity

- What if U.S. capacity is below U.K. capacity (Kimber)?
- NCHRP 572 – Rodel & other models overpredict U.S. capacity
- Reasons for results open to debate
  - Operating at capacity?
  - Effective geometry not used?
  - Driver behavior (cautious)?
- Use 85% CL test, adjust geometry
- Use lower Capacity Factor, adjust geometry
- Opening day vs. 20-year volumes
- Using effective geometry in Rodel – predictions similar to measured

U.S. Capacity vs U.K. Capacity

Source: NCHRP 572   Source: NCHRP 572

Accommodates trucks, but

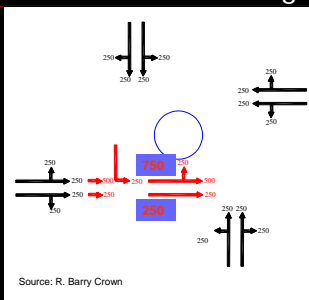**Not effective geometry**

Unbalanced Circulating Flows

- What if unbalanced circulating flows reduce capacity?
- Circulating flows not normally balanced
- LR942 – 65% inside lane and 35% outside lane
- LR942 equations underlie Rodel – already accounted for "normal" imbalance
- Extreme cases may justify higher CL
- Adjust geometry
- No software is responsible for identifying unique circumstances

Unbalanced Circulating Flows

Source: R. Barry Crown

Wide Single Lane Entries

- What if wide single entry lanes are used?
- Wide: entries >13′ - 14′ (FOC to FOC)
- Trucks require 18′ – 22′ entries
- LR942 data for this width range:
  - Sometimes marked as 2 lane entries
  - Sometimes 2 circulating lanes
- Rodel input of E = 18′-22′ for single lane will overpredict capacity
- Use E = 13′ - 14′ in Rodel, draw layout for trucks

Unbalanced Lane Use

- What if unbalanced entry lane use causes problems?
- Multi-lane roundabouts – equal usage is fundamental goal
- Imbalance can result in long queues/delays
- Test using Capacity Factor on each approach
- Must work for both AM and PM peaks
- Lane assignments and geometric adjustments

Queue Lengths

- What if queue lengths are longer than predicted?
- "Maximum queue"
  - Longest queue at end of a time slice (15 min default)
  - All lanes added together
  - Not 95th percentile random queue
- If queue length is critical:
  - Use shorter time slices (1 or 5 min)
  - Consider the 85% CL max queue
  - 95th percentile queue (queue evolution table)

Peak Hour Factor & Arrival Patterns

- What if unusual arrival patterns cause problems?
- Platoons, plant shift changes, schools, events
- Synthesized flows (default) similar to PHF
- Direct flows more refined – high definition
- Synthesized flows usually acceptable
- Adjust flow ratio, time slices, and/or use direct flows
- No commonly accepted method for converting PHF to flow ratio

Pedestrian Volumes

- What if high pedestrian volumes reduce capacity?
- Circulating volumes are important
- Typically <50 (multi-lane) and <200 (single lane) have minimal effect
- FHWA roundabout guide exhibits 4-7 and 4-8
- M factors – enter into Capacity Factor field

Multiple Risks

- May justify use of higher CL?
- Avoid being overly conservative
- Some design adjustments address multiple risks

Rodel Version 2

- Final stages of development
- Addresses most or all of these issues
- Practitioners still need to understand these issues

Conclusions

- Most issues/concerns are due to lack of understanding
- Designer must recognize and prioritize risks
- Every situation is unique
- Avoid obsession with low risks
- Hedge your bet with robust designs
- Other models have notable risks
- More U.S. research needed

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