

TRB Committee on Roundabouts: Research Activities Update

Transportation Research Board
2016 Annual Meeting
January 13, 2016



Selected Research Activities

- FHWA TOPR 34: Accelerating Roundabout Implementation in the United States
- NCHRP 03-78b and 03-78c: Guidelines for the Application of Crossing Solutions at Roundabouts and Channelized Turn Lanes to Assist Pedestrians with Vision Disabilities
- NCHRP Project 03-110: Estimating the Life-Cycle Costs of Intersection Designs
- NCHRP Synthesis 46-02: Roundabout Practices
- NCHRP Project 17-70: Development of Roundabout Crash Prediction Models and Methods



FHWA TOPR 34: Accelerating Roundabout Implementation in the United States

Virginia Tech Transportation Institute
Kittelson & Associates, Inc. (Lee Rodegerdts, PI)
ITRE at North Carolina State University

January 2016



Seven Tasks

1. Assessment of Rectangular Rapid Flashing Beacons (RRFB) for accessibility at multilane roundabouts
2. Reassessment of capacity models for the Highway Capacity Manual
3. Assessing environmental characteristics of roundabouts compared to other intersections
4. Evaluation of fatal and severe injury crashes
5. Evaluation of geometric parameters that affect truck maneuvering and stability
6. Investigation of crosswalk design and driver behaviors
7. Human factors assessment of traffic control device treatments at multilane roundabouts



Evaluation of Geometric Parameters for Trucks (KAI/VT)

- Examination of crash records for crashes involving trucks
- Simulation of truck dynamics over a range of geometric parameters to test hypotheses
- Truck speed – most significant parameter
 - 10 mph provided better stability than 15 mph
 - Education of truck drivers recommended

Evaluation of Geometric Parameters for Trucks (cont.)

- Cross section – mixed findings
 - Crowned more stable in some cases (LT, TH); constant slope more stable in other cases (RT)
 - Higher rollover risk when encountering a modeled 3-inch vertical face; other apron profiles not tested
- Truck type and loads
 - WB-67 trucks less stable than SU-30 and B-train at smaller, single-lane roundabouts; similar stability at larger roundabouts
 - Empty trucks at higher risk of rollover in small roundabouts
 - Fully loaded trucks higher risk in two-lane roundabouts due to higher center of gravity

Investigation of Crosswalk Design and Driver Behaviors (ITRE)

- Goal of maximizing drivers' propensity to yield
- Field measurement of performance over a range of conditions:
 - Various crosswalk positions from circulatory roadway
 - Various alignments of crosswalks
 - Various alignments through splitter island
- Two study types:
 - Yielding study (naturalistic study of staged crossings)
 - Eye tracker study (recorded participant eye movements when driving through roundabouts to evaluate fixation and gaze patterns)

Investigation of Crosswalk Design and Driver Behaviors Summary of Findings

- Yielding higher:
 - Entries more than exits
 - Single-lane crosswalks more than two-lane crosswalks
 - Pedestrians crossing from the splitter island than from the curb
- Study did not find any meaningful change in driver yielding behavior based on the geometric design elements (location and alignment) of the crosswalk

Human Factors Assessment of Traffic Control Device Treatments at Multilane Roundabouts (ITRE)

- Goal is to gain insight on how TCD combinations (signs, pavement markings) affect driver behavior at multilane roundabouts
- Major components of task:
 - Study of erratic maneuvers at multilane roundabouts
 - Eye-tracker study of drivers' attention to traffic control devices as they drive through the roundabout

Human Factors Assessment of TCDs at Multilane Rbts Summary of Findings

- Some pavement marking applications appear to result in a greater likelihood of erratic maneuvers
- Contributing factors appear to be:
 - Inconsistencies between lane use markings on the approach and those within the circulatory roadway
 - Insufficient channelization for drivers when being shifted from the inside lane to the outside lane to exit
 - Both appear to be associated with exclusive lanes (e.g., left turn only)

Human Factors Assessment of TCDs at Multilane Rbts Summary of Findings (cont.)

- Eye-tracker study found that drivers are 2 to 3 times more likely to glance at pavement markings than at signs and for longer periods of time
- Correct pavement markings appear to be the most beneficial in reducing erratic maneuvers
- Care is needed when using exclusive lanes and channelization (spiraling) within the circulatory roadway



NCHRP 03-78b and 03-78c: Guidelines for the Application of Crossing Solutions at Roundabouts and Channelized Turn Lanes to Assist Pedestrians with Vision Disabilities

Kittelson & Associates, Inc. (Bastian Schroeder, PI)
Accessible Design for the Blind
ITRE at North Carolina State University

January 2016



A Vision for the Final Product

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- *Guidelines for Selecting Accessibility Treatment Alternatives at Modern Roundabouts and Intersections with Channelized Turn Lanes*
 - Readily implementable guidance
 - Feasible range of geometric and traffic operational conditions
 - Suitable in planning and preliminary design stage
 - Based on by empirical data and modeling
 - Useful to a broad audience
 - Decision-support tool for practicing engineers

Project Status

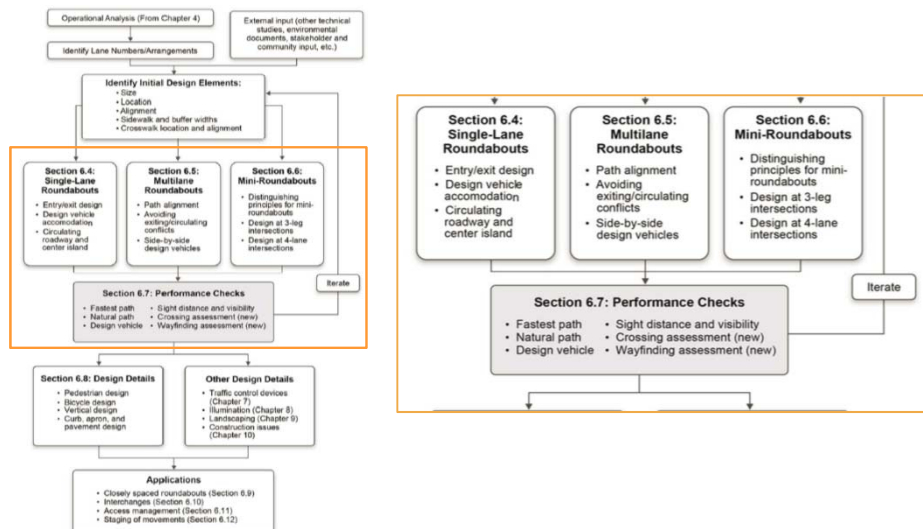
- Draft Guidebook and Draft Final Report currently under panel review (submission Fall 2015)
- Team waiting for formal feedback and revising deliverables in early spring 2016
- Pending two-year technology transfer effort (NCHRP 03-78c) with webinars and FREE workshops across the U.S.

Guidebook Preview

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1. Introduction
2. Design Process
3. General Principles for Pedestrian Wayfinding & Crossing Tasks
4. Design Principles for Pedestrian Access to Roundabouts
5. Design Principles for Pedestrian Access to CTLs
6. Wayfinding Assessment
7. Crossing Assessment
8. References
9. Appendix A: Discussion of Audible Environment and Noise Effects
10. Appendix B: Summary of Crossing Treatments

UPDATED Roundabout Design Process



Sample Content – Wayfinding Principles and Issues



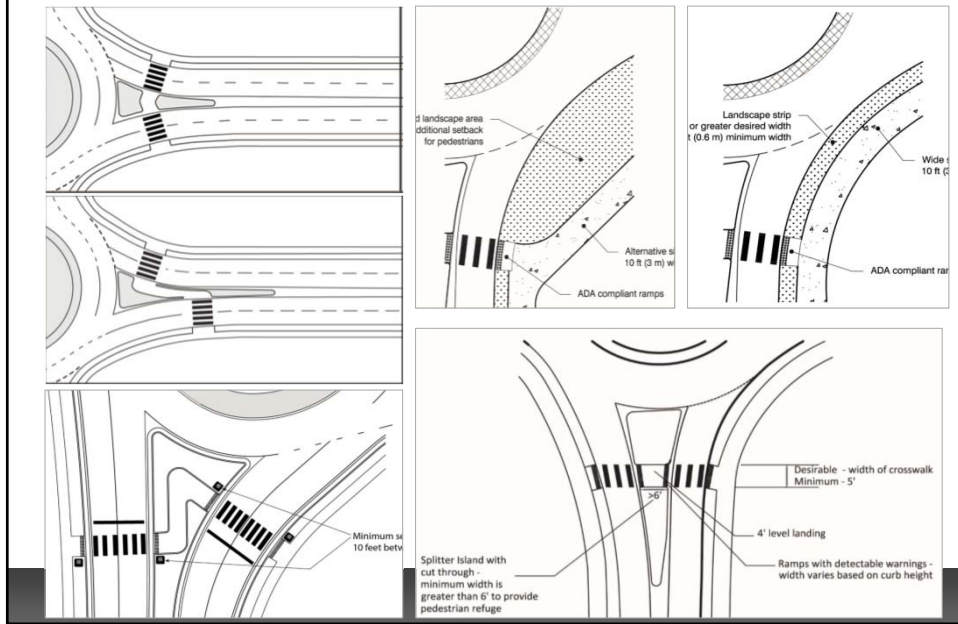
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Sample Content – Treatment Information

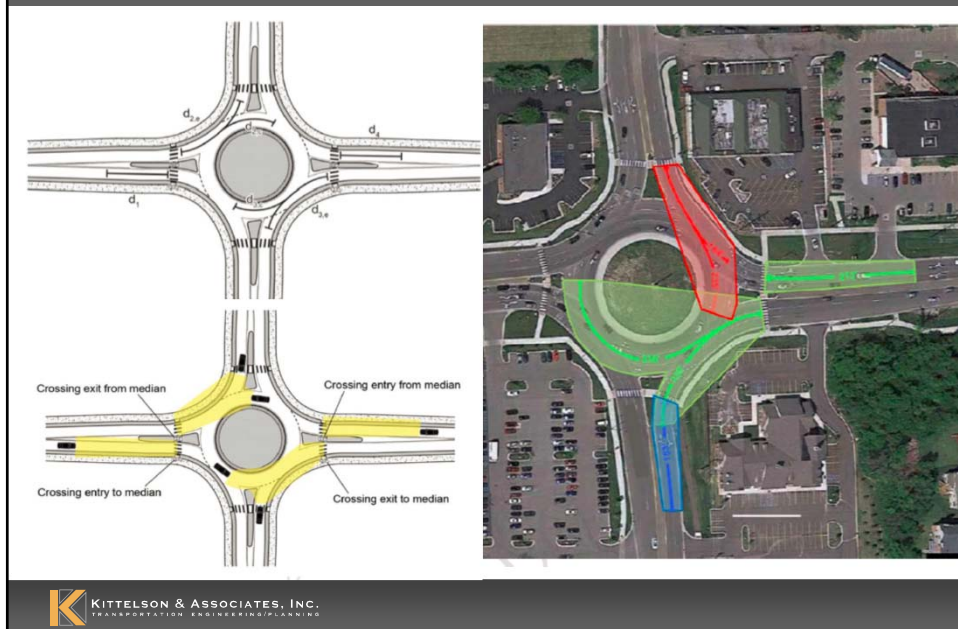


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Sample Content – Design Details



Sample Content – Crossing Sight Distance



NCHRP Project 03-110: Estimating the Life-Cycle Cost of Intersection Designs

Kittelson & Associates, Inc. (Lee Rodegerdts, PI)
EcoNorthwest
Write Rhetoric

January 2016



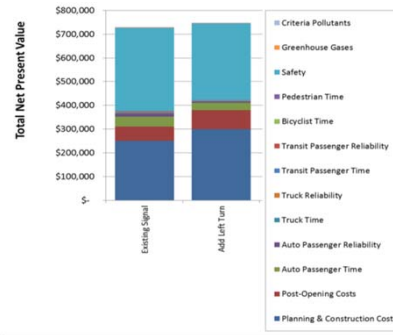
NCHRP Project 03-110: Project Objective

- Develop spreadsheet-based tool for comparing life-cycle costs of alternative designs for new and existing intersections
- Applicable to range of options:
 - Stop-controlled
 - Traffic signal
 - Roundabout
 - Innovative designs



What the Life-Cycle Cost Estimation Tool Does

- Converts units of various metrics into Net Present Value
- Provide the user with national average values for various costs while allowing calibration
- Provides summary in spreadsheet form



Evaluation Framework

- Uses “cordon” concept
- Allows maximum flexibility to analyze a range of conditions:
 - Single intersection
 - Complex intersection or interchange
 - Series of intersections
 - Subarea or area
- Assumes that all significant differences among alternatives are captured within the cordon and can be estimated within the cordon

Tool Inputs

- Planning, construction, operations, and maintenance costs for single or recurring events
- Traffic projections for key study years by mode(s) of interest (e.g., auto, truck, transit, bike, ped)
- Operational and safety performance from outside tools (HCM methods, microsimulation, Highway Safety Manual, CMFs, etc.)
- Options for other user-specified metrics
- Internal tool calculations for some values (e.g., annualized delay, emissions, travel time reliability)

Next Steps

- Project complete
- Report and tool anticipated on TRB website by late January
- Final report out in a few months
- Webinar tentatively planned for April 2016

NCHRP Synthesis 46-02: Roundabout Practices

Kittelson & Associates, Inc. (Alek Pochowski, Andy Paul, co-PIs)

January 2016

DISCLAIMER:

Report is approved for publication (expected late February, 2016), but information presented shall not be distributed or referenced until the report is published.



NCHRP Synthesis 46-02: Roundabout Practices

- Document and summarize the current roundabout policies, guidance, and practices within State DOTs
- Focus is on roundabout selection and design with a secondary focus on performance
- Intended to be a useful reference to agencies that are creating or updating roundabout and intersection control policies



**NCHRP Synthesis 46-02: Roundabout Practices
Study Approach Stages**

Literature Review



Survey



Case Examples

**NCHRP Project 17-70:
Development of Roundabout
Crash Prediction Models and
Methods**

Kittelson & Associates, Inc. (Erin Ferguson, PI)

Persaud & Lyon

Write Rhetoric

January 2016

Research Objective

- Develop SPFs and CMFs for all road users that can be used to estimate the severity and number of crashes likely to occur at roundabouts under a variety of rural and urban contexts for single-lane and multilane roundabouts.



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Specific Questions the Research Is to Address

- How do geometric features – and combinations of features – influence the number and severity of crashes at the roundabout?
- How do operational features – and combinations of features – influence the number and severity of crashes at the roundabout?
- How do driver learning curves influence the number and severity of crashes at any age roundabout?



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Work Plan

- Task 0 – Amplified Work Plan
- Task 1 – Conduct Literature Review
- Task 2 – Develop Data Collection Plan
- Task 3 – Implement Data Collection Plan
- Task 4 – Identify Appropriate Modeling Procedure/Approach
- Task 5 – Preliminary Annotated Outline for HSM Text
- Task 6 – Produce Phase 2 Work Plan
- Task 7 – Test/Validate/Modify Modeling Procedure/Approach
- Task 8 – Annotated Outline of Final Deliverables
- Task 9 – Proposed HSM Text
- Task 10 – Prepare Final Deliverables
- Task 11 – Present Research to AASHTO Subcommittee



Schedule : Key Milestones

- Data Collection Plan – Panel Review/Discussion – Dec 2014
- Interim Report and Panel Meeting – July 2015
- Data Collection Completed – December 2015
- Draft Crash Prediction Models – Panel Review and Discussion – March/April 2016
- HSM Annotated Outline – Panel Review – May 2016
- Final Deliverables – Panel Review – Sept./Oct. 2016



Data Collection

- Recently Completed Data Collection and Database Assembly
 - 369 Roundabouts
 - Focusing on two sets of intersection level crash prediction models to inform: (1) network screening, (2) design decisions
 - Obtained numerous data attributes
 - 50 related to geometric characteristics (e.g., number of legs, entry width per leg, angle to next leg)
 - 8 relate to speed (i.e., posted speed limit per leg and confidence in posted speed limit recorded per leg)
 - Multiple years of traffic volume data by leg
 - 15 related to crash data (e.g., crash type, crash severity)
 - Include sites from:
 - New York, Pennsylvania, North Carolina, Florida, Wisconsin, Michigan, Minnesota, Kansas, Washington, California, and Ontario (Canada)



Questions?

Lee Rodegerdts

lrodegerdts@kittelson.com

503-228-5230

Alek Pochowski

apochowski@kittelson.com

202-642-2916

Bastian Schroeder

bschroeder@kittelson.com

919-345-4412

Erin Ferguson

eferguson@kittelson.com

510-433-8066

