MnDOT Research Need Statement 717

I. Need Statement Champions and Information

I.A. Need Statement Champion Information

I.A.1. First and Last Name of Research Champion: Hannah Pritchard
I.A.2. Research Champion's Office: Transit and Active Transportation
I.A.3. Research Champion's Phone Number: 651-366-4168
I.A.4. Research Champion's Email: hannah.pritchard@state.mn.us

I.C. Research Needs Title (115 Characters):

Roadside feature placement and pedestrian safety on low and intermediate speed road

I.D. Potential Project Sponsor based on research need: MnDOT Research Program

II. Research Need Background and Description

II.A. Research Need Background

II.A.1. Describe the problem or opportunity.

Existing research on the design of low- and intermediate-speed (35 mph and 40-45 mph posted speeds, respectively) urban roadsides does not provide adequate guidance to designers balancing complete streets design principles and roadside safety concerns. While MnDOT design guidance has grown more flexible and emphasizes the role of engineering judgment, designers need relevant, empirical models and evidence on which to base this judgment. The methodology used for this study will be particularly important. In 2006, Dumbaugh found that the study designs of existing research into roadside design on urban low- and intermediate-speed facilities were generally inadequate to define the safety effects of design decisions in a statistically sound way.[1]

The most definitive guidance on the subject is presented in Chapter 10 of the AASHTO Roadside Design Guide (RDG)[2] and is mostly focused on the safety of vehicle occupants. While this chapter includes cursory statements encouraging the provision of buffer space between roadways and sidewalks and general allusions to the multifaceted benefits of trees and other urban street furnishings for aesthetics and livability, it presents these features as potential roadside safety risks and does not consider their influence on vehicle operating speed or overall fatal and serious injury crash rates. Conversely, urban designers have been recommending 'visually narrowing the roadway' for decades based on observations that people drive more slowly in conditions where trees and street furnishings occupy the roadside. During public engagement on roadway projects, people often request trees, barriers, or other fixed objects be placed between the roadway and sidewalk to 'protect' pedestrians from errant vehicles. Recent studies have showed a relationship

[1] Dumbaugh, E. (2006). "Design of safe urban roadsides: An empirical analysis." *Transportation research record*, *1961*(1), 74-82.
[2] Transportation Officials. Task Force for Roadside Safety. (2011). *Roadside design guide*. AASHTO.

between the presence of trees and drivers' selected operating speed and overall crash frequency/severity[3].

The only concrete design parameters that RDG Chapter 10 provides is a recommendation to offset fixed-object hazards at least 4 to 6 feet behind the curb face on intermediate-speed urban arterial roads. This guidance derives from analysis of urban roadway departure crash information compiled and analyzed for NCHRP Report 612[4]. Researchers classified urban roadway departure crashes in the study sites based on the horizontal offset behind the curb face of the impacted fixed object. Observing that nearly all the studied crashes involved fixed objects located less than 4 to 6 feet behind the curb, the authors developed the lateral offset guidance that was later incorporated into the RDG.

Several deficiencies remain in the resulting guidance. The findings differ significantly from prior research using similar methods, which generally found many more crashes where vehicles traveled much further past the curb before impacting a fixed object.[5] Most importantly, however, the research methods do not answer the question of whether maintaining the recommended lateral offsets will significantly reduce fixed-object crashes or if errant vehicles will simply travel a few extra feet before meeting a fixed object. Nor does the guidance address the potential for trees and other roadside infrastructure to influence operating speed or other driver behavior. While the guidance in the current edition of the RDG is generally consistent with MnDOT practices, it does not show any path toward reversing growth in crashes resulting in fatal and serious injuries on Minnesota's urban and suburban streets and arterial roads, which is primarily attributed to vehicle speeds.[6]

America's persistent growth in fatal crashes stands in stark contrast to trends in peer countries, who have made steady progress toward reducing and eliminating factors contributing to fatal crashes over the past half century.[7] In contrast to the principle of forgiving roadsides emphasized by the RDG, peer-nation roadside design guidance puts greater emphasis on the principle of "self-explaining roads," which explicitly encourages the use of contrasting roadside environments to systematically train drivers to adjust driving behavior based on visual cues signaling transitions between high-, intermediate-, and low-speed settings.[8]

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[3] Marshall, W.E., Coppola, N., and Golombek, Y. (2018). "Urban clear zones, street trees, and road safety." *Research in Transportation Business & Management* 29: 136-143.

[4] Dixon, K. K., Liebler, M., Zhu, H., Hunter, M. P., & Mattox, B. (2008) "Safe and aesthetic design of urban roadside treatments" (NCHRP Report 612).

[5] Kloeden, C. N., McLean, A. J., Baldock, M. R. J., & Cockington, A. J. T. (1999). "Severe and fatal car crashes due to roadside hazards." NHMRC Road Accident Research Unit the University of Adelaide.

[6] MN Office of Traffic Safety: "Crash Facts," Accessed 7/25/2023, https://dps.mn.gov/divisions/ots/reports-statistics/Pages/crash-facts.aspx.

[7] Evans L. (2014). "Traffic fatality reductions: United States compared with 25 other countries." *American journal of public health*, 104(8), 1501–1507. https://doi.org/10.2105/AJPH.2014.301922

[8] Theeuwes, J. (2021). "Self-explaining roads: What does visual cognition tell us about designing safer roads?" *Cognitive research: principles and implications*, *6*(1), 15. https://cognitiveresearchjournal.springeropen.com/articles/10.1186/s41235-021-00281-6

MnDOT's emphasis on design flexibility and context-sensitive design, embodied in the Facility Design Guide,[9] aligns with the principle of self-explaining roads by differentiating roadside design practices by facility type and context. However, while clear, prescriptive guidance is available for high-speed facilities (e.g., design speeds of 50 mph or more), MnDOT guidance for low- and intermediate-speed facilities is characterized more by a lack of restrictions than by any proactive guidance to steer design decisions.

How should designers use roadside design—the placement of trees, sidewalks, bikeways, and street furnishings—to cue drivers to adjust operating speed and anticipate curves, intersections, crosswalks, or other conflicts? How should specific roadside design parameters change based on context? What role can the roadside play in converting an intermediate-speed facility to a low-speed facility? In other words, are landscaping, street furnishings, and pedestrian and bicycle facilities ancillary amenities accommodated by the design of a street, or should they be treated more like controlling design criteria that shape operating speeds and other driver behavior?

II.A.2. If applicable, describe how this project will build on previous research.
This project will seek to overcome the limitations of prior car-centric research by employing a study design that measures the effects of specific, definable design decisions between the curb and right-of-way boundary on overall rates of fatal and serious-injury crashes on urban low- and intermediate-speed roads. The study design will build on the methodological insights presented by Dumbaugh (2006), and the findings from Marshall (2018) while leveraging MnDOT's extensive LIDAR-based planimetric asset management data to investigate specific explanatory variables, such as placement of trees and sidewalks, rather than the more general "livable streets" category investigated by Dumbaugh.

II.A.3. If applicable, include the title/s or previous research.

1. Dixon, K. K., Hunter, M. P., Wang, J., Boonsiripant, S., & Wu, S. (2008). "Effects of Urban Street Environment on Operating Speeds" (FHWA-HRT-08-040). United States. Department of Transportation. Federal Highway Administration. https://rosap.ntl.bts.gov/view/dot/49731
2. Dixon, K. K., Liebler, M., Zhu, H., Hunter, M. P., & Mattox, B. (2008) "Safe and aesthetic design of urban roadside treatments" (NCHRP Report 612).
3. Dumbaugh, E. (2006). "Design of safe urban roadsides: An empirical analysis." *Transportation research record*, *1961*(1), 74-82.
4. Evans L. (2014). "Traffic fatality reductions: United States compared with 25 other countries." *American journal of public health*, 104(8), 1501–1507. https://doi.org/10.2105/AJPH.2014.301922
5. Lee, J., & Mannering, F. (2002). "Impact of roadside features on the frequency and severity of run-off-roadway accidents: an empirical analysis." *Accident Analysis & Prevention*, *34*(2), 149-161.
6. Marshall, W.E., Coppola, N., and Golombek, Y. (2018). "Urban clear zones, street trees, and road safety." *Research in Transportation Business & Management* 29: 136-143.

[9]Facility Design Guide, MN Department of Transportation, Accessed 7/24/2023. https://roaddesign.dot.state.mn.us/facilitydesign.aspx

7. Naderi, J. R. (2003). “Landscape design in clear zone: Effect of landscape variables on pedestrian health and driver safety.” *Transportation Research Record*, *1851*(1), 119-130.
8. Ossenbruggen, P. J., Pendharkar, J., & Ivan, J. (2001). “Roadway safety in rural and small urbanized areas.” *Accident Analysis & Prevention*, *33*(4), 485-498.
9. Theeuwes, J. (2021). “Self-explaining roads: What does visual cognition tell us about designing safer roads?” *Cognitive research: principles and implications*, *6*(1), 15.

II.A.4. What is the objective of the proposed research?

The primary objective of the proposed research is to perform a statistical crash analysis for segments of roadway that represent a wide range of sidewalk/furnishing/roadside configurations, operating speeds, and contexts. Proposers should describe the process they will use to identify candidate sites and select study locations – study locations are not limited to MnDOT Trunk Highways. We anticipate study locations will be limited to roadways with posted/operating speeds of 45 mph or less.

Proposers should highlight that they’re familiar with Minnesota’s crash data set and the availability of information about the location (and offset) of roadside features. Site visits to confirm the presence and position of the roadside features will be necessary.

Secondary objectives include:

- Investigation into and documentation of the background for RDG guidance,
- Literature review and synopsis of academic research related to the benefits of roadside features for people walking and biking,
- Development of context-specific guidance (i.e., Urban, suburban, rural) for the installation and placement of sidewalks/trails and roadside features,
- Concrete, quantitative guidance on the effect of different urban roadside design parameters on operating speeds and/or rates of fatal and serious-injury crashes.

III. Strategic Priorities, Benefits, and Expected Outcomes

III.A. Allignment to MnDOT Strategic Priorities

Safety: The project aligns most directly with this priority. In particular, the safety needs of people inside and outside of cars are different and actions taken to improve safety for one group may decrease safety for the other. Guidance on how to address these conflicting needs will help MnDOT improve safety for all users.

Climate Change & Environment: In particular, roadside safety has been cited as a reason to remove trees from MnDOT right of way. Trees have an obvious role to play in carbon sequestration. They also provide shade for pedestrians, which is a necessary mitigation to increasing temperatures.

III.B. Expected Outcomes

- New or improved manual, handbook, guidelines, or training
- New or improved business practices, procedure, or process

III.C. Expected Benefits

- Decrease Engineering/Administrative Costs (Reduced planning/design costs)
  Having clear guidance on roadside design for low-speed/intermediate-speed urban areas will reduce the amount of time project managers spend deliberating on what is currently contradictory design advice.
- Environmental Aspects (Air Pollution)
  Guidance that allows for more liberal application of landscaping (especially trees) will help reduce the carbon footprint of our transportation system.

IV. Technical Advisory Panel

Instructions: Please list the name and affiliation of individuals to consider for the Technical Advisory Panel.

- TL – Hannah Pritchard (OTAT)
- OTE – Derek Leuer
- DSS - Brian Tang or Khamsai Yang
- OES – Carol Zoff
- District staff – at least one metro (Mohammed?) and one greater MN
- Metro District county – TBD, potentially KC Atkins from Hennepin Co
- Greater MN county - TBD

Your assigned Project Advisor is available to answer questions and provide guidance (assigned by the Office of Research & Innovation).
Your Project Advisor is: Dave Glyer, david.glyer@state.mn.us