## Research Problem Statement

### Research Problem Title:

Effectiveness of Regulatory Speeds vs Advisory Speeds

### Statement of Problem

Managing vehicle speeds is critical to ensure the safety of all road users, including drivers, pedestrians, cyclists, and public transit passengers (FHWA, n.d.-f). Regulatory speed limits and advisory speeds are two methods that can influence driver behavior to enhance road safety in areas where a speed reduction is necessary. However, regulatory speeds and advisory speeds may influence driver behavior in different ways.

Regulatory speed limits, sometimes referred to as posted speed limits, are “sign-posted along the road and enforceable by law” (FHWA, n.d.-e). Posted speed limits are set by the city, county, State transportation agency, or by the State legislature.

Alternatively, advisory speeds are “a non-regulatory speed posted for a small portion or isolated section of a roadway (e.g., a sharp curve, an exit ramp) to inform a driver of a safe driving speed” (FHWA, n.d.-e). Advisory speeds are a form of speed management, however, they rely on user discretion, since they are not enforceable. Therefore, there may be concern that motorists may be less compliant with advisory speeds than with regulatory speeds.

Drivers are incentivized to obey regulatory signs to avoid being issued and fine or receiving other consequences, e.g., increased insurance rates. However, drivers may be incentivized to comply with advisory speeds that are tied to a specific warning condition as a matter of personal safety. There is little research on whether regulatory speeds or advisory speeds are more effective in different contexts, such as areas with varying traffic volumes or road geometries. The objective of this research is to explore the effectiveness of advisory speeds compared to regulatory speeds in areas where speed reduction is necessary, but enforcement is limited.

### Summary of Existing Literature

#### Relevant MUTCD Provisions for Advisory and Regulatory Speeds

The 11th Edition of the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) provides the following definitions in Section 1C.02 (FHWA, 2023).

* Advisory Speed—a recommended speed for all vehicles operating on a section of highway and based on the highway design, operating characteristics, and conditions.
* Posted Speed Limit—a speed limit determined by law or regulation and displayed on Speed Limit signs.
* Speed Limit—the maximum (or minimum) speed applicable to a section of highway as established by law or regulation.
* Speed Zone—a section of highway with a speed limit that is established by law or regulation, but which might be different from a legislatively-specified statutory speed limit.

Posted speed limits, also referred to as regulatory speed limits, are displayed on Speed Limit (R2-1) signs. Section 2B.21 of the MUTCD indicates that the Speed Limit (R2-1) sign “shall display the limit established by law, ordinance, regulation, or as adopted by the authorized agency based on an engineering study.” This section of the MUTCD outlines the principles and guidelines for determining appropriate speed limits based on engineering studies, roadway conditions, and traffic patterns. Agencies often implement speed management strategies (e.g., traffic calming measures, geometric design features, speed safety cameras, and increased enforcement) concurrently with setting speed limits to achieve desired operating speeds. Section 2B.21 of the MUTCD also provides guidance on whether or how to use 85th percentile speeds to set speed limits for different roadway classifications. Paragraph 08 also indicates that “when the 85th percentile speed is appreciably greater than the posted speed limit, and the roadway context does not support setting a higher speed limit, the engineering study should consider whether changes to geometric features, enforcement, and/or other speed-reduction countermeasures might improve compliance with the posted speed limit.” When setting speed limits, a range of factors (e.g., land-use context, pedestrian activity, crash history, roadway geometry and functional classification, etc.) can influence the speed limit determined in the engineering study.

Section 2B.21 also lists specific factors that should be considered when conducting an engineering study for establishing or reevaluating speed limits within speed zones. However, paragraph 06 indicates that “Speed zones (other than statutory speed limits) shall only be established on the basis of an engineering study that has been performed in accordance with traffic engineering practices. The engineering study shall consider the roadway context.”

Section 6B.01 on Temporary Traffic Control Plans states that “reduced speed zoning (lowering the regulatory speed limit) should be avoided as much as practical because drivers will reduce their speeds only if they clearly perceive a need to do so”. Additionally, this section provided support information indicating that large reductions in the speed limit (e.g., a 30-mph reduction) can increase speed variance and crashes. Conversely, smaller reductions in the speed limit (e.g., a 10-mph reduction or less) results in smaller changes in speed variance and reduces the potential for increased crashes (FHWA, n.d.-a). Guidance indicates that reduced speed limits, if used, should only be used in the specific portion of the temporary traffic control (TTC) zone where conditions or restrictive features are present.

The MUTCD also includes provisions for the use of an advisory speed (W13-1P) plaque, which may be used to supplement an advance warning sign to indicate an advisory speed for a roadway condition. Table 2C-6 of the MUTCD indicates whether the use of an Advisory Speed plaque for horizontal alignment changes is optional, recommended, or required depending on the speed differential, i.e., the difference between the advisory speed for the horizontal curve and the posted speed limit, statutory speed limit, or the 85th percentile speed on the approach to the curve. Section 2C.59 of the MUTCD also lists established engineering practices (compass method, safety-based method, accelerometer method, design equation method, and ball-bank method) for determining the recommended advisory speed for horizontal curves and Section 6H.32 references AASHTO and ITE design documents containing engineering practices for determining advisory speeds for horizontal curves.

Other sections of the MUTCD include provisions for the optional or recommended use of Advisory Speed plaques with specific warning signs. These warning signs include, but are not limited to, Truck Rollover, Advisory Exit and Ramp Speed, ROAD NARROWS, SPEED HUMP, HILL BLOCKS VIEW, Low Ground Clearance Grade Crossing, and more.

Section 2B.21, Speed Limit Sign (R2-1), reiterates that “an advisory speed plaque mounted below a warning sign should be used to warn road users of an advisory speed for a roadway condition” and states that “a Speed Limit sign should not be used for this purpose.”

The Federal Highway Administration (FHWA) has a handbook titled *Procedures for Setting Advisory Speeds on Curves* that contains the guidelines for establishing advisory speeds, criteria for identifying advisory speeds, and methods for determining advisory speeds, etc, (FHWA, n.d.-c).

#### Relevant Research for Advisory and Regulatory Speeds

Research on the effectiveness of advisory warning speeds versus regulatory speeds on roadways is limited. The following literature analyzes the impacts of either the implementation of advisory speeds or the alteration of regulatory speeds.

The *Speed Concepts: Informational Guide* advises against lowering speed limits to account for isolated hazards or restrictive elements on a roadway, since doing so may reduce the credibility of other existing speed limits. Instead, when a lower speed is necessary for a specific location, such as a curve or ramp, FHWA recommends the use of advisory speed plaques and related traffic control devices. (FHWA, 2009 The MUTCD and various state supplements offer instructions on when and how to use advisory speeds to guide drivers safely without altering the enforceable speed limit.

The FHWA highlights the role of advisory speeds in improving safety on horizontal curves, which are associated with a higher incidence of severe crashes. In the research article, *Procedures for Setting Advisory Speeds on Curves*, it is noted that despite the presence of warning signs, many drivers fail to respond appropriately or adhere to the advisory speed plaques. Studies that have been conducted over the past two decades indicate that approximately half of all speeding-related roadway departure crashes occur on curves, partially due to inconsistent and unreliable advisory speed limits. The research advocates for a standardized, nationwide approach to determine when curve warning signs and advisory speeds are necessary and to ensure these speeds are consistent with driver expectations, thus improving compliance and safety on curves. (FHWA, n.d.-c)

The FHWA *Speed Concepts: Informational Guide* mentions that state or local officials frequently receive requests from residents to lower speed limits due to excessive speeds in their areas. However, research has consistently demonstrated that altering posted speed limits has minimal impact on actual driving speeds (Toole & Administrator, n.d.). Additionally, a 2013 article titled “*Setting Speed Limits for Safety*”, states that when a community is seeking a reduced speed limit that is lower than what is recommended by USLIMITS2, lowering the speed limit alone is not an effective approach. Research shows that reducing speed limits without modifying the road environment has little impact on actual driving speeds and could potentially increase the risk of crashes. This is consistent with the information found in section 2B.21 of the 11th Edition MUTCD. It is recommended that agencies consider implementing modifications to road design or other engineering countermeasures that could help lower speeds in a way that supports the lowered speed limit. (FHWA, n.d.-d)

A study, “*Advisory Speed Signs and Curve Signs and Their Effect on Driver Eye Scanning and Driving Performance*”, conducted in Ohio aimed to evaluate the effectiveness of advisory speed signs used alongside curve warning signs on a two-lane rural road. Forty drivers navigated two test curves—one was a 12.3 degree left curve with a radius of 465 ft and a superelevation of 8.6 percent with a 40-mph advisory speed and another was a 26-degree right curve with a radius of 220 ft and a superelevation of 9 percent and a 25-mph advisory speed. Results showed that, on average, drivers glanced at warning signs twice, but there were no significant differences in driving performance (speed, lane position, etc.) between different runs, driver experience levels, or day/night conditions. The study concluded that advisory speed signs did not significantly influence drivers' speed reduction through curves beyond what curve warning signs alone achieved (Zwahlen, n.d.).

A study performed on rural roads in Montana examined the operational and safety effects of altering posted speed limits to be below the engineering recommendations. The results of this study showed that compliance with speed limits decreased as the difference between posted and recommended speeds increased. The safety analysis indicated a significant reduction in total, fatal, and injury crashes at locations where speed limits were set 5 mph lower than the engineering recommendations. Conversely, areas with limits set 10 mph lower experienced decreases in total and property damage-only (PDO) crashes, but an uptick in fatal and injury crashes. The impact of setting speed limits 15 to 25 mph below recommendations was less clear, with results not reaching statistical significance, likely due to the limited number of sites evaluated. Overall, this research suggests that implementing posted speed limits of 5 mph below engineering recommendations can result in operating speeds that align more closely with those limits and contribute to enhanced safety outcomes (Gayah et al., 2018).

### Potential Research Approach

#### Task 1 – Kick-off Meeting and Project Management

Researchers will attend a kickoff meeting with the Task Order Contracting Officers Representative (TOCOR) and the TCD PFS panel. The research team will work with the TOCOR to ensure a common understanding of the research objective, scope, and research questions. The kickoff meeting may also be used to obtain input on current practices (to support Task 2) and specific roadway contexts of interest (to support Task 3).

#### Task 2 – Literature Review and State of Practice

The research team will review and synthesize literature regarding research that has been performed on the effectiveness of regulatory speed limits or advisory speed limits, including the applications in which the advisory speeds have been applied. Additionally, the research team will gather information on current practices from the TCD PFS members. Specifically, this review will focus on identifying current practices pertaining to implementing advisory speeds, reducing regulatory speeds, and identifying the specific types of locations where TCD PFS members have considered whether to reduce a regulatory speed or apply an advisory speed.

#### Task 3 – Research Plan Development

The research team will work with the TOCOR and TCD PFS members to finalize the research plan. The first step in developing the research plan will be to identify the specific roadway contexts of interest for comparing the effectiveness of regulatory and advisory speeds.The research team will use the findings from the literature and state of practice review to create a list of potential roadway contexts (e.g., horizontal curves, locations with back-to-back roundabouts, etc.) where it would be most useful to compare the effectiveness of regulatory and advisory speeds. Once the research team has drafted a list of potential roadway contexts, they will coordinate with FHWA and the TCD PFS members to finalize the list of target contexts.

The research team will identify 2-3 jurisdictions in which to collect data. The jurisdictions will need to have several instances of different roadway contexts of interest, some of which have regulatory speeds posted and some of which have advisory speeds posted. The research team will also work with the TCD PFS to ensure that other relevant criteria are met. For example, enforcement would likely influence the effectiveness of posted speed limits, so it will be important to consider the level of enforcement in the areas and timeframes where data will be collected.

The research team will develop a research work plan detailing the specific methodology for data collection and analysis. In general, the data collection plan will involve identifying relevant data collection locations that represent the different roadway contexts of interest. There should be several similar roadway contexts within each jurisdiction, some that have posted regulatory speeds and others that have posted advisory speeds. The research team will also consider the length of the stretch of roadway on which the lower speed limit or advisory speed is needed. The research team will collect speed data at all locations. Data will be collected during times that there are low volumes to reduce the likelihood that leading vehicles have an influence on driver speeds.

#### Task 4 – Field Site Selection and Preparation

Once the research plan is finalized, the research team will finalize the appropriate field locations that meet the criteria identified in the research plan and enable the collection of sufficient data to address the research questions.

#### Task 5 – Data Collection & Analysis

The research team will collect and analyze data based on the approved, final, research plan. This will involve the collection and comparison of vehicle speeds at locations with posted regulatory speeds and posted advisory speeds.

#### Task 6 – Final Report and Presentation

The research team will develop a final report that describes the research approach and results and provides a discussion of the findings. The research team will also develop a concise 1-page summary of the project and findings. The team will present their findings to the TCD PFS members.

### Chance of Successful Evaluation

Medium to High

The research team should be able to determine the effectiveness of regulatory and advisory speed limits based on the field data. Some contexts may vary from other contexts, but the results should be valuable to practitioners.

### References

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