Pairing Speed Limit Reductions and Infrastructure to Lower Fatal and Serious (FSI) Crashes

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Abstract

While recent California legislative reforms grant jurisdictions greater flexibility to lower speed limits, evidence suggests that reductions in posted speed limits alone are insufficient to meaningfully reduce crash severity. This research brief examines how speed limit reductions, when paired with infrastructure design, enforcement strategies, and contextual land-use planning, can more effectively lower FSI outcomes. Aligned with the Safe System Approach, the countermeasure layers of roadway geometry, lighting, bicycle-specific infrastructure, and enforcement shape driver behavior and protect vulnerable road users. This approach provides a pathway for communities to advance vulnerable road user safety by reducing speeds through a holistic approach.

Introduction

Speed is a leading contributing factor of fatal and serious injury (FSI) crashes in the United States. In 2023, speed-related crashes accounted for 28% of fatal crashes and 29% of total traffic fatalities (NHTSA, 2023). Speed related crashes have increased by 27% from 9,283 in 2014 to 11,775 in 2023 (NHTSA, 2023). In California, between 2014 and 2023, speeding-related fatalities increased from 995 to 1,303 (NHTSA). This rate of increase, 30%, was higher than the national average. Due to increased kinetic energy, higher speeds increase the risk of FSI crashes (FHWA, 2022). This is especially true for vulnerable road users such as pedestrians or bicyclists whose crash tolerance is lower than those traveling in a vehicle, and whose crash tolerance is lower at lower speeds when compared to those traveling in a vehicle (Caltrans, 2023). Research consistently shows that the probability of pedestrian death rises steeply with impact speed—fatality risk increases by 11% for each 1 km/h increase above 30 km/h, or approximately 18% for every 1 mph increase above 19 mph (Hussain et al., 2019).

Speed limits are typically set based on the underlying assumption that drivers can and should determine safe traveling speeds. The 85th percentile, a rule developed in the 1930s, formalized this by setting speed limits at the speed that 85% of drivers do not exceed based on an Engineering and Traffic Surveys (E&TS) (Caltrans, 2025). Proponents of the 85th percentile rule state that the rule reduces variance between speeds, allowing law enforcement to target the most extreme cases of speeding. Yet this method of setting speed limits does not take into account that drivers do not believe that speed threatens safety (Snowden et al., 1996) and consistently underestimate their traveling speed, especially in adverse weather conditions (UC Berkeley ITS, 2020).

Federal and statewide adoption of the Safe System Approach represents an opportunity to focus on a comprehensive and holistic framework to address road safety. Under this framework, safer speeds are one of five elements that work together, alongside safer people, safer roads, safer vehicles, and post-crash care, as layers that create redundancies to increase road safety. As part of the safer speeds element of the Safe System Approach, recent California State legislation has given local jurisdictions the flexibility to set prima facie zones and explore other options for setting speed limits outside of traditional regulations, such as from the California Vehicle Code, Manual on Uniform Traffic Devices, and California Manual for Setting Speed Limits. These laws make it easier for jurisdictions to lower speed limits outside of the traditional method of conducting an E&TS to identify the 85th percentile.

UC Berkeley SafeTREC

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The following table describes prima facie zones (default speed limits that apply under normal conditions) and new speed limit setting flexibilities allowed under Assembly Bill (AB) 43, AB 321, and AB 1938 (California Legislature, 2021, California Legislature, 2022, California Legislature, 2008).

Law	Prima facie updates	Speed-setting flexibility updates
AB 43	• 25 mph for business districts, residential districts, senior, school, and children's playground zones; • 20 mph at business activity districts; and, • 15 mph at railroad crossings and uncontrolled intersections with obstructed views and alleys.	• Allows local authorities to reduce speed limits by 5 mph in designated safety corridors, near facilities serving seniors, children, unhoused persons, and pedestrians/ bicyclists; • Permits use of lower limits on high-injury networks by designating the road a safety corridor; and, • Provides a 30-day warning-citation period when new limits are introduced.
AB 321	• Establishes a 25 mph prima facie speed limit in school zones.	• Enables local governments to reduce speed limits to 15 or 20 mph within 500 ft of schools when children are present; and, • Extends 25 mph school zones to 1,000 ft from school grounds under qualifying conditions.
AB 1938	• Adjusts prima facie determination process by allowing use of rounding down the 85th-percentile speed.	• Authorizes local jurisdictions to round speed limits down by 5 mph from the nearest 5-mph increment of the 85th percentile speed; and, • Ensures such reductions are legally enforceable (not considered 'speed traps').

Why Speed Reduction Alone Is Not Sufficient

Reducing roadway speed significantly improves safety for pedestrians and bicyclists. A five mph decrease in vehicle speed in a crash results in a 56-88% decrease in serious pedestrian injuries and an 80-96% decrease in pedestrian fatalities (Hussain et al., 2019). Lowering the posted speed from 35 mph to 30 mph can result in a 17-32% reduction in bicycle injuries and a 21-45% reduction in bicycle fatalities (UC Berkeley ITS, 2020).

Yet evidence suggests that lowering posted limits alone does not guarantee reductions in FSI crashes. The California Safe Speeds Toolkit underscores that effective speed management requires more than regulatory change; it also depends on roadway geometry, traffic control devices, enforcement, and traffic calming strategies such as speed humps and chicanes (UC Berkeley SafeTREC, 2023).

Similarly, a Canadian study found that posted speed limits had little effect on injury severity because many drivers failed to comply; instead, roadway design characteristics like lane width and intersection density were more influential in shaping actual driver behavior (Zahabi et al., 2011).

These findings highlight a persistent gap: while speed reduction policies set critical guardrails, without complementary infrastructure and enforcement, they often fail to achieve meaningful safety outcomes.

The Safe System Approach (SSA) situates speed management within a broader framework of system design. Recognizing that human error is inevitable, SSA emphasizes building redundancy into road systems to ensure that crashes do not result in death or serious injury.

How Other Factors Influence Fatal and Serious Injuries (FSI)

Lighting

Lighting conditions substantially alter crash severity. Ferenchak et al. (2022) found that pedestrians injured in a crash in darkness were five times more likely to die than those injured during daylight, and pedestrians struck in areas without street lighting were over twice more likely to be killed than pedestrians struck in environments with street lighting. Woods et al (2025) found that after time changes, with the reduction of light in spring mornings and fall afternoons, all road users experienced an increase in fatal crashes. Notably, this study found that this increase in fatal crashes was especially true for pedestrians and bicyclists. This suggests that while the absence of lighting may not necessarily increase the frequency of crashes, it dramatically amplifies crash severity by reducing both visibility for pedestrians and bicyclists along with reaction times for drivers.

Evidence from rural contexts underscores how lighting interacts with other factors. Jafari Anarkooli and Hosseinlou (2016) showed that insufficient lighting on two-lane roads in Washington State heightened crash severity, particularly, in head-on and rear-end collisions at intersections. Notably, the impact of speed limits on crash severity diminished in darkness, suggesting that drivers instinctively slowed in poorly lit areas. Still, crashes that did occur were more serious due to limited visibility and reduced maneuvering capacity. These findings point to lighting as both a compensatory factor for speed management and an independent safety determinant, particularly along corridors with high pedestrian traffic.

Roadway Geometry and Road Quality

Zahabi et al. (2011) demonstrated that road geometry, including width and shape, exerts a stronger influence on speed reduction and, by extension, injury severity than posted speed limits. In contrast, speed limits were shown to not significantly impact injury severity, suggesting that many motor vehicle drivers do not follow posted speed limits.

Road surface quality also matters. Reynolds et al. (2009) found that paved surfaces and low-angled grades lowered crash and injury risk among bicyclists, while rough or uneven surfaces increased instability and collision likelihood. This suggests that well-maintained road surfaces not only improve bicyclist comfort but contribute directly to crash prevention and reduce crash severity. When combined with other strategies, these infrastructure qualities shape risk level and add an additional layer of protection for road users.

Built Environment and Land Use

Built environment characteristics, including density, intersection frequency, and land use, mediate the effectiveness of speed policies. Zahabi et al. (2011) found that injury severity was shaped more by road geometry and contextual features than by speed limits alone. In dense, mixed-use urban corridors with heavy pedestrian and bicyclist activity, traffic calming and design interventions are a better strategy for road safety. Conversely, in car-centric corridors with infrequent intersections and few pedestrian crossings, reduced speed limits may have less observable effect without parallel infrastructural redesign.

Land use also affects exposure; it is important to design safe streets in commercial or transit heavy areas because there are more pedestrians and bicyclists. This underscores the SSA principle that interventions must be tailored to context rather than uniformly applied.

Bicycle-Specific Infrastructure

Bicyclist infrastructure significantly lowers FSI risk. Across five studies, separated bicycle lanes and marked on-road bicycle lanes reduced injury or collision rates by about 50% compared to unmodified roadways (Reynolds et al., 2009). Evidence also suggests that bicycle routes with clear demarcation and protection yield similar benefits, providing a foundation for transportation engineering guidelines which prioritize separation. These findings are reinforced by the Federal Highway Administration (FHWA) Safe System Roadway Design Hierarchy that highlights how bicyclist safety cannot be addressed solely by lowering vehicle speeds; removing serious conflicts are critical.

Road Diets

Lane reallocation, or 'road diets', is another intervention that reduces or repurposes road lanes, influencing vehicle speed and FSI outcomes. In California and Washington, corridors that underwent road diets experienced a six percent reduction in crashes compared to matched control corridors (Huang et al., 2002). While subsequent modeling suggested effects varied by traffic volume and design context, the evidence nonetheless supports road diets as a promising strategy to moderate traffic flow, reduce exposure, and lower crash severity. Importantly, road diets directly counteract the risks associated with wide, multi-lane corridors that encourage higher speeds and riskier driving behavior.

Enforcement

Enforcement-based strategies can help to lower driver speeds and reduce FSI crashes. High-visibility enforcement (HVE), the practice of placing law-enforcement at targeted locations, can deter speeding (NHTSA). San Francisco's one-year HVE program, consisting of community education in tandem with enforcement on high-injury corridors, reduced both 85th percentile and mean speeds by five percent. Despite the reduction in speeds the effect was not lasting, with speeds climbing one week after the final enforcement on a corridor (Vision Zero SF, 2020). This highlights personnel capacity as a key limitation of traffic enforcement. Disparities are also a concern with regards to HVE; research found that minority drivers were more likely to be cited and fined for speeding when controlling for speeding behavior (Aggarwal et al., 2024).

Alternatively, automated enforcement can play a substantial role in lowering driver speeds. Automated speed-feedback signs, often posted at work zones, school zones, and areas with vulnerable road users including school children and seniors, are able to slow down speeds while in use. Similar to HVE, however, Donnell et al. found that speeds typically rebound shortly after the signs have been removed. Automated speed cameras have proven to be widely effective and are able to disconnect racial bias from enforcement, unlike in discretionary traffic stops. Xu et al. (2024) showed that while police stops disproportionately targeted Black drivers, camera citations more closely reflected the racial composition of actual road users. Still, there are concerns about inequities with speed cameras, as there is a potential for these programs to inadvertently criminalize poverty and inability to pay (Smith et al., 2024). Even if automated speed cameras avoid the racial bias of discretionary traffic stops, other biases may be built into the algorithms used in these systems, typically stemming from how the technology is developed and implemented. Nevertheless, these programs have proven effective at lowering speeds.

New York City's Speed Camera Program has shown a 94% reduction in speeds at locations where cameras are installed and a 14% reduction in injuries and fatalities in comparison to locations without cameras (NYC DOT, 2025). Guerra et. al (2024) found that speed cameras prevented between 15 and 20 crashes per month and resulted in a 90% decrease of speed infractions on an arterial outside of Philadelphia, as compared to untreated arterials. In California, speed cameras as an enforcement strategy are now being tested under AB 645, a 2023 bill that authorizes speed camera pilots in six major cities (Blodgett, 2025).

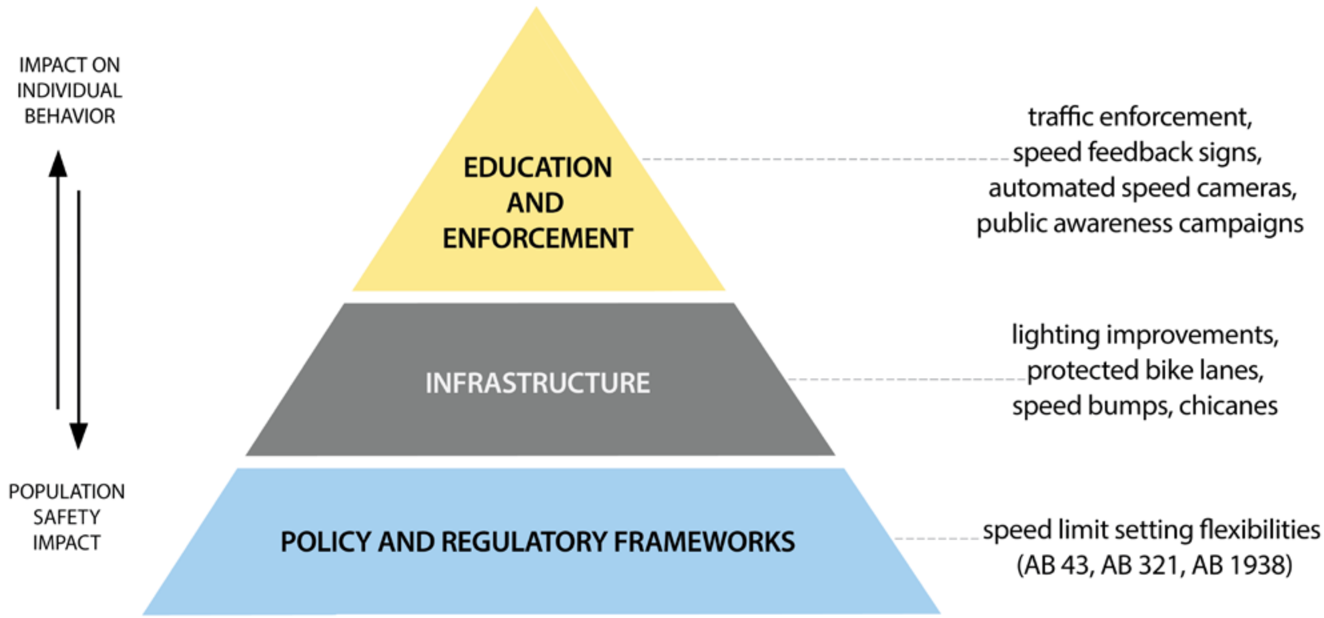
Taken together, these findings reinforce the SSA principle that no single intervention is sufficient; multiple protective layers must work together to minimize death and injury. For speed feedback signs, lighting, or any intervention to have an enduring effect on road user safety, the interventions must be part of a broader, comprehensive strategy that includes other engineering, enforcement, and education countermeasures.

Why a Holistic Approach Is Needed: Policy, Infrastructure, and Speed Reduction

Policy reforms like California's AB 43 mark a necessary departure from the 85th percentile rule, which historically set speed limits based on observed driver behavior rather than road safety needs. By prioritizing context-sensitive speed setting, AB 43 enables cities to proactively align speed policy with pedestrian and bicyclist safety (UC Berkeley SafeTREC, 2023).

Yet, policy is only one lever. Infrastructure changes, when coupled with reduced speed limits and enforcement, can transform road networks from high-speed, car-centric corridors into safer, multimodal ones. Taken together, the evidence suggests a safety "pyramid" framework, similar to the [Safe System pyramid framework] (Ederer et al., 2023). At the base are policy levers like AB 43, which create the regulatory foundation for lowering speeds. Above this sits infrastructure design, including road diets, protected lanes, lighting improvements, speed bumps, chicanes, and context-specific traffic calming measures. Finally, at the top are education and enforcement measures, such as public awareness campaigns, speed feedback signs, speed cameras, and intelligent speed assistance, which directly address driver behavior. By layering these interventions the system achieves redundancy: when one measure fails, such as driver non-compliance with posted limits, other layers, including road geometry and lighting, continue to mitigate crash severity.

The following figure displays a safety pyramid framework for lowering speeds. The pyramid weighs the three countermeasure categories, education and enforcement, infrastructure, and policy and regulatory frameworks, and their respective impacts on individual behavior versus population safety.



Applying this pyramid framework, policy levers can be used in conjunction with infrastructure changes to reduce operating speeds and posted speed limits. This creates a feedback loop: infrastructure narrows the road and lowers operating speeds, which can then be documented in an updated Engineering & Traffic Survey, setting a legal basis to set a lower posted speed limit. The legal lowering of the posted speed limit then reinforces slower vehicle speeds and strengthens the effect of the physical changes.

Another strategy is using the AB 43 provisions of determining the corridor as “land or facilities that generate high concentrations of bicyclists and pedestrians”, allowing the speed limit to be lowered to 25 mph. Land-use decisions and infrastructure installations can invite changes in active transportation and therefore generate the pedestrian and bicyclist traffic necessary for designating a corridor as such.

Other strategies could include the reclassifications of corridors if applicable, which can allow for adjusting the prima facie speed limit. These changes must comply with California MUTCD guidance and statutory rounding rules that provide consistency across jurisdictions. Lowering vehicle speeds through a combination of these strategies can lead to a reduction in speed differentials both between vehicles and modes, decreasing crash risk. Aligned with the Safe System Approach, speed limit flexibilities and contextual infrastructure address road user safety in a comprehensive, layered manner.

Conclusion

Speed management is paramount to reducing FSI crashes, yet the evidence suggests that lowering posted limits alone is insufficient. California’s recent legislative reforms, including AB 43 and AB 1938, allow local jurisdictions the flexibility to set context-sensitive speed limits, representing important progress in shifting away from the outdated 85th percentile rule. Combining these new speed-setting flexibilities with investments in infrastructure, enforcement, and design aligns with the redundancy model of the Safe System Approach by allowing infrastructure to naturally lower driver speeds. A holistic framework: layering policy reforms, roadway redesign, lighting improvements, protected bicycle lanes, and enforcement, creates the redundancy necessary to protect all road users, especially pedestrians and bicyclists whose crash tolerance is lowest. Ultimately, safer speeds are not a matter of regulation alone but of system design. Integrating legislative flexibility, infrastructure improvements, and evidence-based interventions offers a path toward reducing roadway fatalities and achieving Vision Zero and Safe System goals.

For more information on speed limit setting, the California Safe Speeds Toolkit and Safe Speed Limits Assessment (SSLA) provide technical resources to implement speed management strategies tailored to local conditions.

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About the Program

This research brief was developed as part of the Community Pedestrian and Bicycle Safety Program (CPBSP). The aim of the CPBSP is to reduce pedestrian and bicyclist fatalities and serious injuries in California. We partner with communities across California to discuss, plan, and implement safety improvements and projects.

The CPBSP prioritizes working in communities that are at disproportionate risk for road traffic injuries and addressing the safety needs of people who are underserved by traditional transportation resources and planning. For more information, visit: https://bit.ly/CPBSP or email us at safetrec@berkeley.edu.

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