JS|HELD

PERSPECTIVES

Enhancing Intersection Safety: Pedestrian & Line of Sight Considerations

Our perspectives feature the viewpoints of our subject matter experts on current topics and emerging trends.

INTRODUCTION: THE ROLE OF ROADWAY ENGINEERING IN PREVENTING VEHICULAR & PEDESTRIAN ACCIDENTS

Roadway engineering is tied directly to what is known about driver needs and behavior during certain tasks. It is the role of an engineer to plan for events prior to their occurrence and to give drivers the necessary information and opportunities needed to avoid potential conflicts.

Roads are built with the understanding that humans will be the ultimate user of the facility. With that in mind, engineers are tasked with designing and building roads which allow drivers to assess surrounding conditions and make decisions based on that information. However, there are times when circumstances change the initial design of the roadway and its intersections, which can create hazards that are not readily apparent and potentially lead to vehicular crashes.

Pedestrian and vehicular accidents at intersections and driveways are a type of occurrence wherein the accident reconstruction and roadway design industries connect, particularly as it concerns performing causation analyses. An understanding of both industries can be integral when performing a complete analysis to determine the root cause of such accidents.

A common scenario in the accident reconstruction industry involves a vehicle driving on a minor street or driveway anticipating a right turn onto a major road that has pedestrian traffic traveling opposite the flow of vehicular traffic along the major street. As the vehicle's driver is attempting to turn right onto the major road, they look left to check for roadway traffic, and a collision occurs on the right involving the pedestrian traffic traveling across the side street.

In these scenarios, roadway design elements have an opportunity to increase or decrease the likelihood of an impact. An understanding of pavement markings, signage, roadway geometry, and clear sight triangles help Traffic and Transportation Engineers determine if there are any roadway defects that can be contributing factors to a potential crash.

In this article we will address key topics and questions the reader may have, including:

- Is my property safe for customers/residents and compliant with my governing entity's municipal code?
- Where is it safe for me to install my business entrance or community entrance signs?
- Is my advertisement/signage for lease availability a violation of local code requirements?
- Does my HOA have a responsibility to keep its hedges and trees trimmed at the street access?
- What are my responsibilities when it comes to maintaining my landscaping near roadways/public right-of-way?

The following information may be of interest to residential and commercial property maintenance companies, multifamily property owners, homeowners' associations, and attorneys dealing with personal injury litigation.

PAVEMENT MARKINGS & THEIR IMPORTANCE IN ROADWAY DESIGN

Pavement markings can play a key role in communicating roadway configurations to drivers to assist them in understanding the surrounding traffic patterns. This helps ensure they have the information available to anticipate events and conflicts encountered along the route. At intersections the crosswalk pavement markings indicate to drivers and pedestrians where street crossings occur, aiding expectations and overall safety (see Figure 1 below).

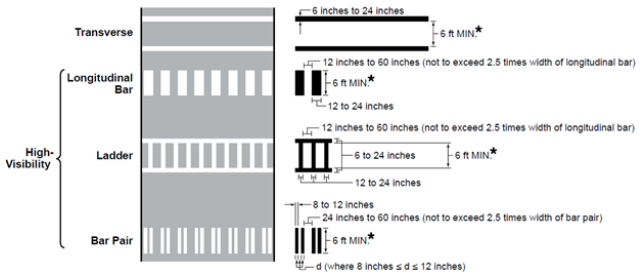

Figure 1 *- Crosswalk markings (Source: MUTCD).*

HOW ROADWAY SIGNAGE CAN INFORM USERS OF POTENTIAL HAZARDS

There are three types of roadway signs used today: regulatory, guide, and warning. Regulatory signs inform drivers of the applicable legal requirements and laws in place for the roadway. Guide signs communicate road names, route intersections, exits, and city locations to road users. Warning signs, as defined by the Federal Highway Administration of the United States Department of Transportation Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), "call attention to unexpected conditions on or adjacent to a highway, street, or private roads open to public travel and to situations that might not be readily apparent to road users." It is typical to see roadway warning signs that read, "Hill Blocks View," "Hidden Driveway," or "Cross Traffic Does Not Stop." At side road intersections, it is typical to see both regulatory and guide signs in the form of stop signs andstreet name designations, respectively. It is not common for warning signs to also be in these spots. In areas where the surrounding elements prevent the desirable line of sight for vehicle and sidewalk users, it leaves both users uninformed of the potential hazards at the intersection.

IMPACT OF ROADWAY GEOMETRY ON INTERSECTION FUNCTIONALITY

The geometry of the roadway has a significant impact on how an intersection functions. The horizontal curvature of the roadway can increase or decrease the sight distance depending on the side road approach location. Urban areas having lower design speeds allow for horizontal curves with smaller radii. The smaller the radius of the horizontal curve, the greater the effect on sight distance. A side road connection on the inside of a radius will have the right-hand sight distance reduced. This reduction will have a more pronounced effect closer to the edge of the roadway, even more so on the sidewalk. The vertical curvature of the roadway works in the same manner as the horizontal curvature, either lengthening sight distance in sag curves or shortening sight distance in crest vertical curves. Likewise, vertical curvatures also have smaller radii in urban sections with lower design speeds.

ENSURING ADEQUATE VISIBILITY WITH CLEAR SIGHT TRIANGLES

The clear sight triangles incorporated below in a state publication only address the limit of clear sight required for drivers to see vehicles along the roadway.

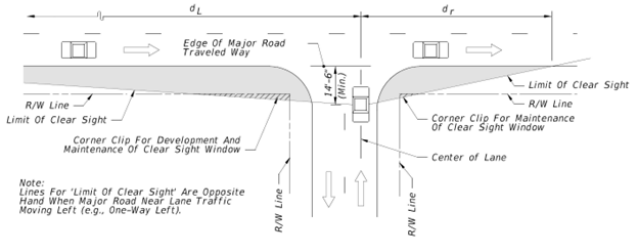

***Figure 2** - Diagram demonstrating clear sight triangles allowing drivers to see other vehicles in the roadway (Source: FDOT Design Manual 2024).*

The American Association of State Highway and Transportation Officials (AASHTO), 2018, A Policy on the Geometric Design of Highways and Streets, commonly referred to as the Greenbook, in Section 10.9.5.2.2 Sight Distance states, "Sight distance sufficient to react to motor vehicle, pedestrian, or bicycle traffic should be provided." With the legal requirements of the Americans with Disabilities Act, sidewalks have become widespread and have encouraged more usage.

However, as the accommodation of the sidewalk has increased volume, so the conflicts between pedestrians and vehicles have increased. It is with this idea in mind that more should be done to prioritize safety for the sidewalk user and not simply access and accommodation. It is typical in urban settings for the back of sidewalks to constitute the limits of the right of way for the roadway facility. As such, the governing agency has less power over what occurs outside of its property lines, adjacent to the sidewalk. The right of way limits create no issues in sections of the roadway without intersecting streets; however, when in connection with other roads it can limit the clear sight triangles necessary to give adequate visibility to the sidewalk and road user for avoidance and anticipation of accidents.

CHALLENGES OF URBAN INTERSECTION VISIBILITY AND BLIND CORNERS

Expanding on the previous scenario, the minimum setback distance for establishing clear lines of sight is 14.5 feet (AASHTO). In urban settings this distance would fall in the middle of the crosswalk. Vehicles approaching this intersection will stop first at the stop bar, since its location is beyond the minimum setback distance and there is not clear sight distance available at that location for the driver to evaluate conflicts and complete a turn safely. Adding the typical urban roadway features of a curb and gutter, sidewalk, crosswalk, and minor road stop bar to Figure 2 will illustrate how a vehicle positioned at the stop bar does not have adequate visibility when the minimum standards are met.

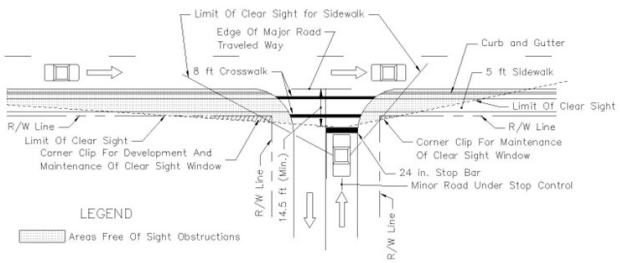

Figure 3 *- Diagram illustrating inadequacy of minimum standard setback distance for sidewalk visibility (Source: J.S. Held, LLC).*

The vehicle will then proceed forward to reach the 14.5 feet setback distance to gain adequate visibility, placing the front of the vehicle in the crosswalk. If the property adjacent to the right-hand sidewalk has visibility issues, any approaching pedestrian(s) may not be recognized as a conflict by the vehicle driver. Also, the vehicle can be hidden from the sidewalk user while at rest at the stop bar. As the vehicle moves forward the time available for both users to be informed of each other's movements and take steps to avoid collision is reduced. This increases the likelihood of a crash.

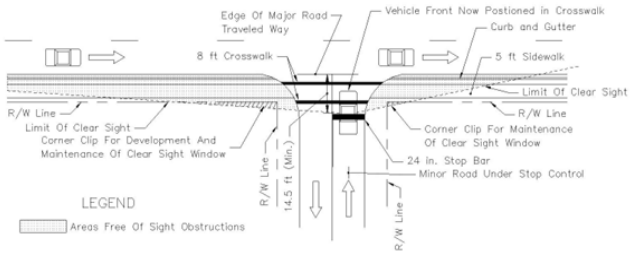

Figure 4 *- Diagram illustrating conflicting overlap in crosswalk (Source: J.S. Held, LLC).*

This issue is especially evident in urban settings that have divided and multiple travel lane roadways. The intersection turning sight distance is easily met due to the width of the roadway. Vehicles traveling from right to left across the driver's view are farther out in front of the vehicle, decreasing the lateral requirement for clear sight lines to the right of the driver. When this occurs the sidewalk user is only given accommodation by the driver, not priority, for the adequate sight distance. It is important to remember that the crosswalk is an extension of the sidewalk, and at an unsignalized intersection sidewalk, users do not have a controlled condition and are free to cross without stopping or yielding. Often, collisions occurring under these circumstances are more likely to involve a jogger, electronic scooter, or bicyclist because their stopping sight distance and traveling speed are greater than a walking pedestrian. Both the driver and sidewalk user can perform their tasks using reasonably safe and typical actions, and a collision can still occur due to a lack of visibility at the intersection.

The aforementioned scenario is referred to as a "blind corner." Blind corners are often created by foliage,

shrubbery, signage, and fences. A driver and a bicyclist, for instance, may both perform an action that has occurred countless times prior and has never resulted in a collision. It is often a learned belief, based on the driver's/cyclist's personal experience, that the action is "likely not hazardous"—that is, until the right sequence of events occurs at the wrong time, causing a situation that could not be avoided because of the lack of available pre-impact time and indicators of an impending conflict.

IMPLEMENTING CLEAR SIGHT TRIANGLES FOR IMPROVED SIDEWALK SAFETY

To provide safer sidewalks, governmental agencies have begun to utilize standards and ordinances that require clear areas for the adjacent properties at intersections to increase sight distance. Visibility is a crucial factor in the avoidance of cross-traffic conflicts between vehicles and sidewalk users. For example, on intersecting streets the municipal code could require a clear area, 25 feet back along each property from the intersection point, connecting to form a triangular area that is free of obstructions. On driveway connections the sight distance triangle would be 10 feet back along each property line.

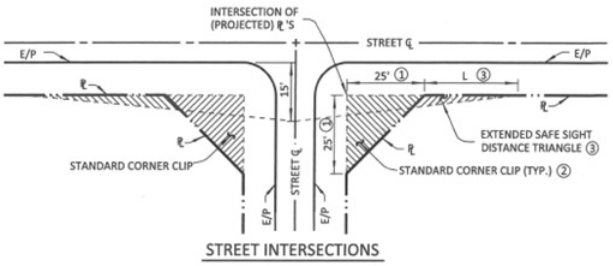

***Figure 5** - Diagram demonstrating clear sight triangles requirements by a governing entity (Source: Palm Beach County Department of Engineering & Public Works).*

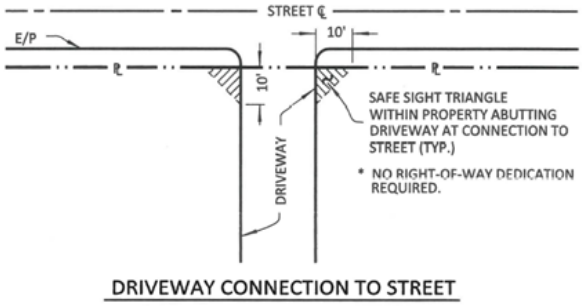

***Figure 6** - Diagram demonstrating clear sight triangles requirements by a governing entity (Source: Palm Beach County Department of Engineering & Public Works).*

It is important to note that trees, bushes, and plants along with other objects can be located within the clear sight triangle granted they allow for clear vision within a certain window that would give visibility to the sidewalk and road user.

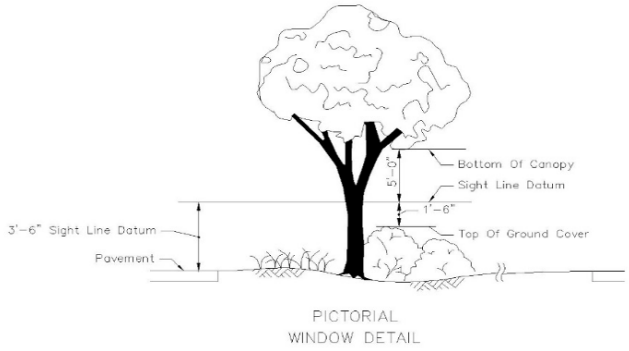

***Figure 7** - Diagram depicting the typical vertical limits of the clear sight triangle window. (Source: 2015 FDOT Standard Index 546).*

CONCLUSION

If you or your organization have concerns about property adjacent to an intersection or pedestrian crosswalks or are unsure what potential liabilities may be relevant to your business, community, etc., be sure to check local codes/laws/ordinances to familiarize with compliance expectations. Additionally, accident reconstruction experts can help by providing insights regarding line of sight, signage, and other elements that may affect

driver, pedestrian, customer, and/or resident safety on and around your property.

ACKNOWLEDGMENTS

We would like to thank our colleagues John C. Carlton, PE & Steven Brabham, PE for providing insights and expertise that greatly assisted this research.

MORE ABOUT J.S. HELD'S CONTRIBUTOR

John Carlton is a Senior Engineer in J.S. Held's Accident Reconstruction practice. John has over 15 years of experience investigating and performing reconstruction analyses on passenger vehicle, commercial vehicle, motorcycle, pedestrian, and bicycle crashes. John holds both a B.S. in Civil Engineering and a Master of Engineering with a concentration in Transportation Engineering from the University of Florida. He is licensed by the State of Florida, Ohio, and Texas as a Professional Engineer.

He has completed Traffic Crash Reconstruction I and II at Northwestern University's Center for Public Safety and is an ACTAR Accredited Traffic Accident Reconstructionist. John is certified in Temporary Traffic Control (Maintenance of Traffic) at the advanced level and has expertise in the preparation and analysis of "Temporary Traffic Control Plans" for use on FDOT projects. In addition to his transportation safety experience, John has design and construction experience in residential and commercial facilities including roadway and infrastructure. He provides accident reconstruction analysis and consulting services to legal, insurance, governmental, and corporate systems throughout the United States.

John can be reached at jcarlton@jsheld.com or +1 954 982 8081.

REFERENCES

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2. Roadside Design Guide, AASHTO
3. International Property Maintenance Code, ICC
4. Manual of Uniform Traffic Control Devices, FHWA