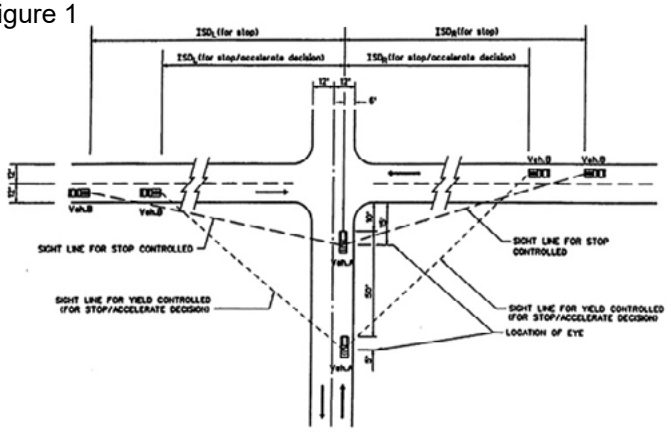
Intersection Safety for Sight Lines

Intersections are points of conflict and a potential hazard. It is important that the design, alignment and sight lines of the intersecting roads permit drivers to perceive potential conflicts and readily make maneuvers necessary to pass through the intersection with safety while minimizing interference between vehicles.

Intersection sight distance is adequate when it allows vehicles to safely make all possible maneuvers without significantly affecting vehicles traveling on the main roadway. Intersection sight distance is a complex issue that requires analysis of numerous conditions that includes but not limited to: urban vs rural, road classification (arterial, collector, local), speed, traffic volumes, turning movements for both passenger vehicles and large trucks, angle at which intersecting roads meet and percent grade of the intersecting road. The area of unobstructed sight distance is called the sight triangle. There are two (2) sight triangles that come into play at an intersection, approach sight triangle and departure sight triangle (Figure 1). Approach triangle sight line distances are calculated when there is no traffic control at an intersection or a yield control exists. Departure triangle sight line distance is considered for each of the three basic maneuvers, left turn, right turn and through for a stopped vehicle at an intersection.

Figure 1



The minimum sight distance criterion for vehicles approaching and/or stopping at an intersection is stopping sight distance based on design speed. Stopping sight distance is the sum of the distance travelled during the perception and reaction time plus the braking distance. Braking distance is the distance that it takes to stop a vehicle once the brakes have been applied. If, for example, a design speed of 90km/h is used with a standard perception and reaction time of 2.5 seconds, the distance travelled in that time is 62.5m. The braking distance at 90km/h would equal 106.2m, on level grade (3 percent or less), therefore the minimum stopping sight distance (rounded) would equal 170m1. Depending of the regulatory requirements at the intersection; uncontrolled, yield controlled, stop controlled additional intersection sight distance over and above the minimum stopping sight distance may be required.

Uncontrolled Intersection Sight Triangle

It is preferable that all intersections be either stop or yield controlled. However, there may be urban intersections which have low traffic volumes and low speed that may not be controlled by a yield sign, stop sign or signals. The minimum requirement for the approach sight line distance is for drivers on both roadways approaching an intersection to have the ability to recognize a potential conflict on the intersecting road and make a decision to accelerate, decelerate or stop in sufficient time to avoid a collision. For this reason, a calculation of decision sight distance is preferred to stopping sight distance as decision sight distance is much greater than stopping sight distance for a given design speed. A sight line triangle for an uncontrolled intersection would be similar and possibly larger than the yield controlled triangle in Figure 1. If the sight triangle cannot be provided or kept clear of sight obstructions (see also sight line below) a yield or stop control must be implemented on one of the intersecting road ways.

Yield Controlled Intersection Sight Triangle

For a yield controlled intersection both the approach and departure sight distances must be calculated. The approach sight line distance is similar to the uncontrolled with the exception that it is only required for the vehicle approaching the yield condition and typically a speed less than the posted speed is used. Suggested speeds on the yield controlled approach are: 20km/h for urban and 30 to 40 km/h for rural. The departure sight distance is calculated in the same manner as for the stop controlled intersection.

Stop Controlled Intersection Sight Triangle

At a stop controlled intersection, departure sight distance must be calculated for all three (3) basic maneuvers. These maneuvers are:

- To travel across the intersecting roadway by clearing traffic on both the left and right of the crossing vehicle without interfering with the passage of the through traffic.
- To turn left onto the intersecting roadway by first clearing traffic approaching from the left and then to accelerate to normal running speed of the vehicles from the right without interfering with the passage of the through traffic.
- To turn right onto the intersecting roadway by entering the traffic stream approaching from the left and accelerate so as to not cause interference with the through traffic stream.

To calculate the sight distance required to travel across the intersecting roadway requires information on the perception and reaction time of the crossing driver (a constant of 2.5 seconds is normally used), the vehicle acceleration time, the width of the intersecting roadway, the length of the crossing vehicle and the speed of an approaching vehicle on the intersecting roadway. Left and right turning movements may require a sight distance greater than the minimum stopping sight distance, to allow the turning vehicle to attain the desired percentage of the intersecting road design speed without being overtaken by a vehicle approaching from the intended direction of travel. The Transportation Association of Canada (TAC) – Geometric Design Guide for Canadian Roads (1999) provides a lower and upper boundary for the sight line distance requirements.

A sight triangle is created by measuring a point that represents the position of the driver of the stopped vehicle, then by measuring along the intersecting road from a point, at or near the center of the lane, where the vehicle would normally be stopped at the intersection a distance equal to intersection sight distance left and right (ISDL and ISDR on Figure 1, sight line for stop controlled) as calculated during the design.

Vertical Sight Line

Once a horizontal triangle (approach and/or departure) has been established, for either the uncontrolled, yield controlled or stop controlled conditions, the area within the triangle must be kept clear of any and all buildings, trees, shrubs greater in height than the sight line, branches of trees within the sight line and other sight obstructions including long grass greater in height than the sight line. Sight line requires two elements; eye height and object height. A constant of 1.05m is used for eye height which represents the height of the driver's eye when seated in the driver's seat of a passenger vehicle. Object height typically ranges from zero to 1.67m. In recent years an object height of 0.38m has been used to represent the height of a passenger vehicle tail/brake light. Sight lines are normally measured from the height of the turning vehicles driver's eye to the top of the approaching vehicle (although it is prudent to use some depth below the top of the vehicle). Ideally, in the center of the lane at the ISDL and ISDR (Figure 1) distances, you would want to see an object from

zero (top of the pavement at the center of the lane) to an object height of 1.15m (equaling said prudent height where the driver's eye in the stopped vehicle would clearly detect an approaching car). Therefore, the vertical sight line(s) should be kept clear of sight obstructions for the area of the sight triangle.

Other Considerations

1. If an intersecting road has multiple lanes and/or a median, additional sight distance is required to account for the extra distance the left turning vehicle must travel to complete the maneuver.
2. If the width of the median is wider than the length of the design vehicle, the left turn maneuver may be considered a two (2) stage turn.
3. If there is a grade, steeper than 3%, on the intersecting road the braking distance would increase for the vehicle on the downgrade and possibly decrease for the vehicle on the upgrade.
4. Intersections that meet at angles greater or less than 90 degrees require individual consideration.
5. Intersections with an unusual layout or that require complex maneuvers may require additional intersection sight distance.
6. Intersections with a high percentage of trucks may require additional intersection sight distance.
7. Collision history at the intersection.
8. All vehicles approaching a stop sign on a stop controlled intersection are required to stop. Drivers of vehicles approaching a stop or yield controlled intersection on the through road may require certain sight distances in the event the driver violates the stop/yield sign.

Removing Sight Obstructions on Private Property

Every municipality with jurisdiction over a highway may enter onto private land for the purpose of removing vegetation, trees and/or branches, buildings or objects on the land which may cause a sight obstruction for motor vehicles on said highway. Section 62 of the *Municipal Act* states the following:

62 (1) A municipality may, at any reasonable time, enter upon land lying along any of its highways, (a) to inspect trees and conduct tests on trees; and (b) to remove decayed, damaged or dangerous trees or branches of trees if, in the opinion of the municipality, the trees or branches pose a danger to the health or safety of any person using the highway. 2001, c. 25, s. 62 (1).

Immediate danger

62 (2) An employee or agent of the municipality may remove a decayed, damaged or dangerous tree or branch of a tree immediately and without notice to the owner of the land upon which the tree is located if, in the opinion of the employee or agent, the tree or branch poses an immediate danger to the health or safety of any person using the highway. 2001, c. 25, s. 62 (2); 2006, c. 32, Sched. A, s. 26.

Application to court

62.1 (1) A municipality may apply to a judge of the Superior Court of Justice for an order requiring the owner of land lying along a highway to remove or alter any vegetation, building or object on the land that may obstruct the vision of pedestrians or drivers of vehicles on the highway, cause the drifting or accumulation of snow or harm the highway if the municipality is unable to enter into an agreement with the owner of the land to alter or remove the vegetation, building or object from the land. 2002, c. 17, Sched. A, s. 10.

Order

62.1 (2) Upon application by the municipality under subsection (1), the judge may make an order, subject to the payment of such compensation to the owner or other conditions as the judge may fix, (a) requiring the owner of the land to remove or alter the vegetation, building or object in respect of which the application is made; or (b) authorizing the municipality to enter upon the land, upon such notice to the owner as the judge may fix, to remove or alter the vegetation, building or object. 2002, c. 17, Sched. A, s. 10.

1TAC – Geometric Design Guide for Canadian Roads (1999)

intact public entities