TRAFFIC ENGINEERING

Civil Engineering Department

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Intersection Sight Distance

- The driver of a vehicle approaching or departing from an intersection should have unobstructed view of the intersection, including any traffic control devices, and sufficient lengths along the intersecting highway to permit the driver to anticipate and avoid potential collisions.

- These unobstructed views from triangular areas known as sight triangles. Sight triangles are the specified areas along an intersection's approach legs and across the included corners as shown in figures below.

- These areas should be clear of obstructions that might block a driver's view of conflicting vehicles or pedestrians. The two types of sight triangles are approach sight triangles and departure sight triangles.

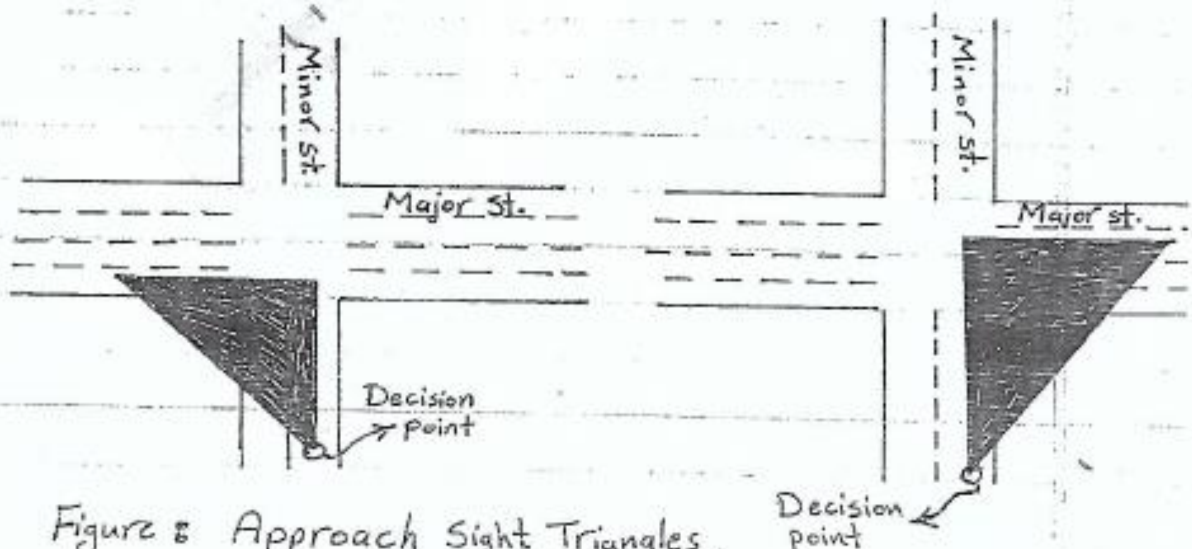


Figure : Approach Sight Triangles.

Approach Sight Triangles

Approach sight triangles provide the driver of a vehicle approaching an intersection an unobstructed view of any conflicting vehicles or pedestrians. These triangular areas should be large enough that drivers can see approaching vehicles and pedestrians in sufficient time to slow or stop and avoid crash.

Departure Sight Triangles

Departure sight triangles provide adequate sight distance for a stopped driver on a minor roadway to depart from the intersection and enter or cross the major roadway.

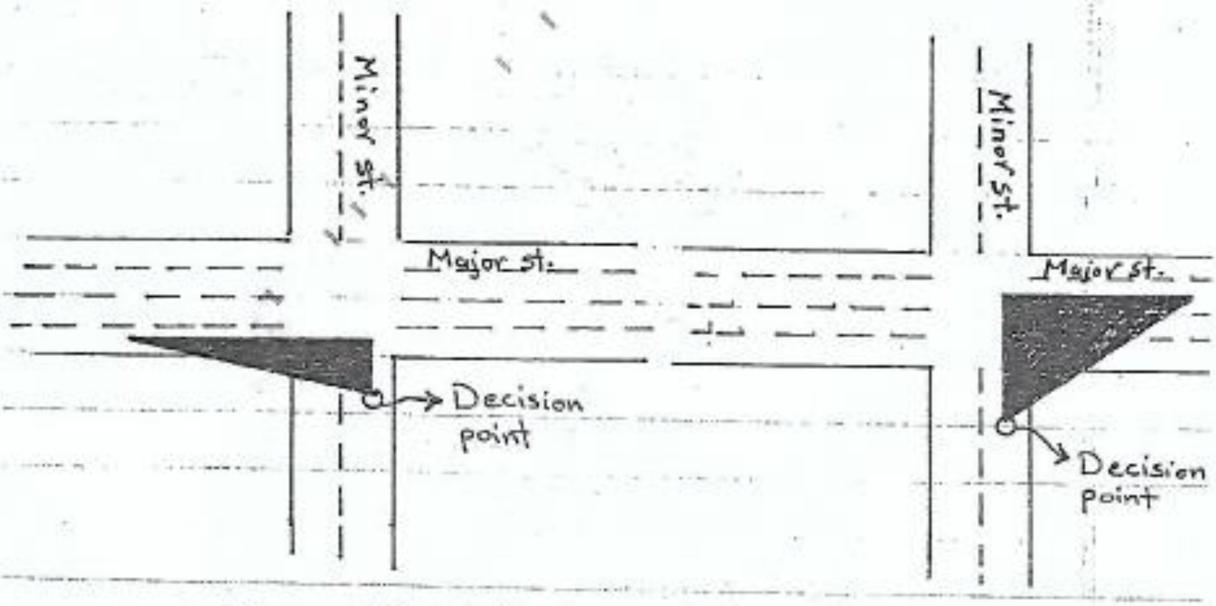


Figure: Departure Sight Triangles.

Obstruction within Sight Triangles

To determine whether an object is a sight obstruction, consider both the horizontal and vertical alignment of both roadways, as well as the height and position of the object. For passenger vehicles, it is assumed that the driver's eye height is 3.5 ft and the height of an approaching vehicle is 4.25 ft above the roadway surface as shown in figure below. At the decision point, the driver's eye height is used for measurement.

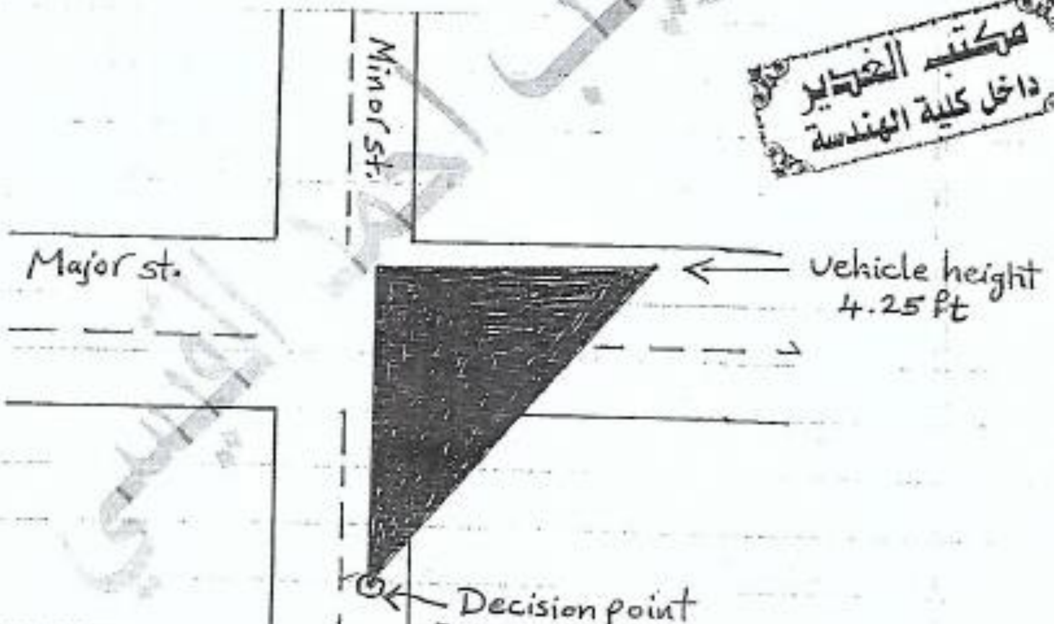


Figure: Heights pertaining to Sight Triangles

Any object within the sight triangle that would obstruct the driver's view of an approaching vehicles (4.25 ft in height) should be removed or modified or appropriate traffic control devices should be installed. Obstruction within sight triangles could be building, vehicles, trees, fences, etc. Figure below shows a clear sight triangle and an obstructed sight triangle.

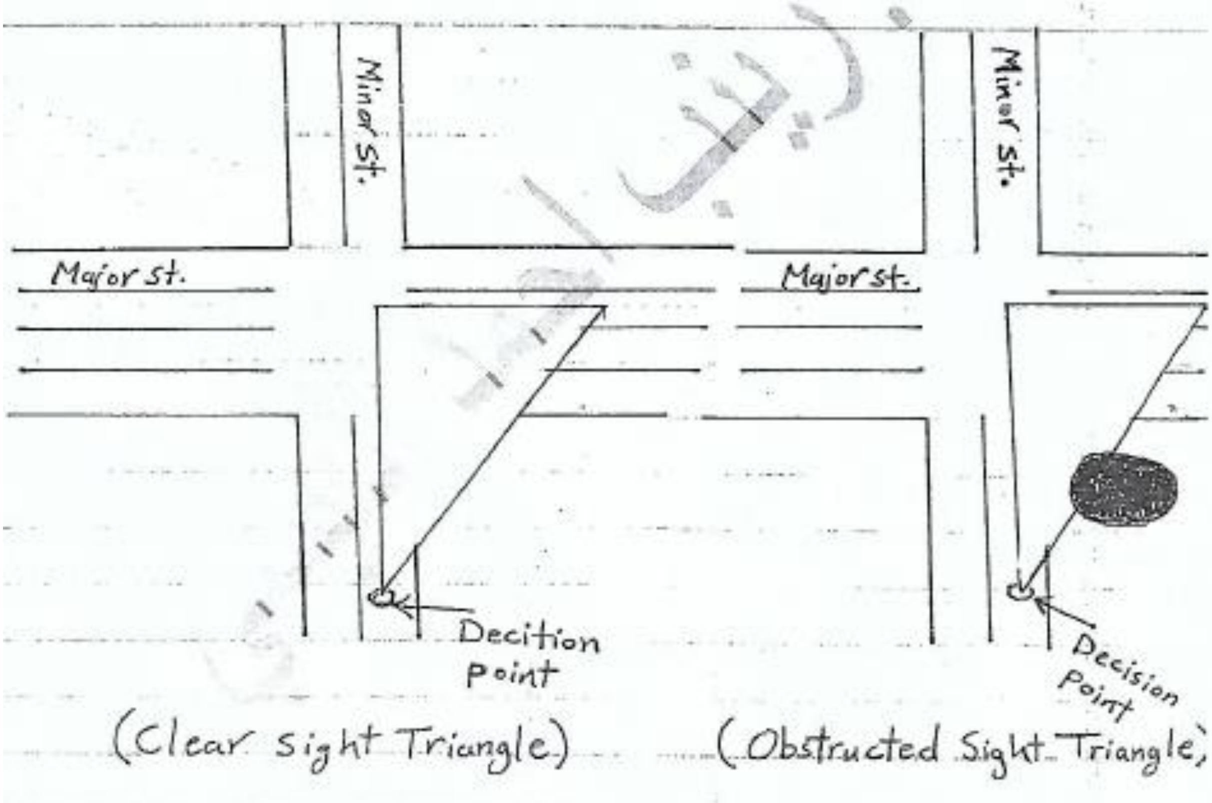
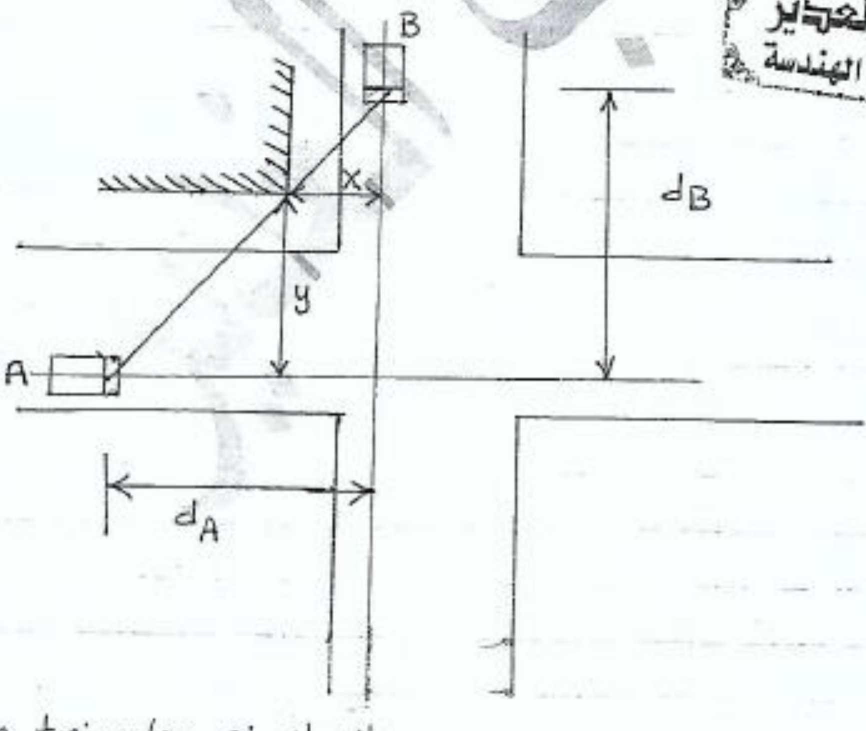


Figure: Clear versus Obstructed Sight Triangle.

- The operation of intersection is affected by sight distances and vehicle speed.

- If the following variables are known X, Y, V_A required V_B.

$$d_A = 0.278\, V_A t + \frac{V_A^2}{254\,(f \mp g)} \quad \text{--- (1)}$$



From triangles similarity:

$$\frac{d_B}{d_A} = \frac{y}{d_A - X} \quad \Rightarrow \quad d_B = \frac{d_A\, y}{d_A - X}$$

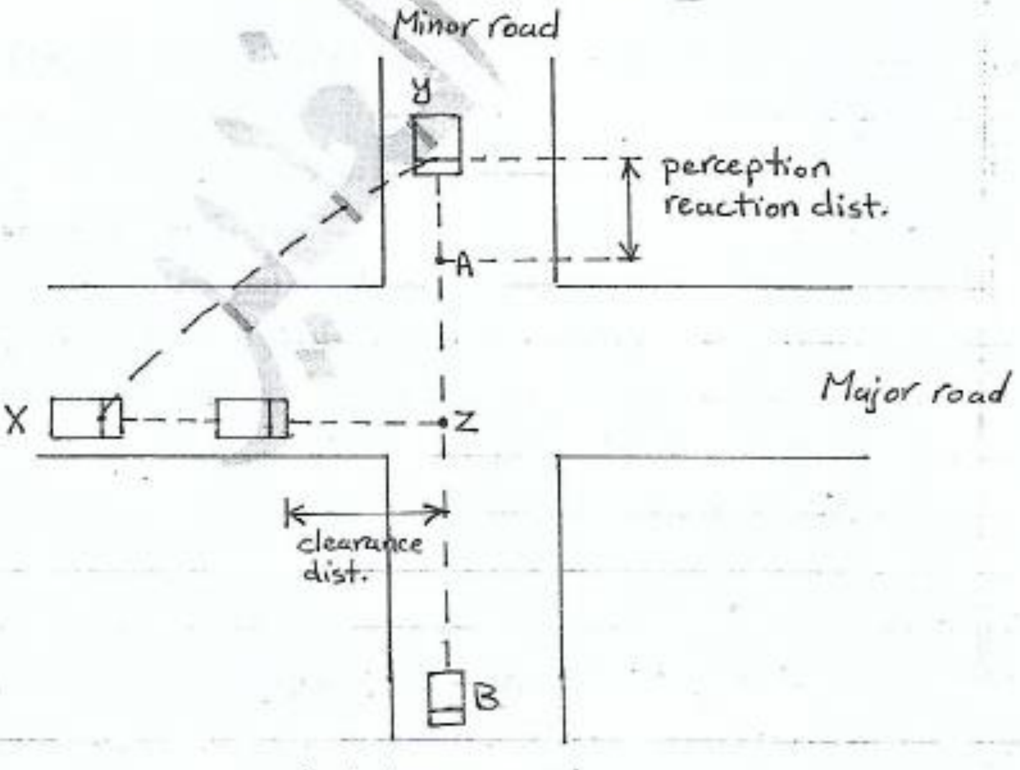
by substituting d_B in equ. (1)

$$d_B = 0.278\, V_B\, t + \frac{V_B^2}{254\,(f \mp g)}$$

Then, the safe V_B can be found.

Priority Junctions

On the side of sight triangle (xyz), there must be no obstruction to the visible between the approaching vehicles.



(Urban areas)

1. YZ : distance traveled by the approaching vehicle whilst driver perceives and reacts to the situation, and the required braking distance to bring the vehicle to rest. It is determined from :

$$YZ = Vt_1 + \frac{V^2}{2d}$$

where:

V: approach speed (m/s).
t_1 : perception reaction time (sec.).
d : allowable deceleration (m/sec^2).
YZ : distance in meter.

2. XZ : distance traveled by the major road vehicle during
   a) (t_1): the perception-reaction time of other vehicle.
   b) (t_2): the time for the minor road vehicle to accelerate from point A to reach point B clear the junction.
   c) (t_3): a safety clearance time = 2 seconds.

$$XZ = V(t_1 + t_2 + t_3)$$

where:

V: speed of major road vehicle (m/s).
t_2 : is dependent on AB length and this include the braking distance, the length of minor road vehicle

and the width of the major road

$$t_2 = \frac{(V^2 + 2as)^{1/2} - V}{a}$$

Where:

S: distance (AB), meter.

V: approach speed of minor road vehicle (m/s).

a: acceleration (m/s^2).

If $T = t_1 + t_2 + t_3 \Rightarrow$ The length $XZ = VT$

where:

V: design speed of major road.

At stop control sign the required (SD) in meter, sight distance is given by:

$$SD = V(t_1 + t_2)$$

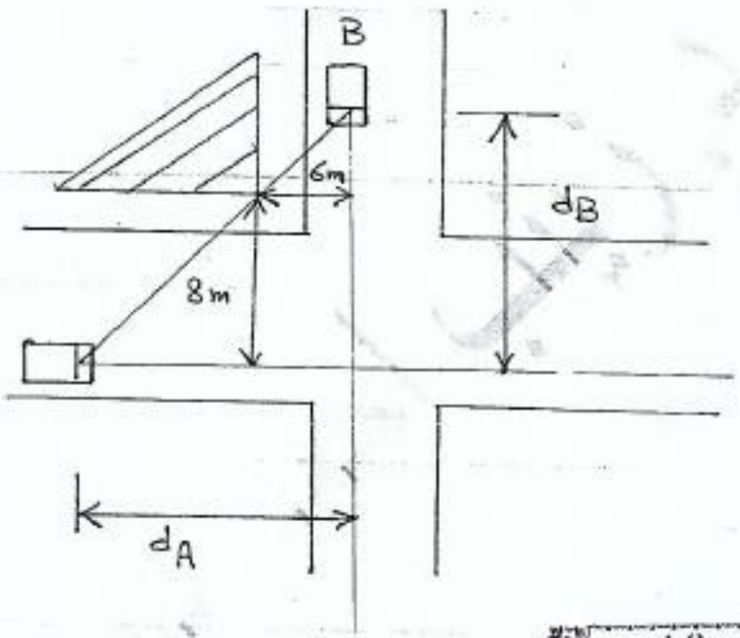
where:

V: major road design speed (m/s).

t_2: acceleration time to move dist. S(m) from stop line to clearance point at an acceleration rate of $a\ (m/s^2)$.

$$t_2 = \left(\frac{2s}{a}\right)^{1/2}$$

Example: calculate the safe distance d_A and safe speed on minor road at the intersection shown in the figure below. If the velocity in the major road is 80 km/hr. (Assume reaction time of the driver 2.5 sec. and coefficient of friction = 0.7).



Solution:

$$d_A = 0.278\, V_A t + \frac{V_A^2}{254\,(f \mp g)}$$

$$d_A = 0.278 \times 80 \times 2.5 + \frac{(80)^2}{254\,(0.7 - 0)} = 91.59 \text{ m}$$

$$\frac{d_B}{d_A} = \frac{8}{d_A - 6}$$

$$d_B = \frac{8(91.59)}{(91.59-6)} = 8.56\ m$$

$$d_B = 0.278 \times 2.5 \times V_B + \frac{(V_B)^2}{254(0.7)}$$

$$8.56 = 0.695\, V_B + 0.00562\, V_B^2$$

$$V_B^2 + 123.571\, V_B - 1521.96 = 0$$

$$\therefore V_B = 11.29\ Km/hr$$

Example: For a priorty junction, determine the distance traveled by the approaching vehicle if you know the following:

approach speed = 25 km/hr.

braking deceleration rate = 4 m/s^2.

perception - reaction time = 2.5 sec.

Solution:

$$yz = Vt_1 + \frac{V^2}{2d}$$

$$yz = \left(\frac{25 * 1000}{3600}\right) * 2.5 + \frac{\left(\frac{25 \times 1000}{3600}\right)^2}{2 \times 4}$$

$$yz = 23.42\ m$$