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Sign Up Now &Daily Live Classes3000+ TestsStudy Material & PDFQuizzes With Detailed Analytics+ More BenefitsGet Free Access Now Sight distance is a critical parameter in road design and safety analysis. It refers to the length of roadway ahead visible to a driver at any given moment. Proper sight distance allows drivers to perceive and react to potential hazards, ensuring safe vehicle operation. This article explores the concept, types, and factors influencing sight distance, along with its importance in highway design. The minimum or optimum distance along the centre of the road to the object which offers a diver visibility of the approaching object is called Sight Distance. During this short distance, a diver will have enough time to react upon approaching the objects. However, this is affected by some factors as discussed below. The sight distance depends upon the following factors:- Speed of the vehicle The friction resistance of the road Height of the divers eyes Slop of the road surface Perception time and brake reaction time Given the above factor and the importance of sight distance, to ensure that drivers have enough distance to perceive, react, and safely manoeuvre their vehicles under various conditions. Sight distance is categorized into different types based on the design needs: The clear distance needed by a diver to bring his vehicle to a complete stop or to rest before meeting the stationary object on the road is called stopping sight distance. This is sometimes called minimum sight distance. It includes; Perception-reaction distance: Time taken to perceive and react. Braking distance: Distance travelled during braking. Formula for SSD: \(SSD=\frac{V^2}{2gf}+0.278Vt \) Where,\(v\) = vehicle speed (m/s or km/h)\(g\) = acceleration due to gravity (9.81 m/s)\(f\) = coefficient of friction\(t\) = perception-reaction time (seconds) Some of the examples of sight distance at various situations of the road are:- Sight Distance at Horizontal Curve as illustrated below. Sight Distance at Road Intersection as illustrated below. Sight Distance at Vertical Summit Curve as illustrated below. SpeedPerception & Break ReactionBreakingSafe Stopping Sight DistanceVTime, t (sec)Distance (m), d1=0.278VtCoefficient of longitudinal friction (f)Distance (m) d2=V2/254fCalculated values (d1+d2)Values (m)202.5140.4041820252.5180.4062425302.5210.4093030402.5280.38174545502.5320.37276260602.5420.36398180652.5450.36469190802.5560.35721201301002.5720.35112182180Table below shows the safe stopping sight distances for various design speeds: The distance that offers reasonable opportunities for a driver to overtake his vehicle with caution is known as intermediate sight distance. It is twice the stopping sight distance. Speed (km/h)Intermediate Sight Distance (m)204025503060358040905012060180802401003 60 Decision sight distance is the length of roadway needed for a driver to detect, interpret, and react to complex situations, such as road diversions or intersections. It is longer than SSD and accounts for situations requiring more cognitive effort. The following are examples of locations where it is desirable to provide decision sightdistance: Exit ramps Diverging roadway terminals Intersection stop bars Changes in the cress section Areas of concentrated demand where there is apt to be visual noiseAlso, read: Traffic Islands: Types and Functionality The minimum distance required by the diver to overtake a slow-moving vehicle ahead in the same direction and safely manoeuvre against the approaching vehicle from the opposite direction is called overtaking sight distance. The minimum overtaking sight distance depends upon the following factors: Speed of overtaking, overtaking and the speed of the vehicle coming from the opposite direction. Distance between the vehicles. Rate of acceleration of the overtaking vehicle. Skill and reaction time of the driver. Let, d1= Distance travelled by the overtaking vehicle A during the reaction time t sec of the driver from position A1 to A2.d2= Distance travelled by the overtaking vehicle A from position A2 to A3 during the actual overtaking operation, in time T sec.d3= Distance travelled by the oncoming vehicle C from position C1 to C2 during the actual overtaking operation of A, in time T sec.VB = Speed of the overtaken vehicle in m/sec.S = Minimum spacing between vehicles A and B. Thus, d1= VB. t The minimum spacing (S) between the vehicle is given by the empirical formula: S = (0.7 VB+ 6) m The distance covered by the overtaken vehicle B from position B1 to B2 during the overtaking operation in T sec is given by, b = VB.T d2= 2S + b = VB.T + aT/2 Where a is acceleration of the vehicle A in m/Sec Or, T = (4S/a) Hence d2 = 2S + VB.T3=V.T Where V is the design speed of vehicle C in m/Sec Overtaking Sight Distance Formula For Two-way Traffic =d1 + d2 =V.t+2S+(V.B.t+V.T). Overtaking Sight Distance Formula for One-Way Traffic = d1+ d2 = (VB .t + 2S+ VB.T) m If VB is not given then its value may be assumed as VB = (V 4.5) m/Sec, Where V is the design speed in m/Sec. Also, read: Traffic Signs: The System For Traffic Control 09/17/2023 02/12/2024 09/13/2023 While designing the highway the most important factor to keep in mind is overtaking sight distance. Without the proper use of these factors, there is no point in designing a road as it may cause several accidents.But engineers have to work always with safety while designing any structure. So, here I have explained the procedure, derivation, and numerical example of overtaking sight distance (OSD).I highly request you to read each line carefully to get an idea and full understanding of overtaking sight distance. Let us start. The minimum distance on a highway required by a vehicle/driver to overtake a slow-moving vehicle ahead i.e. traveling in the same direction safely against approaching traffic in the opposite direction is known as overtaking sight distance (OSD).Various overtaking maneuvers models have been suggested and compared with actual crossing practice. One of them is discussed below & based on the following simple assumption.The overtaken (Slow) vehicle travels at a uniform speed. The overtaking (fast) vehicle reduces its speed and follows the overtaken vehicles and prepares for overtaking operation.The driver requires a short period of time (In average 2 sec.) to perceive the situation and start acceleration when the passing operation is called into play.Overtaking is accomplished under a delayed start & early return. Consider the overtaking model as shown on the next page.Overtaking Sight DistanceLet us consider, A1, A2, A3 Stands for overtaking vehicle being the various position of the vehicle during overtaking operation.B1 Stands for the overtaken vehicle which reached at position B2 during overtaking operation. C1, C2 Stands for the vehicle coming from the opposite direction. d1: Distance traveled by overtaking vehicle during reaction time t taken by the driver to decide he should overtake or not. d2: Distance traveled by overtaking vehicle during actual overtaking operation. d3: Distance traveled by a vehicle coming from the opposite direction during actual overtaking operation. Vb: Speed of slow moving (overtaken) vehicle. In design practice it is taken as (V- 16),V = Design Speed in kmph or (V-4.5) V in m/s. [If not given in Numerical] Vc: Speed of oncoming vehicle, same as design speed. Now from figure, (Overtaking sight Distance), OSD = d1 + d2 + d3(i) But, d1 = Vb * t (t=2 sec.)(ii) And, d2 = b + 2S = (Vb*T + 2S) (iii) Where, S= (0.69 Vb + 6.1) is spacing between vehicles. b = Vb*T Here, T is overtaking time from A2 to A3. Then d2 becomes , d2 = {(Vb*T + 2(0.69Vb + 6.1)} Also, d2 = VbT + 1/2 (aT^2)(iv) From Solving equation (iii) and (iv)We get, T = (4S/a) Where (a) is the acceleration of overtaking the vehicle. Again, d3 = v * T -(v) Where (v) is designed speed i.e speed of overtaking vehicles while overtaking and (T) is overtaking time between (A2) to (A3). Therefore, Putting the value of equation (ii), (iii), (iv), and (v) in equation (i)We get, OSD = d1 + d2 + d3 = Vb.t+Vb.T+1/2.a.(4S/a)+vT = (Vb + VbT+ 2S + vT) For single lane road, neglect (d3)So, OSD = d1 + d2 Minimum length of overtaking zone= 3 * OSDBut, desirable length of overtaking zone= 5 * OSD For clear understanding let us take a numerical example on it. Q) The speed of overtaking and the overtaken vehicle is 80kmph and 65 kmph respectively on two-way traffic. The acceleration of the overtaking vehicle is 3.6 kmph. Calculate. (i) Safe overtaking sight distance. (ii) Minimum and desirable overtaking zone. Solution:- Given, Design velocity(v) = 80 kmph =22.22 m/s Slow moving vehicle(Vb)= 65 kmph = 18.05 m/s We know, OSD = d1+d2+d3(i) Let us assume total reaction time = 2 seconds. Then, d1 = Vb * t = 18.05 * 2 = 36.1 meter. (ii) d2 = 2S + b =2(0.69Vb+6.1) + Vb*T = 2*18.55+18.05+8.61 = 192.51 meter.(iii) d3 = v * T = 22.22 * 8.61 = 191.31 meter.(iv)Hence, OSD = d1+d2+d3 {from equation (i).} Put the value of equation (ii), (iii), and (iv) in equation (i)We get , (1) Safe overtaking sight distance OSD= 36.1+ 292.51 + 192.51 = 420 Approx. (2) Minimum overtaking zone = 3 * OSD = 3 * 420 = 1260 meter. Desirable overtaking zone = 5 * OSD = 5 * 420 = 2100 meter. Hence, In this way, the overtaking sight distance can be calculated. I Hope friends, you liked my written article on Procedure, Derivation and Numerical example of overtaking sight distance (OSD) and remains helpful.Read Also,How to calculate no. of bricks, Quantity of cement and sand required in a wall?Types of bond in brickworkDifferent types of canalHow to calculate Slope and deflection of beam by conjugate method?. Lecture Notes in Transportation Systems Engineering 1 Overview 2 Types of sight distance 3 Stopping sight distance 4 Overtaking sight distance 4.0.1 Overtaking zones 5 Sight distance at intersections 6 Summary 7 Problems Exercises References Acknowledgments _____ The safe and efficient operation of vehicles on the road depends very much on the visibility of theroad ahead of the driver. Thus the geometric design of the road should be done such that anyobstruction on the road length could be visible to the driver from some distance ahead . This distanceis said to be the sight distance. Sight distance available from a point is the actual distance along the road surface, over which a driverfrom a specified height above the carriage way has visibility of stationary or moving objects. Threesight distance situations are considered for design: Stopping sight distance (SSD) or the absolute minimum sight distance Intermediate sight distance (ISD) is defined as twice SSD Overtaking sight distance (OSD) for safe overtaking operation Head light sight distance is the distance visible to a driver during night driving under the illumination of head lights Safe sight distance to enter into an intersiection.The most important consideration in all these is that at all times the driver traveling at the design speedof the highway must have sufficient carriageway distance within his line of vision to allow him to stophis vehicle before colliding with a slowly moving or stationary object appearing suddenly in his owntraffic lane. The computation of sight distance depends on: Reaction time of the driver Reaction time of a driver is the time taken from the instant the object is visible to the driver to the instant when the brakes are applied. The total reaction time may be split up into four components based on PIEV theory. In practice, all these times are usually combined into a total perception-reaction time suitable for design purposes as well as for easy measurement. Many of the studies shows that drivers require about 1.5 to 2 secs under normal conditions. However, taking into consideration the variability of driver characteristics, a higher value is normally used in design. For example, IRC suggests a reaction time of 2.5 secs. Speed of the vehicle The speed of the vehicle very much affects the sight distance. Higher the speed, more time will be required to stop the vehicle. Hence it is evident that, as the speed increases, sight distance also increases. Efficiency of brakes The efficiency of the brakes depends upon the age of the vehicle, vehicle characteristics etc. If the brake efficiency is 100%, the vehicle will stop the moment the brakes are applied. But practically, it is not possible to achieve 100% brake efficiency. Therefore the sight distance required will be more when the efficiency of brakes are less. Also for safe geometric design, we assume that the vehicles have only 50% brake efficiency. Frictional resistance between the tyre and the road The frictional resistance between the tyre and road plays an important role to bring the vehicle to stop. When the frictional resistance is more, the vehicles stop immediately. Thus sight required will be less. No separate provision for brake efficiency is provided while computing the sight distance. This is taken into account along with the factor of longitudinal friction. IRC has specified the value of longitudinal friction in between 0.35 to 0.4. Gradient of the road. Gradient of the road also affects the sight distance. While climbing up a gradient, the vehicle can stop immediately. Therefore sight distance required is less. While descending a gradient, gravity also comes into action and more time will be required to stop the vehicle. Sight distance required will be more in this case.Stopping sight distance (SSD) is the minimum sight distance available on a highway at any spothaving sufficient length to enable the driver to stop a vehicle traveling at design speed, safely withoutcollision with any other obstruction. There is a term called safe stopping distance and is one of the important measures in trafficengineering. It is the distance a vehicle travels from the point at which a situation is first perceived tothe time the deceleration is complete. Drivers must have adequate time if they are to suddenly respond to a situation. Thus in highway design, sight distance atleast equal to the safe stoppingdistance should be provided. The stopping sight distance is the sum of lag distance and the brakingdistance. Lag distance is the distance the vehicle traveled during the reaction time t and is given byvt, where v is the velocity in msec2. Braking distance is the distance traveled by the vehicle duringbraking operation. For a level road this is obtained by equating the work done in stopping thevehicle and the kinetic energy of the vehicle. If F is the maximum frictional force developedand the braking distance is l, then work done against friction in stopping the vehicle isFl = fWl where W is the total weight of the vehicle. The kinetic energy at the design speed isTherefore, the SSD = lag distance + braking distance and given by: (1)where v is the design speed in msec2, t is the reaction time in sec, g is the acceleration due togravity and f is the coefficient of friction. The coefficient of friction f is given below for various design speed. Table1: Coefficient of longitudinal friction Speed, kmph 80 f 0.40 0.38 0.37 0.36 0.35 When there is an ascending gradient of say +n%, the component of gravity adds to braking actionand hence braking distance is decreased. The component of gravity acting parallel to the surfacewhich adds to the the braking force is equal to W sin W tan = Wn100. Equating kineticenergy and work done: Similarly the braking distance can be derived for a descending gradient. Therefore the generalequation is given by Equation2. (2) Figure1: Time-space diagram: Illustration of overtaking sight distance The overtaking sight distance is the minimum distance open to the vision of the driver of a vehicleintending to overtake the slow vehicle ahead safely against the traffic in the opposite direction. Theovertaking sight distance or passing sight distance is measured along the center line of the road overwhich a driver with his eye level 1.2 m above the road surface can see the top of an object 1.2 mabove the road surface. The factors that affect the OSD are: Velocities of the overtaking vehicle, overtaken vehicle and of the vehicle coming in the opposite direction. Spacing between vehicles, which in-turn depends on the speed Skill and reaction time of the driver Rate of acceleration of overtaking vehicle Gradient of the road The dynamics of the overtaking operation is given in the figure which is a time-space diagram.The x-axis denotes the time and y-axis shows the distance traveled by the vehicles. The trajectory ofthe slow moving vehicle (B) is shown as a straight line which indicates that it is traveling at aconstant speed. A fast moving vehicle (A) is traveling behind the vehicle B. The trajectoryof the vehicle is shown initially with a steeper slope. The dotted line indicates the pathof the vehicle A if B was absent. The vehicle A slows down to follow the vehicle B asshown in the figure with same slope from t0 to t1. Then it overtakes the vehicle B andoccupies the left lane at time t3. The time duration T = t3 - t1 is the actual duration of theovertaking operation. The snapshots of the road at time t0,t1, and t3 are shown on theleft side of the figure. From the Figure1, the overtaking sight distance consists of threeparts. d1 the distance traveled by overtaking vehicle A during the reaction time t = t1 - t0 d2 the distance traveled by the vehicle during the actual overtaking operation T = t3-t1 d3 is the distance traveled by on-coming vehicle C during the overtaking operation (T). Therefore: It is assumed that the vehicle A is forced to reduce its speed to vb, the speed of the slow movingvehicle B and travels behind it during the reaction time t of the driver. So d1 is given by:Then the vehicle A starts to accelerate, shifts the lane, overtake and shift back to the original lane.The vehicle A maintains the spacing s before and after overtaking. The spacing s in m is given by:Let T be the duration of actual overtaking. The distance traveled by B during the overtakingoperation is 2s + vbT. Also, during this time, vehicle A accelerated from initial velocity vb andovertaking is completed while reaching final velocity v. Hence the distance traveled is given by:The distance traveled by the vehicle C moving at design speed v msec during overtaking operation isgiven by: The the overtaking sight distance is (Figure1) (8)where vb is the velocity of the slow moving vehicle in msec2, t the reaction time of the driver in sec,s is the spacing between the two vehicle in m given by equation5 and a is the overtaking vehiclesacceleration in msec2. In case the speed of the overtaken vehicle is not given, it can be assumed thatit moves 16 kmph slower the the design speed. The acceleration values of the fast vehicle depends on its speed and given in Table2. Table2: Maximum overtaking acceleration at different speeds Speed Maximum overtaking (kmph) acceleration (m/sec2) 25 1.41 30 1.30 40 1.24 50 1.11 65 0.92 80 0.72 100 0.53 Note that: On divided highways, d3 need not be considered On divided highways with four or more lanes, IRC suggests that it is not necessary to provide the OSD, but only SSD is sufficient. Overtaking zones are provided when OSD cannot be provided throughout the length of the highway.These are zones dedicated for overtaking operation, marked with wide roads. The desirablelength of overtaking zones is 5 time OSD and the minimum is three times OSD (Figure2). Figure2: Overtaking zones At intersections where two or more roads meet, visibility should be provided for the driversapproaching the intersection from either sides. They should be able to perceive a hazard and stop thevehicle if required. Stopping sight distance for each road can be computed from the design speed. Thesight distance should be provided such that the drivers on either side should be able to see each other.This is illustrated in the figure3. Figure3: Sight distance at intersections Design of sight distance at intersections may be used on three possible conditions: Enabling approaching vehicle to change the speed Enabling approaching vehicle to stop Enabling stopped vehicle to cross a main road One of the key factors for the safe and efficient operation of vehicles on the road is sightdistance. Sight distances ensure overtaking and stopping operations at the right time.Different types of sight distances and the equations to find each of these had been discussedhere. Calculate SSD for V =50kmph for (a) two-way traffic in a two lane road (b) two-way traffic in single lane road. (Hint: f=0.37, t=2.5) [Ans: (a)61.4 m (b) 122.8 m]. Given: V =50km/hr = 13.9m/s f=0.37 t= 2.5 sec stopping distance=lag distance + braking distance Stopping Distance = 61.4 m. Stopping sight distance when there are two lanes = stopping distance= 61.4m. Stopping sight distance for a two way traffic for a single lane = 2[stopping distance]=122.8m Find minimum sight distance to avoid head-on collision of two cars approaching at 90 kmph and 60 kmph. Given t=2.5sec, f=0.7 and brake efficiency of 50 percent in either case. (Hint: brake efficiency reduces the coefficient of friction by 50 percent). [Ans: SD=153.6+82.2=235.8m] Given: V 1 =90 Km/hr. V 2 = 60 Km/hr. t = 2.5sec. Braking efficiency=50%. f=.7. Stopping distance for one of the cars Coefficient of friction due to braking efficiency of 50% = 0.5*0.7=0.35. Stopping sight distance of first car= SD1= 153.6m. Stopping sight distance of second car= SD2= 82.2m. Stopping sight distance to avoid head on collision of the two approaching cars SD1+ SD2=235.8m. Find SSD for a descending gradient of 2% for V=80kmph. [Ans: 132m]. Given: Gradient(n) = -2V = 80 Km/hr. SSD on road with gradient = 132m. Find head light sight distance and intermediate sight distance for V=65 kmph. (Hint: f=0.36, t=2.5 s, HSD=SSD, ISD=2*SSD) [Ans: 91.4 and 182.8 m] Given: V =65km/hr f=0.36 t= 2.5 sec Headlight Sight distance = 91.4m. Intermediate Sight distance= 2[SSD]= 182.8m. Overtaking and overtaken vehicles are at 70 and 40 kmph respectively. find (i) OSD (ii) min. and desirable length of overtaking zone (iii) show the sketch of overtaking zone with location of sign post (hint: a=0.99 m/sec2) [Ans: (i) 278 m (ii) 834 m/1390] Calculate OSD for V=96 kmph. Assume all other data. (Hint: Vb=96-16kmph. a=0.72, t=2.5s) [Ans: OSD one way 342m, OSD two way 646m] LR Kadiyali. Traffic Engineering and Transportation Planning. Khanna Publishers, New Delhi, 1987. SK Khanna and CEG Justo. Highway Engineering. Nemchand Bros.,, Roorkee, 1991. WilliamR McShane, RogerP Roess, and ElenaS Prassas. Traffic Engineering. Prentice-Hall, Inc, Upper Saddle River, New Jesery, 1998. C.S Papacostas. Fundamentals of Transportation Engineering. Prentice-Hall, New Delhi, 1987. I wish to thank several of my students and staff of NPTEL for their contribution in this lecture. Ialso appreciate your constructive feedback which may be sent to tvm@civil.iitb.ac.inProf. Tom V. MathewDepartment of Civil EngineeringIndian Institute of Technology Bombay, India_____Thu Jan 10 12:41:42 IST 2019 Sight distance is a crucial aspect for drivers on roads, defining the distance they can see ahead at any given moment. This visibility is essential for safe driving, involving factors like curves, intersections, and various types of sight distances. Lets explore these aspects in detail. Sight Distance RestrictionsHorizontal Curves : At horizontal curves, visibility can be obstructed by objects on the inner side of the curve. Sight distance is measured along the curves center line, allowing drivers to spot objects or vehicles on the roadway.Vertical Curves : Vertical curves, especially summit curves with an upward convexity, can obstruct the line of sight. Similar to horizontal curves, the sight distance is measured along the center line to ensure visibility.Uncontrolled Intersections : At uncontrolled intersections, drivers should have sufficient sight distance to observe vehicles approaching from other roads. The sight distance, in this case, extends from the point of mutual visibility up to the intersection. Types of Sight DistanceConsiderations for sight distance extend to various scenarios in highway design, emphasizing safety for drivers. Three primary types are:1. Stopping Sight Distance (SSD):Also known as absolute minimum sight distance.Ensures a driver traveling at the design speed has enough visibility to stop safely in case of an obstruction.2. Safe Overtaking Sight Distance (OSD):Allows a driver to overtake slower vehicles at reasonable intervals without causing hazards to oncoming traffic.3. Safe Sight Distance at Controlled Intersections:Ensures visibility for drivers entering controlled intersections to avoid collisions. Road Geometric Design ConsiderationsSafe Stopping : For safe stopping, the road design must provide sufficient sight distance for a driver to stop the vehicle without collision. This is imperative to prevent accidents, making it a non-negotiable requirement throughout the road.Safe Overtaking : Designing for safe overtaking involves ensuring that drivers can overtake slower vehicles at their design speed without posing risks to oncoming traffic.Safety at Uncontrolled Intersections : Ensuring visibility at uncontrolled intersections is vital, allowing drivers to take control of their vehicles and prevent collisions with vehicles from other approaches. Additional Sight Distances in Highway DesignIntermediate Sight Distance (ISD) : ISD, twice the stopping sight distance, provides limited overtaking opportunities for fast vehicles when OSD cannot be accommodated.Headlight Sight Distance : Critical during night driving, headlight sight distance refers to the distance visible under vehicle headlight illumination. This is particularly important on uphill stretches and in valley curves. Factors Affecting Stopping Sight DistanceFeatures of the Road Ahead : Horizontal alignment, vertical profile, traffic conditions, and obstruction positions impact sight distance.Height Considerations : Drivers eye height and object height above the road surface, especially at vertical summit curves, play a crucial role in visibility. Understanding Stopping DistanceStopping distance depends on various factors:1. Total Reaction Time of the Driver : Perception time and brake reaction time are crucial components.2. Speed of the Vehicle : Higher speeds result in longer stopping distances during the total reaction time and braking.3. Efficiency of Brakes : Braking efficiency affects skidding, and balancing braking forces is crucial to avoid dangerous situations.4. Gradient of the Road : The roads slope influences stopping distance. Breakdown of Total Reaction Time (PIEV Theory)The total reaction time is split into four parts in the PIEV theory:1. Perception Time : Time to realize the need for brakes.2. Intellection Time : Time to understand the situation and process thoughts.3. Emotion Time : Time for emotional reactions and mental disturbances.4. Volition Time : Time for the final action, such as brake application.Understanding these elements provides insight into the complexities of driver reactions and their impact on stopping distance. In conclusion, sight distance is a multifaceted concept crucial for road safety, encompassing various types and factors that collectively ensure a secure driving experience. The distance along the center line of the road at which a driver has visibility of an object, stationary or moving at a specified height above the carriage way is known as sight distance.Sight distance is the length of road visible ahead to the driver at any instance. The standards for sight distance should satisfy the following conditions :Driver travelling at the design speed has sufficient sight distance or road length visible to stop vehicle, in case of any obstruction on the road ahead, without collision.Driver travelling ahead should be able to overtake slow moving vehicles, at reasonable intervals, without causing obstruction or hazard to traffic of opposite direction.The driver entering a uncontrolled intersection, he should have sufficient visibility to enable him to control his vehicle in order to avoid collision with another vehicle. The sight distance depends upon following factorsSpeed of the vehicle.The frictional resistance of the road surface.Height of drivers eye.Slope of the road surface.Perception time and brake reaction time. Following `types of sight distances are considered for geometrical design of road :Stopping or non-passing sight distanceOvertaking or passing sight distanceIntermediate sight distanceLateral sight distance. The clear distance ahead needed by a driver to bring his vehicle to a stop before meeting a stationary object on the road is called as stopping or non-passing sight distance.Below are given some of the examples of sight distance at various situations of road.1. Sight Distance @ Horizontal Curve2. Sight Distance @ Road Intersection3. Sight Distance @ Vertical Summit Curve In this case of a summit curve, minimum stopping sight distance is the distance measured along the center line of a road at which a drive whose eye sight is 1.22 m above the road surface can see the top of an object 15 cm high on the road.Below table shows the various safe stopping sight distances for various design speeds :SpeedPerception and Brake ReactionBrakingSafe Stopping Sight DistanceV (km/h)Time t (sec)Distance (m)d1=0.278 VtCoefficient of longitudinal friction (f)Distance (m)d2= V/254 fCalculated values (d1 + d2)Design Values (m)202.5140.4041820252.5180.4062425302.5210.4093030402.5280.38174545502.5350.37276260602.5420.36398180652.5450.36469190802.5560.35721281301002.5700.35112182180 The minimum distance open to the vision of the driver on a two way road to enable him to overtake another vehicle ahead with safety against the traffic from opposite direction to called overtaking or passing sight distance.The minimum over taking sight distance depends upon the following factors:Speed of overtaking, overtaken and the speed of the vehicle coming from the opposite direction.Distance between the vehicles.Rate of acceleration of the overtaking vehicle.Skill and reaction time of the driver.Consider a two lane straight road with three vehicles A, B and C as shown in Fig.Let the speed of fast moving vehicle A be V1 m/sec and that of slow moving vehicle B be V2 m/sec. Let a third vehicle C be coming from opposite direction with a speed of V3 m/sec.Assume V = design speed in m/sec. V = V1 V3In order to overtake vehicle B, driver of vehicleA should apply the following criteria :He should slow down his speed to V2 and come out on second lane. When he begins to come out, vehicle A should be at a safe distance S behind vehicle B.Driver at A should accelerate his vehicle on second lane A till vehicle B is overtaken. He should then run his vehicle back on his original first lane, ahead of vehicle B and at this instant, vehicle A should be again at a safe distance and a head of vehicle B.In this process of overtaking he must avoid collision with vehicle C because then he is moving with the acceleration on the second lane on which vehicle C is coming from the opposite direction.Then, L = Length of OSDL = d1 + d2 + d3Where,d1 = The distance travelled by the overtaking vehicle A on the first lane before it comes out on second lane for the purpose of overtaking during this it slows down.Its speed V2, by allowing space S is a safe spacing between A and B, d1 = (V2 t)d2 = The distance by vehicle A during the total overtaking time while coming from first lane to second lane, accelerating along the second lane and coming back to,First lane = (2S V2 t0)Where,t0 = Time taken in overtaking, with acceleration a m/sec to cover a distance of (d2 2S).d3 = Distance travelled by vehicle C on second lane during the accelerating time, t0 = (V x t0).Substituting for d1, d2, and d3 in Equation, L = (V2 x t) + (2S + V2 x t0) + (V x t0) = [V2t +(Vst0+2S) + V t0]The safe spacing S to be kept between vehicle A (fast moving) and vehicle B (slow moving) is given by expression. S = (V2 0.7) + length of vehicle A (assume 6m) = 0.7 V2 + 6.The value of t0 is obtained by the following equation, t0 = 2S/a, here a = acceleration in m/sec.Below table shows the overtaking sight distance for various speed as recommended by IRC Sr. no.Speed in Km/hTime Component in SecondsFor Overtaking ManocurveFor Opposite VehicleTotalSafe OSD in meters1409615165250107172353601 0.87.21830046511.57.51934058012.58.52147061001492364 0 The distance which affords reasonable opportunities to drivers to overtake the vehicle ahead with caution is known as intermediate sight distance. ISD is taken as twice the safe stopping distance.Design Values of ISD as recommended by IRC are given belowSpeed (Km/h)Intermediate Sight DistanceSpeed (Km/h)ISD (m)204050120255060160306065180358080240409010036 0 The sight distance needed by the driver of a vehicle who see another vehicles approaching the intersection, reacts and applies brakes to bring his vehicle to dead stop at the intersection without any collision or accident is called safe sight distance for entering into an intersection or lateral sight distance.The lateral sight distance should be sufficient to satisfy the following three conditions :To enable both or at least one approaching vehicles to change their speeds to avoid collision.To bring at least one or both the approaching vehicles to stop before reaching a point ofcollision.To enable the stopped vehicles on minor road to start, accelerate and cross the main road before the approaching vehicle, traveling at design speed on main road, reaches the interaction.Also Read : Alignment of Road (Highway Engineering)Also Read :Super Elevation and How to Calculate itAlso Read :Reservoir | Types and Storage Zones of ReservoirAuthored by: Vikrant ManeVikrant Mane is a civil engineer by education but has found his passion in SEO. He works as an SEO specialist, helping websites grow with smart strategies and useful content. Stopping Sight Distance (SSD) is the viewable distance required for a driver to see so that he or she can make a complete stop in the event of an unforeseen hazard. SSD is made up of two components: (1) Braking Distance and (2) Perception-Reaction Time. Forces acting on a vehicle that is braking For highway design, analysis of braking is simplified by assuming that deceleration is caused by the resisting force of friction against skidding tires. This is applicable to both an uphill or a downhill situation. A vehicle can be modeled as an object with mass \(m\) sliding on a surface inclined at angle \(\theta\). While the force of gravity pulls the vehicle down, the force of friction resists that movement. The forces acting this vehicle can be simplified to: \[F=W(sin (\theta)-fcos(\theta))\] where \(W=mg\) = objects weight, \(f\) = coefficient of friction. Using Newtons second law we can conclude then that the acceleration (\(a\)) of the object is \[a=g(sin(\theta))-fcos(\theta))\] Using our basic equations to solve for braking distance (\(d_b\)) in terms of initial speed (\(v_i\)) and ending speed (\(v_e\)) gives \[d_b=\frac{v_i^2-v_e^2}{-2a}\] and substituting for the acceleration yields \[d_b=\frac{v_i^2-v_e^2}{2g(fcos(\theta)-sin(\theta))}\] For angles commonly encountered on roads, \(cos(\theta) \approx 1\) and \(sin(\theta) \approx tan(\theta)=G\), where \(G\) is called the roads grade. This gives \[d_b=\frac{v_i^2-v_e^2}{2g(f \pm G)\] Using simply the braking formula assumes that a driver reacts instantaneously to a hazard. However, there is an inherent delay between the time a driver identifies a hazard and when he or she mentally determines an appropriate reaction. This amount of time is called perception-reaction time. For a vehicle in motion, this inherent delay translates to a distance covered in the meanwhile. This extra distance must be accounted for. Ample Stopping Sight Distance For a vehicle traveling at a constant rate, distance \(d_r\) covered by a specific velocity \(v\) and a certain perception-reaction time \(t_r\) can be computed using simple dynamics: \[d_r=(vt_r)\] Finally, combining these two elements together and incorporating unit conversion, the AASHTO stopping sight distance formula is produced. The unit conversions convert the problem to metric, with \(v_i\) in kilometers per hour and \(d_s\) in meters. \[d_s=d_r+d_b=0.278t_rv_i+\frac{(0.278v_i)^2}{19.6(f \pm G)}\] A Note on Sign Conventions We said \(d_b=\frac{v_i^2-v_e^2}{2g(f \pm G)\) Use: \((f-G)\) if going downhill and \((f+G)\) if going uphill, where G is the absolute value of the grade Passing Sight Distance (PSD) is the minimum sight distance that is required on a highway, generally a two-lane, two-directional one, that will allow a driver to pass another vehicle without colliding with a vehicle in the opposing lane. This distance also allows the driver to abort the passing maneuver if desired. AASHTO defines PSD as having three main distance components: (1) Distance traveled during perception-reaction time and accleration into the opposing lane, (2) Distance required to pass in the opposing lane, (3) Distance necessary to clear the slower vehicle. The first distance component \(d_1\) is defined as: \[d_1=1000t_1 \left(u-m+\frac{at_1}{2} \right)\] where \(t_1\) = time for initial maneuver, \(a\) = acceleration (km/h/sec), \(u\) = average speed of passing vehicle (km/hr), \(m\) = difference in speeds of passing and impeder vehicles (km/hr). The second distance component \(d_2\) is defined as: \[d_2=(1000ut_2)\] where \(t_2\) = time passing vehicle is traveling in opposing lane, \(u\) = average speed of passing vehicle (km/hr). The third distance component \(d_3\) is more of a rule of thumb than a calculation. Lengths to complete this maneuver vary between 30 and 90 meters. With these values, the total passing sight distance (PSD) can be calculated by simply taking the summation of all three distances. \[d_p=(d_1+d_2+d_3)\] Sight distance is the length of road visual a head to the driver at any distance. (it is considered by taking the height of eyes of the driver to be 1.2 m and height of object to be 0.15 m).Note: This topic is part of the second chapter of Highway Engineering. I suggest reading this topic in the context of the complete chapter: Geometric Design of Highway. If you want to read the entire Highway Engineering, click here: Highway Engineering.SIGHT DISTANCE ON CURVERestriction to the visibility/sight distance maybe caused in the following cases:At horizontal curve, when the line of sight is obstructed by the object and the inner side of the curve.At a vertical curve the line of sight age of obstructed by the road surface of the curve.At an uncontrolled intersection when a driver from one of the approach road is able to sight a vehicle from another approach road towards it at the intersection, due to the presence of obstruction.SIGHT DISTANCE AT INTERSECTIONThe sight distance available to the driver is depend upon following factor:Feature of road ahead: Horizontal curve, vertical profile, traffic condition, position of obstruction.Height of driver eyes above the road surface.Height of object above the road surface.Sight distance on a highway depends upon the following factors:Total Reaction Time of DriverDesign speedBraking EfficiencyFrictional Resistance Between Road and TyresGradient of RoadIt is the time taken from the instant the object is visible to the driver to the instant brakes and apply effectively.The total reaction time is further divided into different components and can be explained as follows:Perception(P): The time required for the sensation received by the eyes or ears of a driver to be transmitted to the brain through the nervous system and spinal cord.Intellection Time (I): it is the time required to the driver to understand the situation. It is also the time required for comparing different thoughts, regrouping & registering new sensation.Emotion Time (E): It is the time elapsed during emotional sensations and other mental disturbances such as fear, anger, superstition etc with the situation to come into play.This time varies from person to person and even for the same person in different situations .Volition Time (V): It is the time taken by a driver, for final action, like application of brakes.The above can be termed as PIEV analysis for Total Reactions Time.TOTAL REACTION TIME OR PIEV PROCESSNote:It is also possible that the driver may apply brakes or take any other avoiding action, like turning, by the reflex action, without normal thinking process, that is observed to be min time for avoiding the collision.This reaction time depend on several factor like driver skill, type of obstruction involved, environmental condition, age, etcTotal reaction time is measured on the basis of PIEV theory which varies from 0.5 second for simple situations to 3-4 second for complex situations.Remember:IRC recommended, reaction time of 2.5 second for stopping sight distance and 2.0 seconds for overtaking sight distance calculations.2.Design speed:During the total reaction time of the driver the distance moved by the vehicle is depend upon design speed.If speed of vehicle is not mentioned in the problem then consider the design speed of the highway as the speed of vehicle.Braking distance means distance traveled by vehicle before coming to a stop/half also depends on design speed.3.Braking Efficiency:Efficiency of brakes depends upon the age and characteristics of the vehicle. If we say the brakes are 100% efficient, it means the vehicle will stop at the moment of application of brakes. But practically 100% efficiency update is not achieved, otherwise skidding will occur which is uncontrollable and dangerous for the vehicle and road users.For the design purpose of the highway, we considered 50% brake efficiency of the vehicle.4.Frictional Resistance Between Road and Tyres:The frictional resistance developed between the road and tyres depends on the coefficient of friction.Higher is coefficient of friction, higher is the frictional resistance and lower is SSD.Coefficient of friction further depends upon the condition of tyres and Road.It is further linked with the design speed of vehicle as follows:SPEED WITH FRICTION5.Gradient of Road (If Any):When we are going down on a gradient, gravitational force also come into action which causes the vehicle to take more time to stop the vehicle means more sight distance is required. While in climbing up a gradient less sight distance is required because the time taken to stop the vehicle will be less.Sight distance are of following types:For Detailed Analysis of Highway Engineering Step By Step.Highway Engineering Join TheConstructor to ask questions, answer questions, write articles, and connect with other people. When you join you get additional benefits. Have an account? Sign In

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