SNS COLLEGE OF TECHNOLOGY

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Department of Civil Engineering

UNIT- II

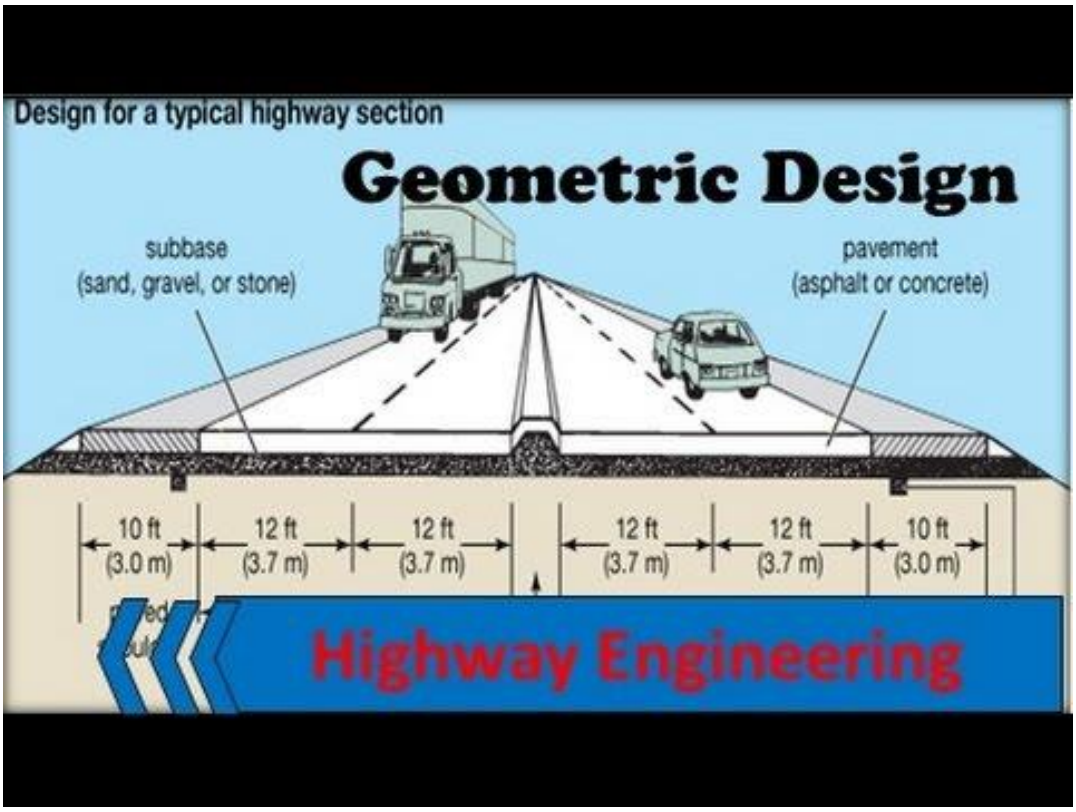
19CET205-

HIGHWAY

AND

RAILWAY

ENGINEERING

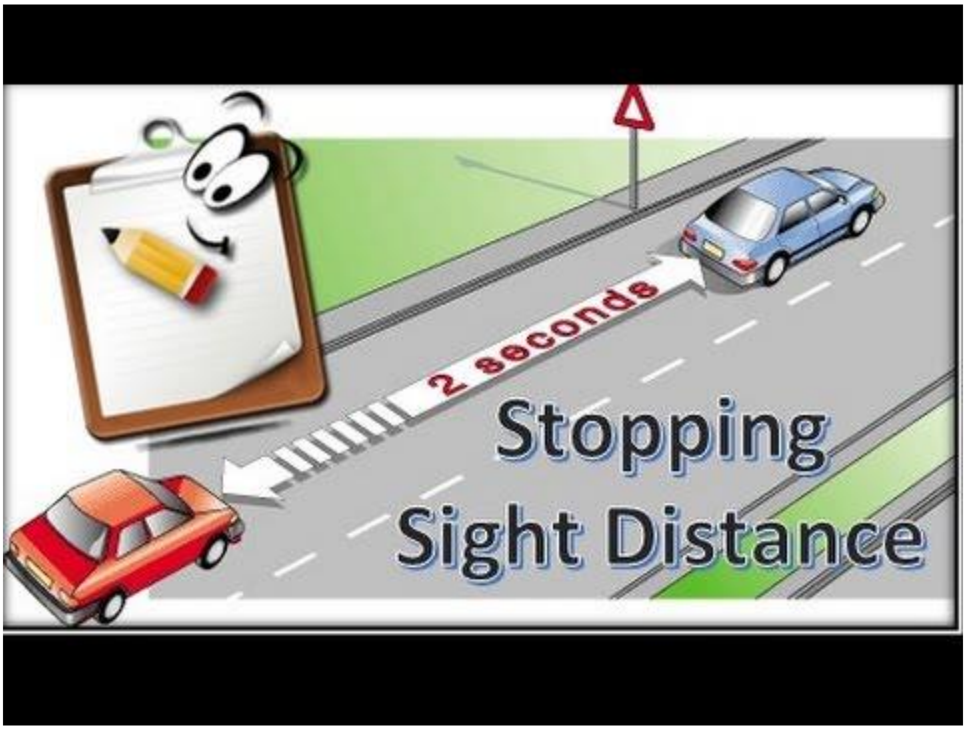


PIEV theory

&

Problems in in S.S.D

STOPPING SIGHT DISTANCE



Stopping sight distance (SSD) is the minimum sight distance available on a highway at any spot having sufficient length to enable the driver to stop a vehicle traveling at design speed, safely without collision with any other obstruction.

There is a term called safe stopping distance and is one of the important measures in trace engineering. It is the distance a vehicle travels from the point at which a situation is rst perceived to the 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 at least equal to the safe stopping distance should be provided. The stopping sight distance is the sum of lag distance and the braking distance. Lag distance is the distance the vehicle travelled during the reaction time t and is given by

$$t=vt$$

Where **v** is the velocity in m=sec². Braking distance is the distance travelled by the vehicle during

Braking operation. For a level road this is obtained by equating the work done in stopping the vehicle and the kinetic energy of the vehicle. If F is the maximum frictional force developed and the braking distance is l, then work done against friction in stopping the vehicle is F l = f W l where W is the total weight of the vehicle. The kinetic energy at the design speed is

Therefore, the SSD = lag distance + braking distance and given by:

where

v is the design speed in m=sec²,

t is the reaction time in sec,

g is the acceleration due to gravity and f is the coefficient of friction.

The coefficient of friction f is given below for various design speed.

When there is an ascending gradient of say +n%, the component of gravity adds to braking action and hence braking distance is decreased. The component of gravity acting parallel to the surface which adds to the braking force is equal to W sin W tan = W n=100. Equating kinetic energy and work done:

Similarly the braking distance can be derived for a descending gradient.

$$\frac{1}{2}mv^2 = \frac{1}{2}\frac{Wv^2}{g}$$

$$fWl = \frac{Wv^2}{2g}$$

The factors that affect the OSD are:

1. Velocities of the overtaking vehicle, overtaken vehicle and of the vehicle coming in the opposite direction.

2. Spacing between vehicles, which in-turn depends on the speed

3. Skill and reaction time of the driver.
4. Rate of acceleration of overtaking vehicle.
5. 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 travelled by the vehicles. The trajectory of the slow moving vehicle (B) is shown as a straight line which indicates that it is traveling at a constant speed. A fast moving vehicle (A) is traveling behind the vehicle B. The trajectory of the vehicle is shown initially with a steeper slope. The dotted line indicates the path of the vehicle A if B was absent. The vehicle A slows down to follow the vehicle B as shown in the figure with same slope from t0 to t1. Then it overtakes the vehicle B and occupies the left lane at time t3. The time duration T = t3 t1 is the actual duration of the overtaking operation. The snapshots of the road at time t 0 ; t1, and t3 are shown on the left side of the figure. From the Figure, the overtaking sight distance consists of three parts.

It is assumed that the vehicle A is forced to reduce its speed to vb , the speed of the slow moving vehicle B and travels behind it during the reaction time t of the driver. So d1 is given by:

d1 = vb t

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.

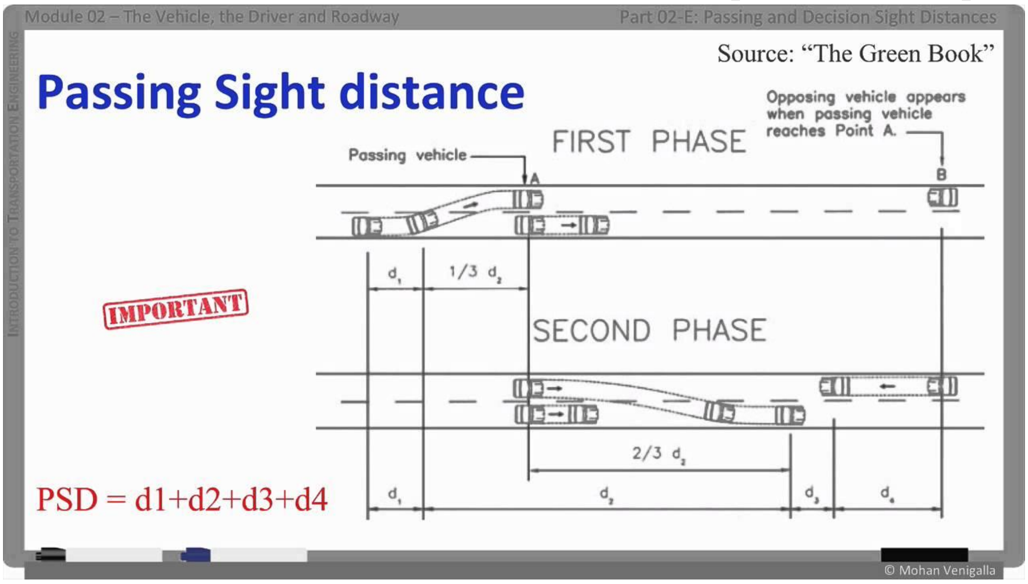
The spacing s in m is given by:

s = 0:7vb + 6

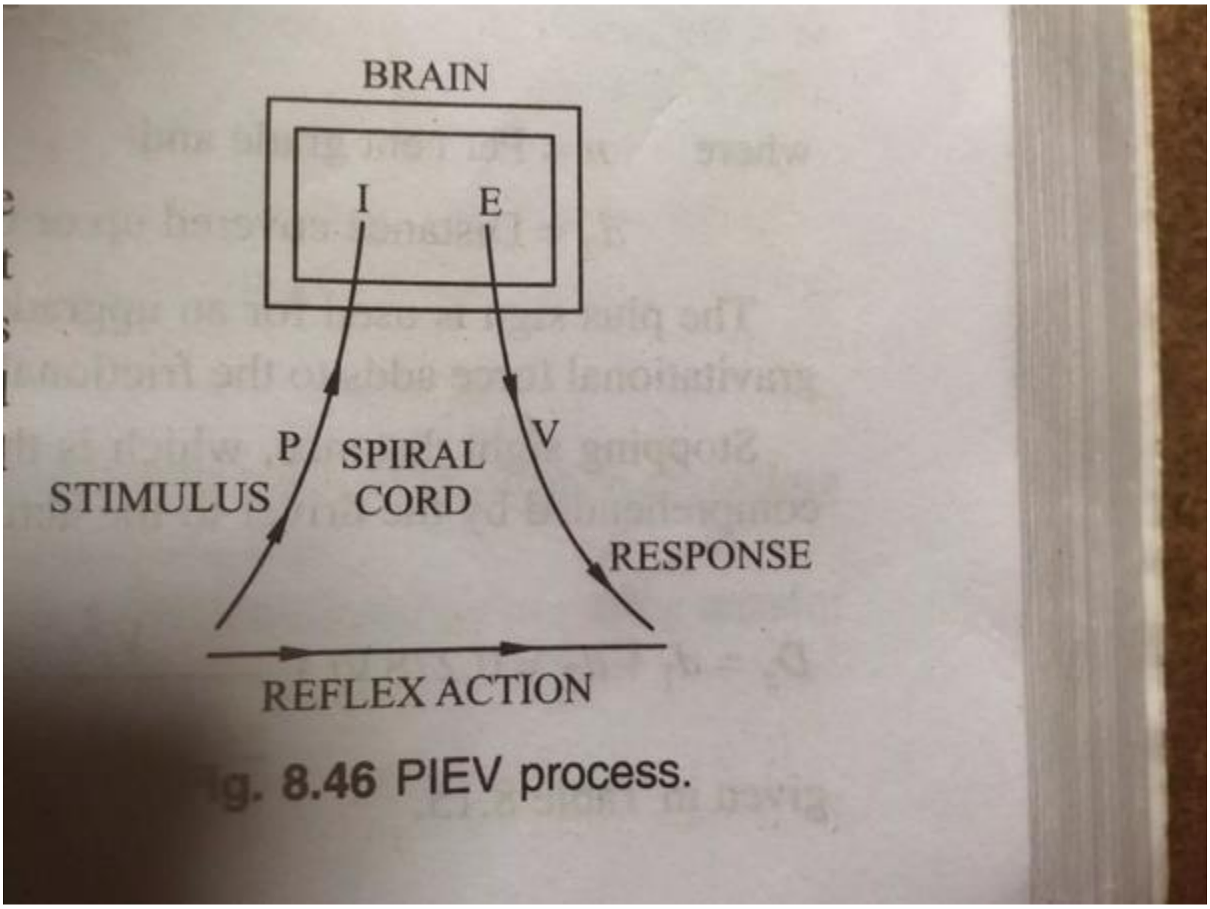
Let T be the duration of actual overtaking. The distance travelled by B during the overtaking operation is 2s + vb T. Also, during this time, vehicle A accelerated from initial velocity vb and overtaking is completed while.The distance travelled by the vehicle C moving at design speed v m=sec during overtaking operation is given by:

Where **vb** is the velocity of the slow moving vehicle in m=sec^2, t the reaction time of the driver in sec, s is the spacing between the two vehicle in m and a is the overtaking vehicles acceleration in m=sec^2. In case the speed of the overtaken vehicle is not given, it can be assumed that it moves 16 kmph slower the design speed.

The acceleration values of the fast vehicle depends on its speed.



PIEV Theory



ig. 8.46 PIEV process.

The PIEV Theory was proposed To Provide a Detailed Account of Drivers Reaction Time.

PIEV Theory Splits the Reaction Time of Driver into 4 Components.

Perception: Time Required To Perceive an Object or Situation.

[Function of Eyes, Ears]

Intellection: Time Required For Understanding The Situation.

[Function of Brain]

Emotion: Based on Our Emotions at the time

[Fear, Anger etc] We Reach The Decision Weather We Want To Stop or Not. [Function of Brain]

Volition: Once The Decision of Stopping Has Been Finalised, Time Required For Moving the Foot From the Gas to the Brake Peddle.

Function of Hands or Legs.

During the Geometric Design of Road, Sight Distance is An Important Parameter That is taken into Consideration.

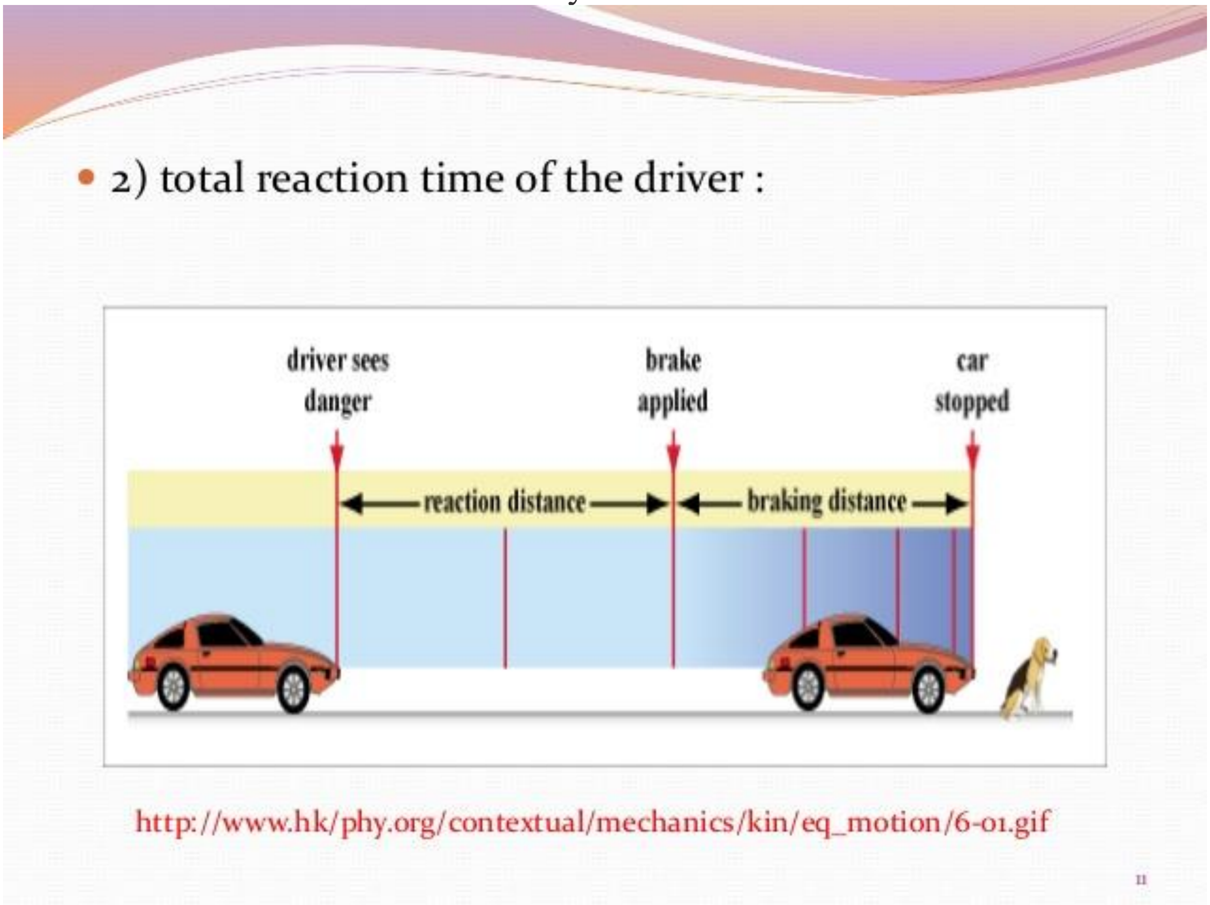
This Sight Distance Depends on Factors Like

Driver's Reaction Time

Vehicle's Speed

Efficiency of Brakes

Frictional Resistance between the Tyre and the Road Gradient of the Road.



NOTE THIS:

P.S.: *Reaction Time Used By IRC* in Sight Distance Calculation is *2.5 Seconds*.

P.P.S.: Many Studies Have Shown 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 [2.5 Seconds].

Department of Civil Engineering