CMR
INSTITUTE OF
TECHNOLOGY

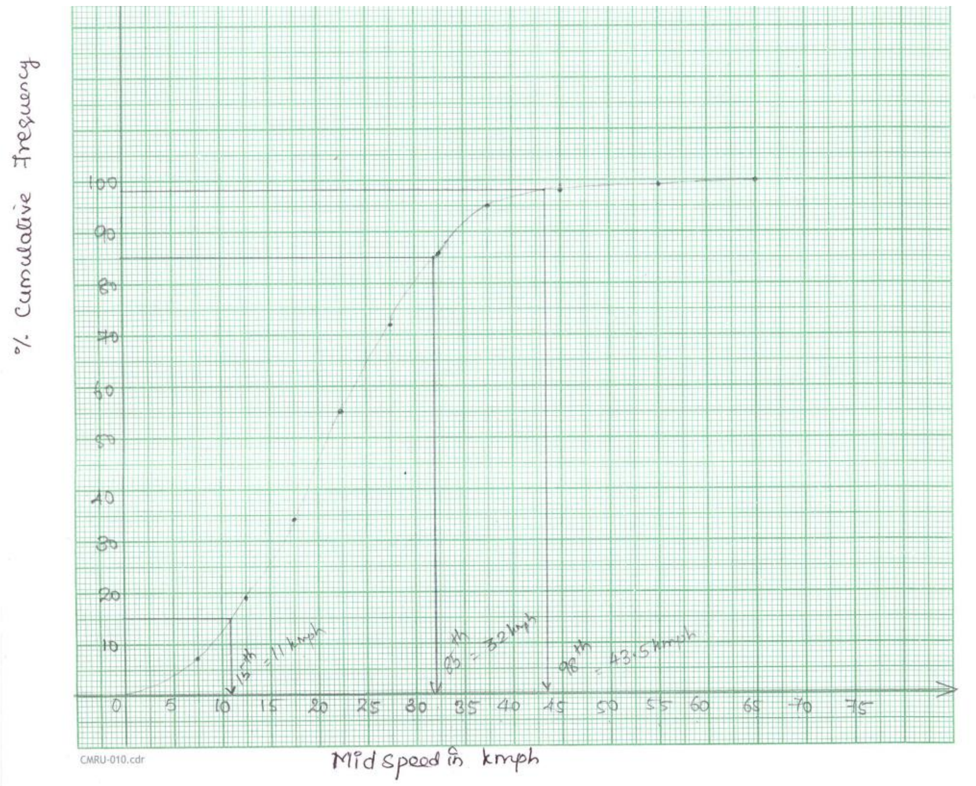
Internal Assessment Test 2 – May 2017
Solutions

Sub: Traffic Engineering **Code:** 10CV667

Sem: VI **Branch:** CIVIL

1.

Speed range	**Mid speed**	**Frequency**	**% Frequency**	**Cumulative Frequency**
0-10	2	12	1.41	1.41
10-20	15	18	2.12	3.53
20-30	25	68	8	11.53
30-40	35	89	10.47	22
40-50	45	204	24	46
50-60	55	255	33	76
60-70	65	119	14	90
70-80	75	43	5.06	95.06
80-90	85	33	3.88	98.94
90-100	95	9	1.06	100
Total				



85^{th} percentile speed = 60kmph

15th percentile speed = 30 kmph
98th percentile speed = 84 kmph

2. Moving car observer method:

Consider a stream of vehicles moving in the north bound direction. Two different cases of motion can be considered. The first case considers the traffic stream to be moving and the observer to be stationary. If n_o is the number of vehicles overtaking the observer during a period, t, then flow q is $\frac{n_0}{t}$, or

$$n_0 = q \times t \tag{4.1}$$

The second case assumes that the stream is stationary and the observer moves with speed v_o. If n_p is the number of vehicles overtaken by observer over a length l, then by definition, density k is $\frac{n_p}{l}$, or

$$n_p = k \times l \tag{4.2}$$

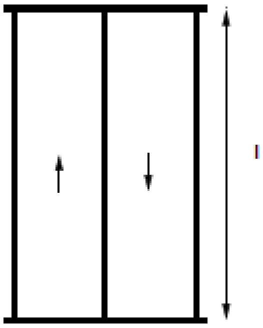


Figure 4:1: Illustration of moving observer method

or

$$n_p = k.v_o.t \tag{4.3}$$

where v_0 is the speed of the observer and t is the time taken for the observer to cover the road stretch. Now consider the case when the observer is moving within the stream. In that case m_o vehicles will overtake the observer and m_p vehicles will be overtaken by the observer in the test vehicle. Let the difference m is given by m_0 - m_p, then from equation 4.1 and equation 4.3,

$$m = m_0 - m_p = q\,t - k\,v_o\,t \tag{4.4}$$

This equation is the basic equation of moving observer method, which relates q, k to the counts m, t and v_o that can be obtained from the test. However, we have two unknowns, q and k, but only one equation. For generating another equation, the test vehicle is run twice once with the traffic stream and another one against traffic stream, i.e.

$$\begin{aligned} m_w &= q\,t_w - k\,v_w\,t_w && (4.5)\\ &= q\,t_w - k\,l \\ m_a &= q\,t_a + k\,v_a\,t_a && (4.6)\\ &= q\,t_a + k\,l \end{aligned}$$

where, a, w denotes against and with traffic flow. It may be noted that the sign of equation 4.6 is negative, because test vehicle moving in the opposite direction can be considered as a case when the test vehicle is moving in the stream with negative velocity. Further, in this case, all the vehicles will be overtaking, since it is moving with negative speed. In other words, when the test vehicle moves in the opposite direction, the observer simply counts the number of vehicles in the opposite direction. Adding equation 4.5 and 4.6, we will get the first parameter of the stream, namely the flow(q) as:

$$q = \frac{m_w + m_a}{t_w + t_a} \tag{4.7}$$

Now calculating space mean speed from equation 4.5,

$$\begin{aligned}
\frac{m_w}{t_w} &= q - k v_w \\
&= q - \frac{q}{v} v_w \\
&= q - \frac{q}{v}\left[\frac{l}{t_w}\right] \\
&= q\left(1 - \frac{l}{v} \times \frac{1}{t_w}\right) \\
&= q\left(1 - \frac{t_{avg}}{t_w}\right)
\end{aligned}$$

If v_s is the mean stream speed, then average travel time is given by $t_{avg} = \frac{l}{v_s}$. Therefore,

$$\begin{aligned}
\frac{m_w}{q} &= t_w\left(1 - \frac{t_{avg}}{t_w}\right) = t_w - t_{avg} \\
t_{avg} &= t_w - \frac{m_w}{q} = \frac{l}{v},
\end{aligned}$$

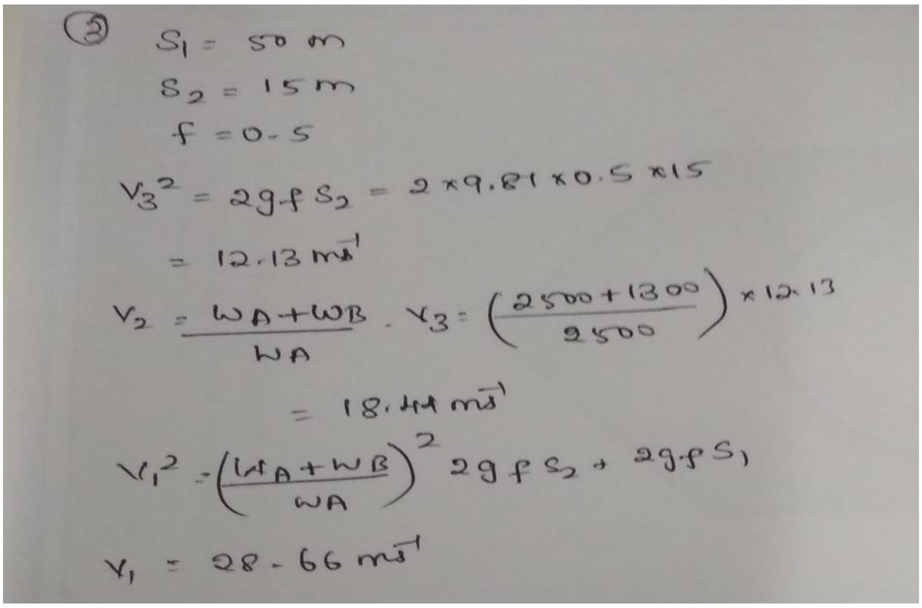
Rewriting the above equation, we get the second parameter of the traffic flow, namely the mean speed v_s and can be written as,

$$v_s = \frac{l}{t_w - \frac{m_w}{q}} \tag{4.8}$$

Thus two parameters of the stream can be determined. Knowing the two parameters the third parameter of traffic flow density (k) can be found out as

$$k = \frac{q}{v_s} \tag{4.9}$$

For increase accuracy and reliability, the test is performed a number of times and the average results are to be taken.



(3) $S_1 = 50\ m$

$S_2 = 15\ m$

$f = 0.5$

$V_3^2 = 2gfS_2 = 2 \times 9.81 \times 0.5 \times 15$

$= 12.13\ ms^{-1}$

$V_2 = \frac{WA + WB}{WA} \cdot V_3 = \left(\frac{2500 + 1300}{2500}\right) \times 12.13$

$= 18.44\ ms^{-1}$

$V_1^2 = \left(\frac{WA + WB}{WA}\right)^2 2gfS_2 + 2gfS_1$

$V_1 = 28.66\ ms^{-1}$

4)

Definition:

Intelligent Transport Systems (ITS) are transport systems that apply modern information-technologies to improve the operation of transport networks. The systems acquire vast volume of data on various aspects of transport operation such as traffic volume, speed, headway & load carried, process them and apply the result to guide traffic, improve operations enhance safety and transport costs

Application of ITS:

ITS has the following variety of applications:

- Monitoring traffic flow, provide information to drivers on the congestion on the road, road closures, alternative routes, weather conditions and speeds to be observed. Advanced Traveller Information System (ATIS) gives the information to highway users on traffic jams, road closures, alternative routes and weather condition.
- Monitoring incidents on the road, such as vehicle break-down and collisions.
- Electronic collection of toll.
- Intelligent Vehicle-Highway System (IVHS), in which vehicles are guided longitudinally and laterally by the use of electronic devices. The advanced Vehicle Control Systems (AVCS) dispense with human control of vehicles and rely on computers
- Traffic control on urban streets by using information on traffic flows and adjusting the signal operations to reduce congestion and delay.
- Asset Maintenance Management System (AMMS) cover the data on assets, the traffic using the asset,

periodic condition survey data and use software packages to optimize maintenance interventions

– Public Transport Management Systems (PTMS) wherein the fleet can be managed efficiently by analyzing data on vehicle location, adherance to schedules and passenger loadings. Demand responsive Public Transport and Taxis can also be a part of the system where GIS is extensively used.

– Truck Transport Management Systems (TTMS) wherein the data on vehicle location, breakdowns, accidents, detention etc. can be analysed and action initiated to improve the operations with the use of GIS.

– Electronic Road Pricing System to decongest the city centres.

– Information Technology has been used for acquiring large volume of data on travel patterns in a city, analyse the data, develop forecasting models and plan efficient transport plans.

(5) a) $m = 1300\ kg$

$f = 0.024$

$C_a = 0.36$

$A = 1.65\ m^2$

$P_p = 0$ [∵ vehicle stopped]

$P_i = 0$ [∵ Level road]

$$P_p = P_f \pm P_a \pm P_j \pm P_i$$

$$0 = mgf + C_a V^2 A + m \cdot \frac{dv}{dt}$$

$$\frac{dv}{dt} = \frac{A \cdot C_a \cdot V^2}{m} + gf$$

$$= \frac{1.65 \times 0.36 \times \left(\frac{70}{36}\right)^2 + 9.81 \times 0.024}{1300}$$

$$= 0.40\ ms^{-2}$$

5. B)

Vision -

It is one of the important factors that affects almost all aspects of highway design and safety. It includes the acuity of vision, peripheral vision and eye movement, glare vision, glare recovery and depth judgement. Minimum standards for acuity of vision are laid down by licensing authorities. Field of clearest and acute vision is within a cone whose angle is only 3 degrees, ~~through the vision~~ about the centre of retina. This signifies that for very distant vision, the objects should be within this narrow cone for satisfactory perception. and it is important for locating traffic signs & signals.

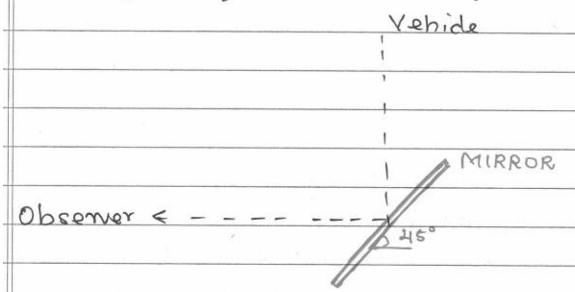
Peripheral vision is the total visual field for the two eyes, within which the eyes are able to see the objects, but without clear details and colour. The angle of peripheral vision is about 160° in the horizontal direction and 115° in the vertical direction. If the detailed attention is needed, the driver turns his head or eyes so that the object now comes within the cone of clear vision. The cone of peripheral vision also depends on speed. The angle of the cone falls down from about 110° @ 30 kmph to 40° @ 100 kmph speed.

Colour vision is important for discerning the traffic lights and colour schemes in traffic signs. The ability of the driver's eyes to adapt to glare due to head lights or to

6A) **Enoscope method:**

- Enoscope:

- It eliminates the parallax effect.
- It is also known as mirror-box is an L-shaped box, open @ both ends, with a mirror set at a 45 degree angle to the arms of the instrument.



The instrument bends the line of sight of the observer so that it is perpendicular to the path of the vehicle.

This method can be used with one enoscope or with two enoscopes.

One enoscope:

The instrument is placed directly opposite the first reference point & the observer stations himself at the other reference point.

The stop watch is started as soon as the vehicle passes the first reference point and is stopped as soon as it passes the observer.

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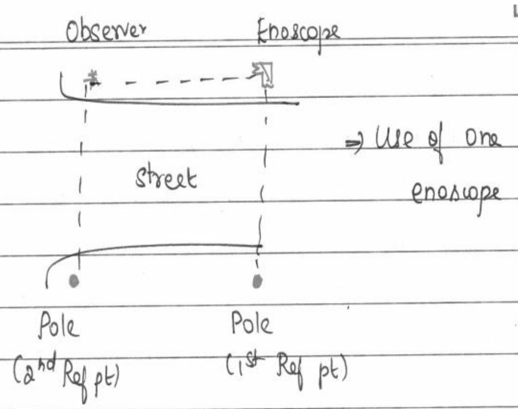

Two enoscope:

The observer stations himself mid-way between the two reference points and starts the stop-watch as soon as vehicle crosses the first reference point and stops the stop-watch when it crosses the second reference point

6 B) **Warning Signs:**

Characteristics:

- To warn traffic of exiting or potentially hazardous conditions
- Adjacent to a highway or street
- To ensure safety of traffic

Example:

FALLING ROCKS

- Equilateral triangle - one point upwards
- Side of triangle – std size -900mm

  - Reduced size – 600mm
- BORDER – RED
- BACKGROUND – WHITE
- TEXT – SYMBOLS – BLACK

Example Figures :