CMR
INSTITUTE OF
TECHNOLOGY

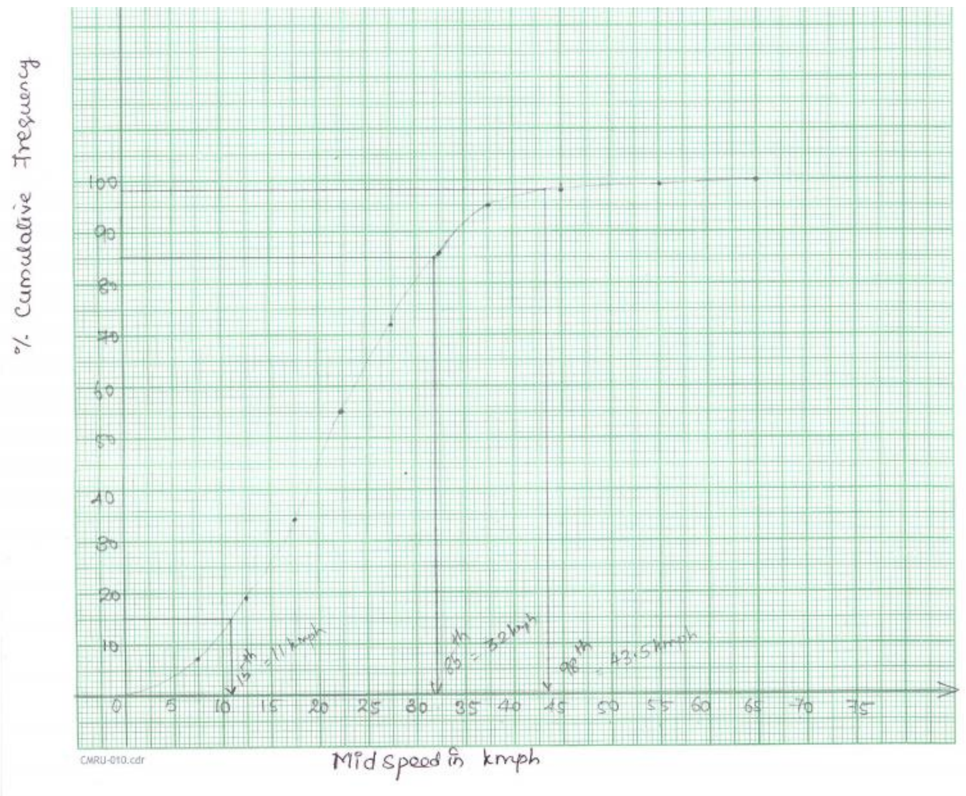
Internal Assessment Test 2 – May 2017
Solutions

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

Sem: VI **Branch:** CIVIL

1.

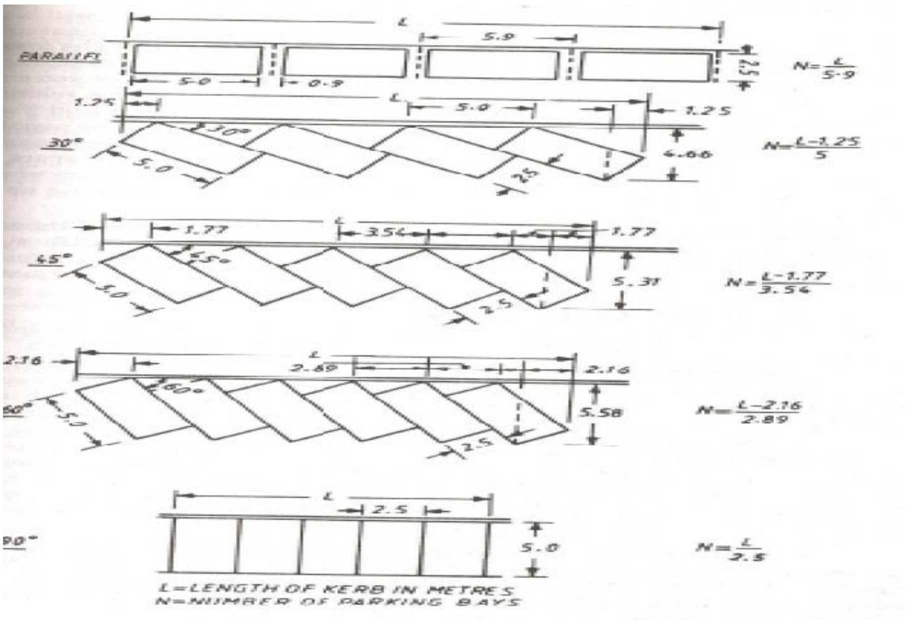
Speed range	Mid speed	Frequency	% Frequency	Cumulative Frequency
5-10	7.5	230	7.2	7.2
10-15	12.5	375	11.8	19
15-20	17.5	500	15.8	34.8
20-25	22.5	680	21.4	56.2
25-30	27..5	525	16.6	72.8
30-35	32.5	430	13.6	86.4
35-40	37.5	290	9.1	95.5
40-50	45	110	3.5	99
50-60	55	25	0.8	99.8
60-70	65	8	0.2	100
Total		3173		



85^{th} percentile speed = 32kmph
15^{th} percentile speed = 11 kmph

98th percentile speed = 43.5 kmph

2. On street parking facilities :



3. A)

Weight of moving vehicles , $W_a = 30$ tonnes

Parked vehicle $W_b = 3$ tonnes

Skid distance $S_2 = 16$ m

Friction coefficient , $f = 0.4$

Initial speed $= v_1$ $S_1 = 50$ m

v_2 = Before collision speed

v_3 = After collision speed

$v_4 = 0$

$S_2 = 16$ m $f = 0.4$

a) After collision :

$$\frac{(W_a + W_b)(v_3^2 - v_4^2)}{2g} = (W_a + W_b) f . S_2$$

$v_4 = 0$

$$\frac{v_3^2}{2g} = 0.4 \times 16 \Rightarrow v_3 = 11.2 \, ms^{-1}$$

b) At collision

$$\frac{W_a v_2}{g} = \frac{(W_a + W_b) v_3}{g}$$

$$v_2 = \frac{(W_a + W_b)}{g} . v_3$$

$$v_2 = 12.32 \, ms^{-1}$$

$$v_1 = \sqrt{2 \times 9.81 \times 0.4 \times 50 + (12.32)^2}$$

$$= 23.31 \text{ m/s}$$

$$V_1 = 83.91 \text{ kmph}$$

4. **Rotary intersections**
   Design factors :

Design elements

The design elements include design speed, radius at entry, exit and the central island, weaving length and width, entry and exit widths. In addition the capacity of the rotary can also be determined by using some empirical formula. A typical rotary and the important design elements are shown in figure

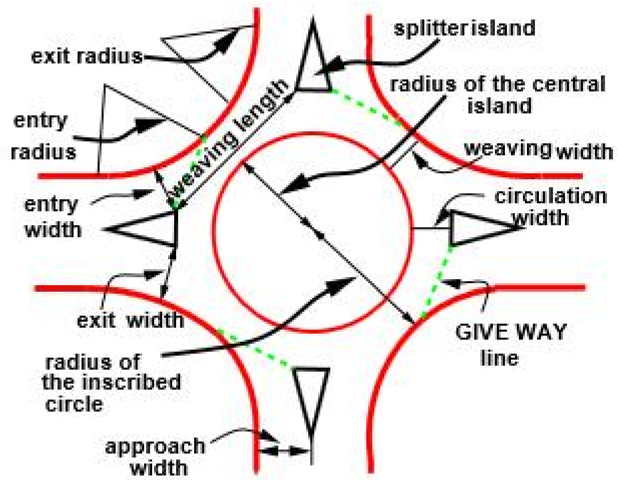


Figure 40:2: Design of a rotary

Design speed

All the vehicles are required to reduce their speed at a rotary. Therefore, the design speed of a rotary will be much lower than the roads leading to it. Although it is possible to design roundabout without much speed reduction, the geometry may lead to very large size incurring huge cost of construction. The normal practice is to keep the design speed as 30 and 40 kmph for urban and rural areas respectively.

Entry, exit and island radius

The radius at the entry depends on various factors like design speed, super-elevation, and coe cient of friction. The entry to the rotary is not straight, but a small curvature is introduced. This will force the driver to reduce the speed. The entry radius of about 20 and 25 metres is ideal for an urban and rural design respectively. The exit radius should be higher than the entry radius and the radius of the rotary island so that the vehicles will discharge from the rotary at a higher rate. A general practice is to keep the exit radius as 1.5 to 2 times the entry radius. However, if pedestrian movement is higher at the exit approach, then the exit radius could be set as same as that of the entry radius. The radius of the central island is governed by the design speed, and the radius of the entry curve. The radius of the central island, in practice, is given a slightly higher radius so that the movement of the tra c already in the rotary will have priority. The radius of the central island which is about 1.3 times that of the entry curve is adequate for all practical purposes.

Width of the rotary

The entry width and exit width of the rotary is governed by the tra c entering and leaving the intersection and the width of the approaching road. The width of the carriageway at entry and exit will be lower than the width of the carriageway at the approaches to enable reduction of speed. IRC suggests that a two lane road of 7 m width should be kept as 7 m for urban roads and 6.5 m for rural roads. Further, a three lane road of 10.5 m is to be reduced to 7 m and 7.5 m respectively for urban and rural roads. The width of the weaving section should be higher than the width at entry and exit. Normally this will be one lane more than the average entry and exit width. Thus weaving width is given as,

$$W_{weaving} = \{(e_1+e_2)/2\} + 3.5m$$

where e_1 is the width of the carriageway at the entry and e_2 is the carriageway width at exit. Weaving length determines how smoothly the tra c can merge and diverge. It is decided based on many factors such as weaving width, proportion of weaving tra c to the non-weaving tra c etc. This can be best achieved by making the ratio of weaving length to the weaving width very high. A ratio of 4 is the minimum value suggested by IRC. Very large weaving length is also dangerous, as it may encourage over-speeding.

Capacity

The capacity of rotary is determined by the capacity of each weaving section. Transportation road research lab (TRL) proposed the following empirical formula to find the capacity of the weaving section.

$$Q_w = \frac{280w[1 + \frac{e}{w}][1 - \frac{p}{3}]}{1 + \frac{w}{l}}$$

Where, e=average entry & exit width i.e. $=(e_1+e_2)/2$

w= weaving width

l = weaving length

p = proportion of weaving traffic to the non-weaving traffic

The figure below shows four types of movements at a weaving section, a andd are the non-weaving tra c and b and c are the weaving tra c.

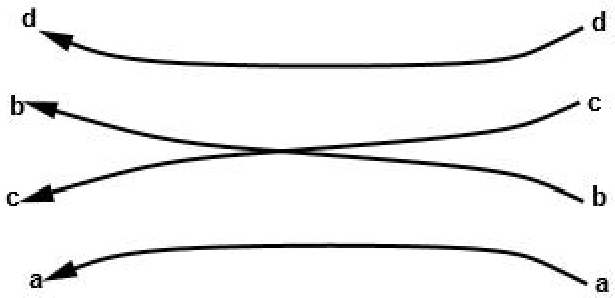


Figure 40:3: Weaving operation in a rotary

Therefore,
p = (b + c) / (a + b + c + d)

The key advantages of a rotary intersection are listed below:
1. Tra c flow is regulated to only one direction of movement, thus eliminating severe conflicts between crossing movements.
2. All the vehicles entering the rotary are gently forced to reduce the speed and continue to move at slower speed. Thus, none of the vehicles need to be stopped,unlike in a signalized intersection.
3. Because of lower speed of negotiation and elimination of severe conflicts, accidents and their severity are much less in rotaries.
4. Rotaries are self governing and do not need practically any control by police or tra c signals.
5. They are ideally suited for moderate tra c, especially with irregular geometry, or intersections with more than three or four approaches.

5. **A) Case (i)**
Spacing = (Lamp lumens * Coefficient of utilization * Maintenance factor) / (Average Lux * Width of road) = (6000*0.44*0.8) / (6*15) = 23.4m

Case (ii)

Spacing = (Lamp lumens * Coefficient of utilization * Maintenance factor) / (Average Lux * Width of road) = (7000*0.44*0.8) / (6*12) = 34.2m

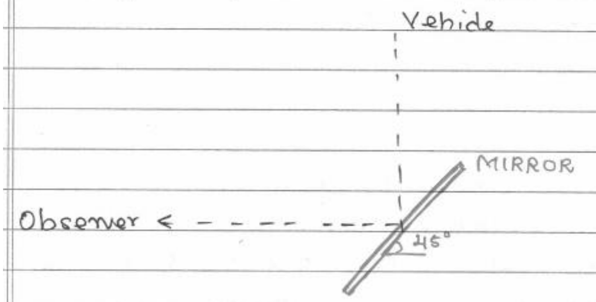
B**) Spot speed**: It is the instantaneous speed of a vehicle at a specified section or location
Journey speed: it is the overall speed or the effective speed of a vehicle between 2 points
Running speed : the average speed maintained by a vehicle over a particular stretch of road while the vehicle is in movement.
Delay: It is the time lost by traffic during the travel period either due to fixed delays or operational delays
Capacity : It is the maximum number of vehicles in a lane or a road that can pass a given point in unit time.

6. A**) 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.



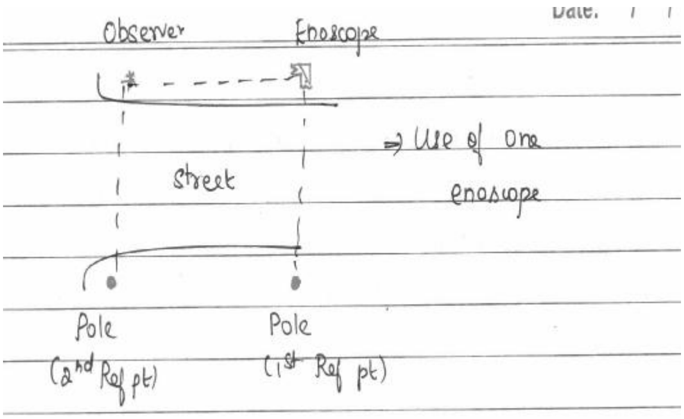
The instrument bends the line of sight of the observer so that it is perpendicular to the path of the vehicle.

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.



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

b) **Collision diagram** :

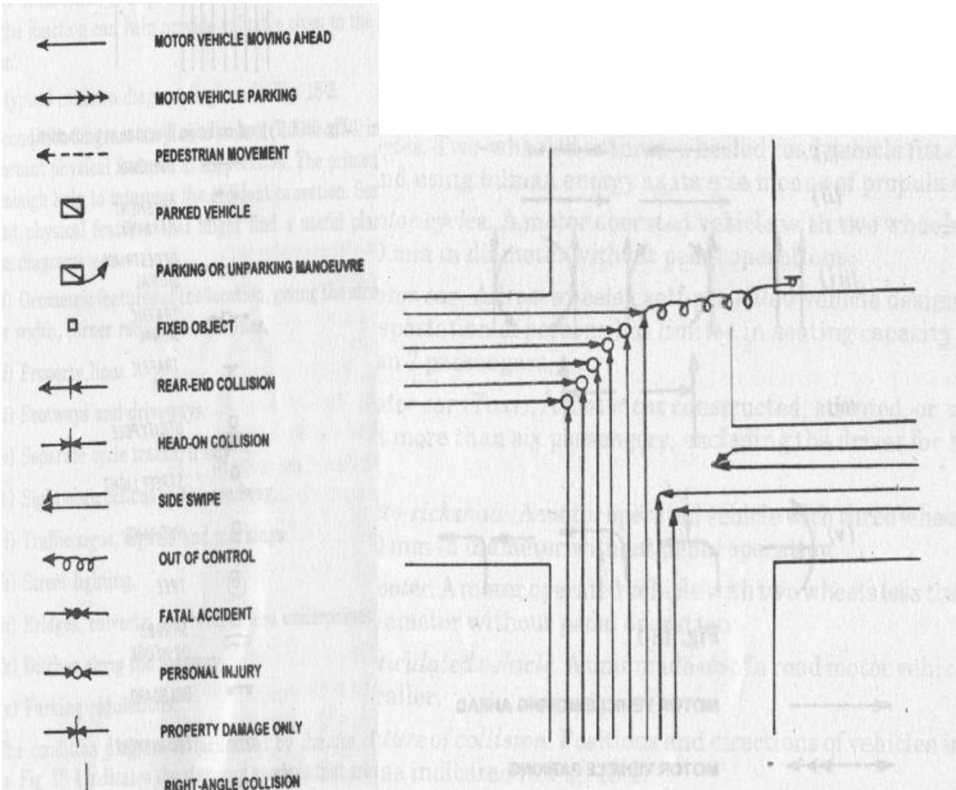


Fig. 18·3. Typical collision diagram at a junction.