INTERSECTION DESIGN

PART-A
SHORT QUESTIONS WITH SOLUTIONS

Q1. What are the requirements of At-grade intersection?

(May-16, (R13), Q9(a) | Model Paper-I, Q1(g))

OR

List the factors to be considered in the design of intersection At grade.

Answer :

May-17, (R13), Q1(g)

The general requirements of at-grade intersection are as follows,

1. The area of conflict at the intersection should be minimum
2. There should be a sufficient visibility for vehicles which is approaching the intersection junction
3. The angle of approach of vehicles must be kept small
4. The sudden or instantaneous change in path should be avoided
5. The relative speed of the approaching vehicles should be minimum
6. Separate or special provisions should be made for cyclists and pedestrians at large intersections
7. The width of pavement and turning radius should be sufficiently provided
8. Proper road signs, markings etc., should be provided before intersection so as to warn the drivers
9. Proper illumination is desired during night.

Q2. List out the merits and demerits of grade separated intersections.

Answer :

Model Paper-II, Q1(g)

Merits of Grade Separated Intersections

1. It prevents stopping of the vehicles. The design is such that the accidents can be avoided
2. Safer turning movements which improves vehicles safety
3. It is comfortable and accessible to the drivers. It saves operation cost of a vehicle and time to travel
4. It is less dangerous to the crossing traffic due to the facilities provided
5. Confliction of crossing traffic at the intersection is eliminated
6. It consists of ramps which provide the interchanging facility
7. It is an efficient intersection as compared to other intersections
8. The capacity accommodated by grade separation is same as provided by the two cross roads
9. It is adopted at the highways such as express way and free way.

Demerits of Grade Separated Intersections

1. Costlier to afford interchanging facilities and grade separation
2. It is not suitable in urban regions because of availability of space
3. Grade separated intersection gives rise to unuseful sage and crest in flat landscape.

Q3. Describe the advantages of rotary intersection.

Answer :

Advantages of Rotary Intersection

1. Traffic flow can be easily controlled and it maintains an orderly movement of the vehicle

2. It provide one way movement of traffic flow

3. Uniform traffic flow across the rotary prevents the stopping of vehicles

4. At-grade, annual crossings can be replaced by weaving movements

5. No need of police to control the traffic because at rotary the speed of the vehicles is low and the design is such that it avoids accidents

6. It is constructed with ease, when the intersection legs are more than five

7. The capacity to accommodate the traffic is very high at grade intersection as compared to other types of intersection.

Q4. What are the limitations of rotary intersection?

**Answer :**

Limitations of Rotary Intersection

1. It cannot be constructed where there is a limited space. (i.e., it constitute a large land area)

2. Cost to construct rotary is much high

3. Traffic police is required at the rotary if the pedestrian traffic flow is high. Since, the pedestrian traffic cannot be controlled the design of rotary becomes complex

4. It is not suited when the intersection legs or roads are more than seven because the intersection angle of two roads is quite less

5. It is not suitable in rural areas since the traffic is quite low

6. Vehicles has to travel extra distance for all turning movements except left turns

7. The lighting system with many number of warning signs must be provided at rotary to avoid accidents in the late night.

Q5. Draw typical conflict points in an intersection and suggest different types of treatments.
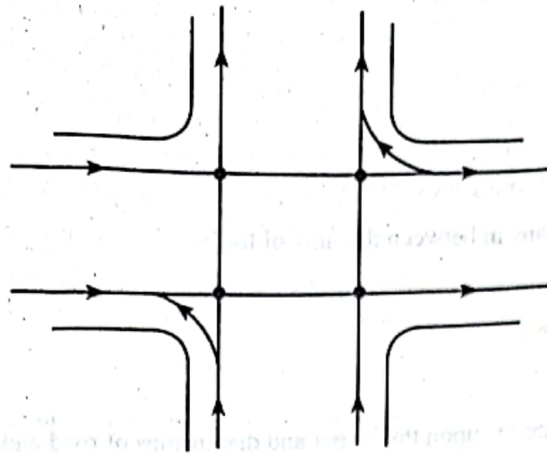
Answer :
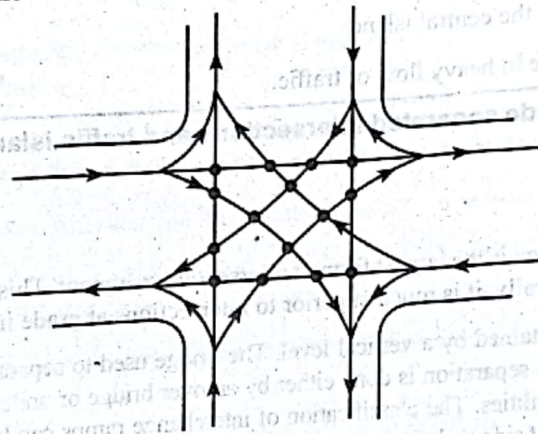
(i) **Conflicts with One-way Regulation on One Road**
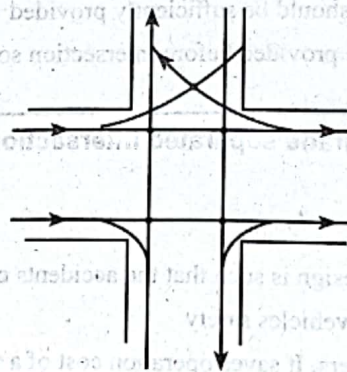
Types of Conflict	Number of Conflicts Points
+	4
↘→	4
⅄	1
✕	2
	Total = 11

(ii) **Conflict Points with One-way Regulation on Both Roads**

Types of Conflict	Number of Conflict Points
┼	4
↗	2
	Total = 6

Conflict Points with Two-way Traffic

Types of Conflict	Number of Conflict Points
↗	4
┼	4
⤬	12
↘	4
	Total = 24

Different Type of Treatments

For answer refer Unit-IV, Q10, Topic: Control of Conflict Angle and Conflict Separation.

Q6. What is traffic rotary?

Answer :

Traffic rotary is the channelized road intersection where the traffic move around the central island in a clockwise direction before going to their respective directions. Stopping at a road intersection is not required when rotary is provided. The crossing conflicts are completely removed on a rotary.

Q7. **What are the advantages and limitations of channelized and unchannelized intersections?**

Answer :

Channelized Intersections

Advantages

1. It reduces accidents and conflict turning movements

2. It provide refuge for the pedestrians in between the flow of traffic

3. It acts as a control device

4. It also guides the traffic at intersections.

Limitations

1. Size and shape of channeling depends upon the layout and dimensions of road and their point of intersection

2. For minimum size of channeling intersection, it is 5 sq.m in area.

Unchannelized Intersections

Advantages

1. These intersections are simple

2. Traffic volume can be controlled by traffic police or signals.

Limitations

1. It does not have any provision to the central island

2. These are dangerous and increase in heavy flow of traffic.

Q8. **Write a short notes on : Grade separated intersections and traffic islands.**

Answer :

Grade Separated Intersections

Grade separated intersection design is the largest form of intersection treatment. This intersection does not cause any delay and hazard to the crossing traffic. Generally, it is much superior to intersections at grade in case of traffic operation and safety.

A highway grade separation is obtained by a vertical level. The bridge used to separate the intersecting roads eliminates all crossing conflicts at the intersection. This separation is done either by an over bridge or under pass. Transform of route at the grade separation is provided by interchange facilities. The classification of interchange ramps can be direct, semi-direct or indirect. In the direct interchange ramp, it diverges to right side and merge from the right. In semi-direct interchange ramp, it diverges to left but merge from right. The indirect method of interchange ramp, involves diverging to the left and merging from the left side.

Traffic Signals

For answer refer Unit-IV, Q13.

PART-B
ESSAY QUESTIONS WITH SOLUTIONS

4.1 TYPES OF INTERSECTIONS – CONFLICTS AT INTERSECTIONS – REQUIREMENTS OF AT-GRADE INTERSECTIONS – TYPES OF AT-GRADE INTERSECTIONS: CHANNELIZED AND UNCHANNELIZED INTERSECTIONS – TRAFFIC ISLANDS – TYPES OF GRADE SEPARATED INTERSECTIONS

Q9. Define intersection. Explain its principle to be considered for a good design.

Answer :

Intersection

An intersection can be defined as the area where two or more highways joins the path of the road and the roadside designed features facilitates to move the traffic in an orderly manner. The intersection design plays a very important role and is dependent upon safety, speed, cost of operation and efficiency of a road system. Generally, intersection problems cannot be avoided. Only in the expressways or free way system these problems can be overcome by providing grade separated intersection and controlled access. Intersections can be classified into two main types. They are,

    (i)   Intersection at grade

    (ii)   Grade separated intersection.

The principles to be considered for a good design of intersection are as follows,

1.   A minimum number of intersections should be maintained. If possible, minor roads should be connected with each other before joining the intersection junction

2.   The design should be such that the driver feels conveniently and drives effectively. This can be achieved by providing a good layout, traffic islands, signs and carriage way markings. A good visibility facilitates in improving safety

3.   The geometric layout should be selected such that it prevents the hazardous movements by driver

4.   The design must follow the natural vehicle paths. Smoothness should be maintained for fast driving while sharp and rough corners should guide traffic into stopping or slowing down positions

5.   By separation of cutting, merging or diverging movements from the roadside, the number of conflict points should be minimized

6.   The vehicles which are parked should be maintained with adequate space at the junctions

7.   Intersections must be illuminated during night driving.

Q10. What are the basic forms of intersections? Explain the traffic factors to be considered in intersection design.

Answer :   Model Paper-I, Q8

The basic forms of intersection are listed below,

1.   Tee intersection

2.   Cross intersection

3.   Staggered intersection

4.   Skewed intersection

5.   Skewed-cross intersection

6.   Skewed-staggered intersection

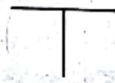7.   Wye intersection

8.   Multiple intersection.

Figure (1): Tee   Figure (2): Cross   Figure (3): Staggered   Figure (4): Skewed

Figure (5): Skewed-cross   Figure (6): Skewed-staggered

Figure (7): Wye   Figure (8): Multiple

There are two main factors which must be considered in intersection design. They are,

1.   Relative speed and

2.   Maneuver areas.

1.   Relative Speed

It is the vector difference between the velocities of two vehicles in the same flow. It mainly depends on the absolute velocities of the intersecting vehicles and the angle between them. If the merging angle is smaller then the relative speed will be less. On other hand, if collision occurs between two vehicles at small angle and at low or same speed then impact between them is less compared to higher speeds. Thus, when the speed increases, the judgement time taken by the driver and the distance is less and inaccurate causing severity of accidents.

2.   Maneuver Areas

Maneuver areas formed by only two single one-way lanes of flow when they diverge, merge or cross are known as elemental maneuver areas. While, if more than two one-lane one-way flows are present, then it is called as multiple maneuver areas. These multiple maneuver should be avoided in intersection design as it involves more complex traffic operations. Also, the conflict points should be minimum in the intersection design so as to reduce the conflict area.

Q11.   What are the various types of at-grade intersections possible? Describe the same with suitable sketches showing their layout.

OR

Present on different types of intersections.

Answer :

The road intersections can be broadly categorized into at-grade intersection and grade intersection. The at-grade intersection has normally one way traffic movements which have only left diverging and merging maneuvers are evolved to elimate the possibilities of road accidents. Generally, the at-grade intersection are classified into two types. They are,

1.   Unchannelized intersections and

2.   Channelized intersection.

1.   Unchannelized Intersections

The unchannelized intersection is as shown in figure (1). It does not have any provision of direction islands or central island. Such intersections are most simple type but is dangerous and insecure if the traffic is heavy. It can be only controlled either by installing traffic signals or with the traffic police who should gives the appropriate directions i.e., stopping traffic at one road and allowing at the other road simultaneously. If an extra width is provided at an intersection area, then it is known as flared intersections. At such intersections, the traffic on one road should be allowed to cross while at the other road, it should be stopped.
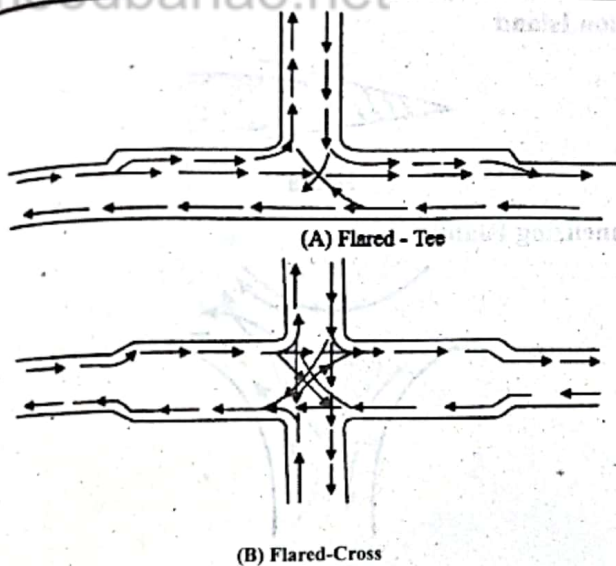
(A) Flared - Tee

(B) Flared-Cross

Figure (1): Flared and Cross

2. **Channelized Intersection**

Figure 2(a), 2(b) and 2(c) shows various channelized intersection paths. This type of intersection, considerably reduces the high rate of accidents and conflicting turning movements. It can only be achieved by means of traffic markings and islands. In addition, it controls the angle of conflict, speed and provide a refuge for the pedestrians in between the traffic flow.
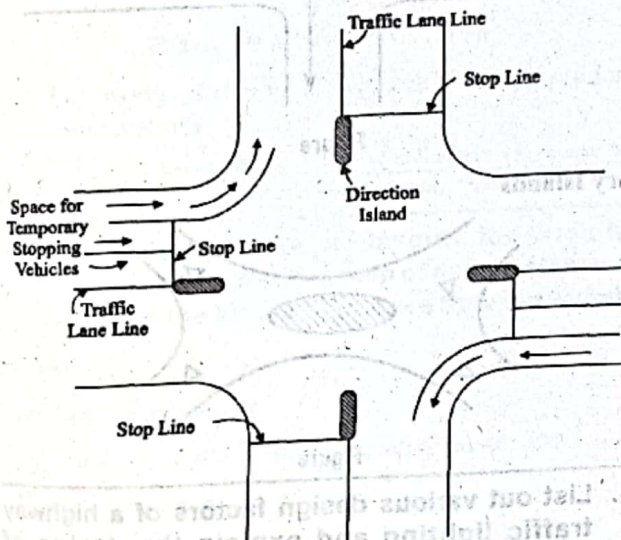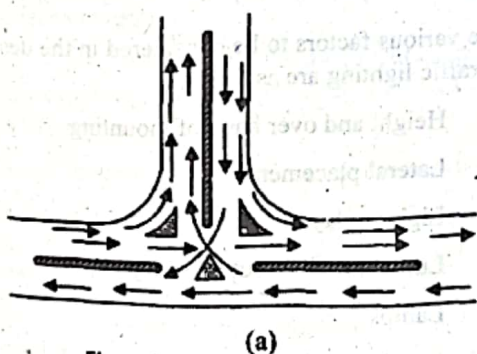

Figure 2(a): Marking Lines at Level Intersection
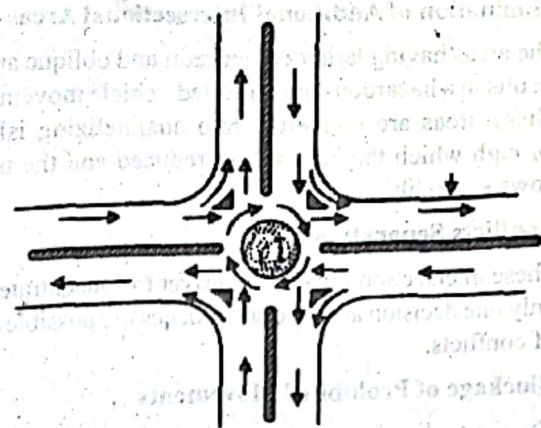

(a)

Figure 2(b): Channelized - Tee

Figure 2(c): Channelized - Cross

Q12. What is channelization? State its objectives.

OR

What are the purposes of channelization? What are the salient features of channelizing islands?

Answer : April-18, (R15), Q9(a)

Channelization

A channelization can be defined as the one in which the traffic is directed into definite paths by means of islands or traffic markings. A divisional islands should be introduced on undivided highways so as to warn the drivers and regulate smooth traffic flow through the junction.

Channelization serves the following objectives given below,

1. **Control of Conflict Angle**

Crossing angle is made very small to prevent from severe accidents. Thus, reducing accidents by controlling the angle of conflict.

2. **Control of Speed**

The speed of the traffic entering the intersection is decreased and its speed is increased on leaving the intersection.

3. **Location of Traffic Control Devices**

Traffic control devices such as direction indicators, signs etc., are installed for smooth traffic flows.

4. **Vehicle Protection**

The protection of vehicle leaving or crossing the main traffic stream is controlled by providing separate storage pockets for right turning traffic as well as the left one.

5. **Pedestrians Protection**

Channelization intersections possess a refuge for pedestrians between traffic flows which makes the crossing of pedestrians more safe.

6. **Elimination of Additional Intersectional Areas**

The areas having larger corner radii and oblique angles results in a hazardous uncontrolled vehicle movements. These areas are converted into channelizing islands through which the hazards are reduced and the traffic flows smoothly.

7. **Conflicts Separation**

These intersection-enables the driver to concentrate with only one decision at a time and reduces the possible areas of conflicts.

8. **Blockage of Prohibited Movements**

By channelization arrangement, the traffic can easily choose the desired path and also supports regulations by providing improper movements.

Q13. **With neat sketches, explain the Different types of traffic Islands and conflicts at Intersections.**

May-17, (R13), Q8(b)

OR

Present the different types of islands and their functionality in reducing the conflicts.

Answer : May-16, (R13), Q8(a)

The various types of traffic islands are as follows,

1. Divisional islands
2. Channalising islands
3. Pedestrian loading islands
4. Rotary islands.

Uses

1. **Divisional Islands**

(a) Due to the construction of Kerbs they help in preventing vehicles from entering the islands. Thus, they prevent accidents and head-on collisions.

(b) They generally eliminate the conflict area.

2. **Channelizing Islands**

(a) They guide the traffic at intersections.

(b) They are used as traffic control devices.

(c) These islands serve as refuge island for pedestrians.

3. **Pedestrian Loading Islands (Refuge Islands)**

(a) They act as a safety measure for the passengers.

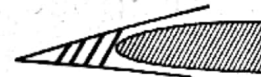(b) They prevent accidents.

4. **Rotary Islands**

(a) They separate vehicular traffic from pedestrian traffic.

(b) They increase the traffic safety.

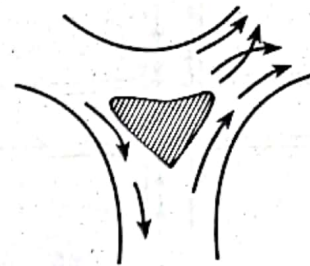(c) They make the traffic to proceed with uniform speed.

(d) They separate traffic into specified paths.
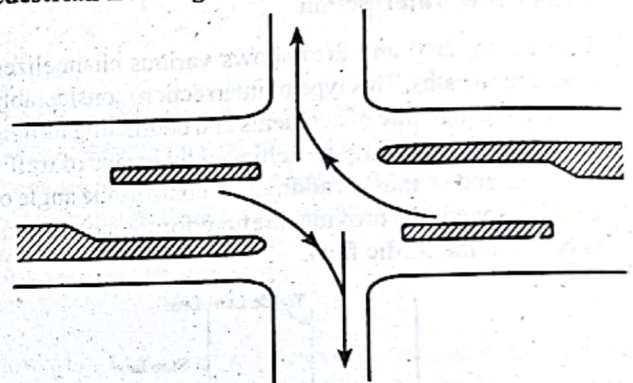
Division Island
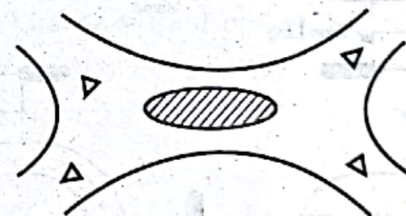

Figure

Channelizing Island

Figure

Pedestrian Loading Islands

Figure

Rotary Islands

Figure

Q14. **List out various design factors of a highway traffic lighting and explain the design of highway lighting system.**

Answer :

The various factors to be considered in the design of a highway traffic lighting are as follows,

1. Height and over hang of mounting
2. Lateral placement
3. Lighting layouts
4. Luminaire distribution of light
5. Lamps
6. Spacing of lighting units.

Design of Highway Lighting Systems

The design of highway lighting system mainly depends on the determination of average lux of intensity over the road area.

If the lamp lumen, mounting height, width of paved area and spacing between the lighting poles are known, then the average lux of intensity can be determined by the utilization coefficient chart as shown in the following figure,
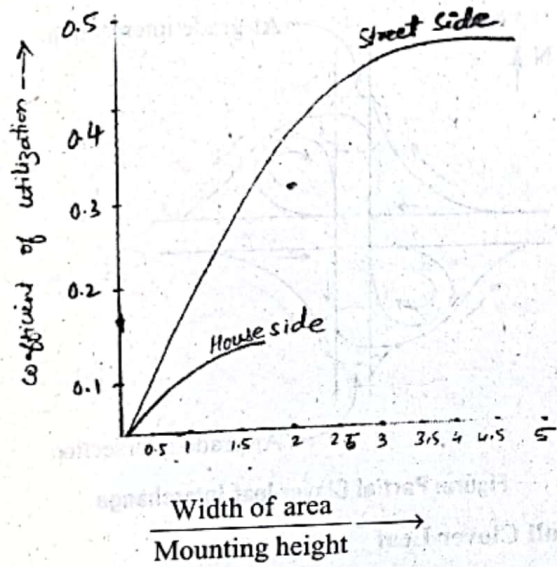

Figure: Coefficient of Utilization

Following is the relationship which is employed for the design computations,

$$\text{Spacings} = \frac{\text{Lamp lumen} \times \text{Coefficient of utilization} \times \text{Maintenance factor}}{\text{Average lux of intensity} \times \text{Road width}}$$

Q15. Describe the possible layouts for three legs interchanges with the help of neat sketches and indicate the situations where they are suitable.

Answer :

Three Leg Interchanges

Various layouts for three leg interchanges are,

1. T interchange
2. Y interchange
3. A practical rotary interchange.

1. T Interchange

(i) It is the junction at which the intersection leg (or) road and the highway meet at right angle is known as trumpet interchange.

(ii) The intersection leg does not cross the highway.

(iii) It provides interchanging facility. They are particularly useful in a situation where a major road is to be terminated at other road.

The figure below shows a trumpet interchange where the arrows represent the flow (or) movement of the path.
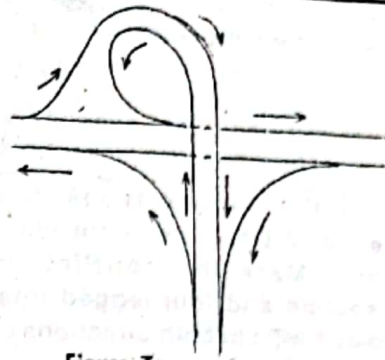

Figure: Trumpet Interchange

In a trumpet interchange, except from the point of at grade intersection, the curved lines always represent the movement of path and the dotted lines represents that a specified movement of path is at lower level at the grade divided part of intersection.

2. Y Interchange

(i) The junction at which the intersection leg and the highway meets at acute (or) obtuse angles is known as Y interchange.

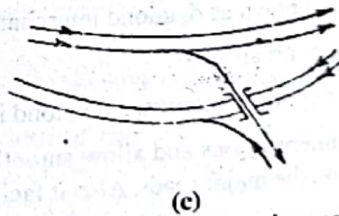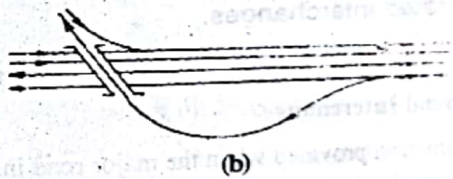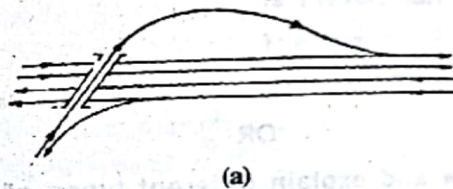(ii) It is adopted in major streets with highways such as express highway.

(a)

(b)

(c)

Figure: Y-shaped Interchanges

3. A Practical Rotary Interchange

Three-leg interchange can be converted to a clover leaf when the junction is supposed to become four leg inter change. Also, partial bridged rotary intersection can be adopted.
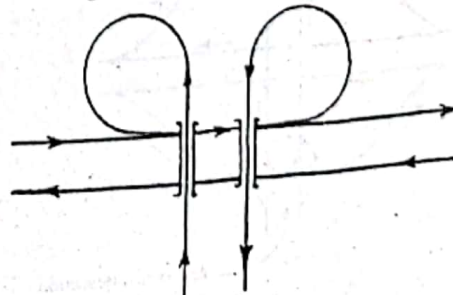

Figure: Three-leg Interchange Which can be Converted to a Clover Leaf

Q16. List the various advantages of At-grade and Grade separated Intersections.

Answer :   May-17, (R13), Q9(b)

For answer refer Unit-IV, Q7, Topic: Advantages and Q2, Topic: Merits of Grade Separated Intersections.

Q17. What are the various types of at-grade intersection? Describe them will suitable sketches. Mark the conflict points at T-intersection and four-legged intersection (for two-ay traffic in both directions).

Answer :   April-18, (R15), Q8

For answer refer Unit-IV, Q11 and Q5.

4.2 ROTARY INTERSECTION – CONCEPT OF ROTARY – DESIGN FACTORS OF ROTARY – ADVANTAGES AND LIMITATIONS OF ROTARY INTERSECTIONS

Q18. With the help of neat sketches, indicate the traffic movements of all directions in the following types of grade separated interchanges,

(a) Diamond interchange

(b) Half clover leaf

(c) Full clover leaf.

Model Paper-I, Q9

OR

Draw and explain different types of grade separated interchanges.

Answer :   May-16, (R13), Q1(g)

(a) Diamond Interchange

1. The junction provided when the major road intersect a minor road is known as diamond interchange.

2. It is suitable in urban areas.

3. Less area is required to construct diamond interchanges.

4. It prevents interruptions and allow smooth running of traffic flow on the major roads. Also it facilitate the use of two at grade intersections on the minor road.
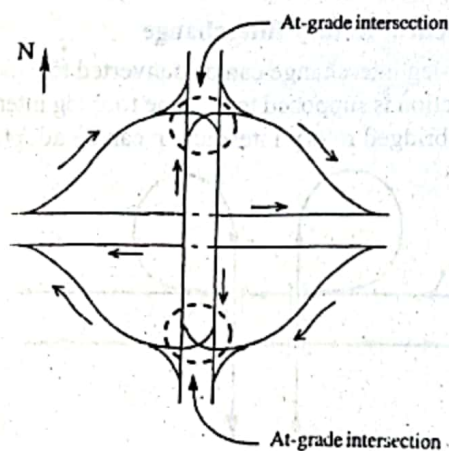

Figure: Diamond Interchange

(b) Half Clover Leaf

1. It is a modified form of diamond interchange which is provided where a major crosses a minor road.

2. It requires more space as compared to diamond interchange junctions

3. Such interchange has looping ramps which helps to replace the critical turning movements with the merging movements. These are used when the at grade intersections are accepted on minor roads.
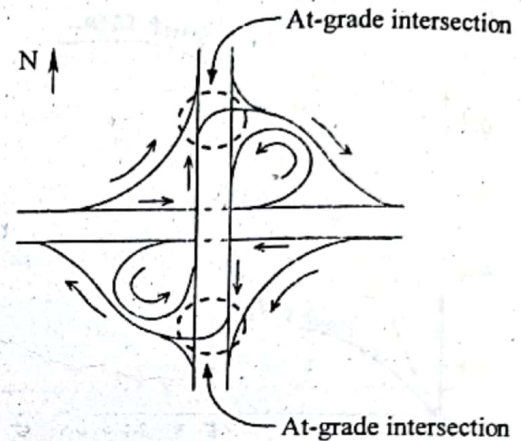

Figure: Partial Clover-leaf Interchange

(c) Full Clover Leaf

1. It is provided at the intersection of all the major roads. Generally, it is provided in the areas where the availability of space is more.

2. It prevents interruptions of traffic flow and separate the conflicting movements on major road.

3. The path is such that it is easy to use and does not create any confusion in the minds of drive

4. It cannot be provided in urban areas.

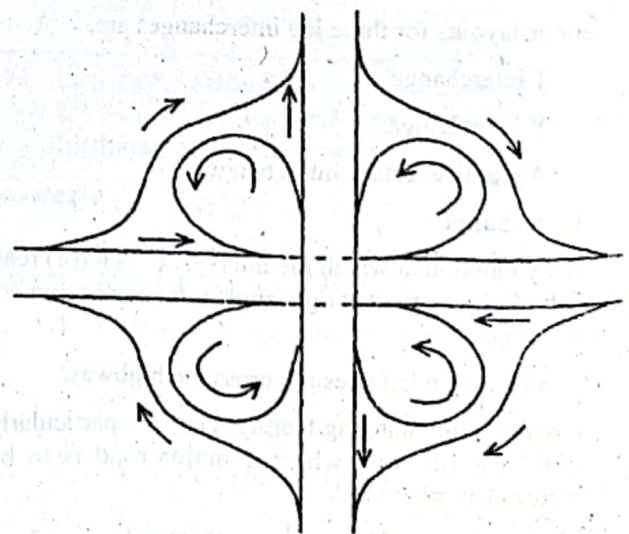5. It has a single structure with number of intersection legs as four.

Figure: Full Clover-Leaf Interchange

Q19. With the help of a neat diagram indicating the various geometric elements of a traffic rotary, explain about the design elements of a rotary intersection.

OR

Briefly explain the various design factors to be considered in the design of rotary.
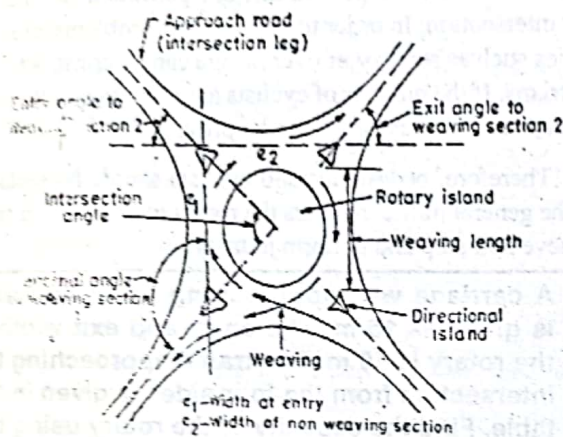
Answer :

Figure: Rotary Elements

Design Element of a Rotary Intersection

Various elements of a rotary intersection are,

1. Design speed
2. Entry radius
3. Exit radius
4. Shape of the central island
5. Weaving length
6. Width of carriage way both at entry and exit
7. Width of rotary carriage way
8. Angles at the entrance and exit
9. External curbline
10. Super elevation
11. Capacity.

1. Design Speed

The various elements such as radii and weaving lengths are influenced by design speed of rotary intersection. The design speed of the vehicles in a traffic rotary should be lower as compared to the standard speed of intersection highways. In India, the design speed adopted for rural and urban areas are 40 kmph and 30 kmph.

2. Entry Radius

Factors such as coefficient of friction, superelevation and design speed are needed to determine radius at entry. It must be designed in such a way that the driver should lower the speed. The radius designed for rural and urban areas are in the range of 20-35 m and 15-25 m.

3. Exit Radius

The radius at the exit should be designed such that it should be more than the radius of rotary island which enable the vehicles to move quickly from rotary intersection.

4. Shape of the Central Island

It should be designed with number of curves and the design speed of a rotary governs radius of the central island Inorder to slow down the traffic approaching the rotary, the radius of the island must be slightly greater than radius at entry. Different shapes such as elliptical, circular and tangent shapes can be designed for central island.

5. Weaving Lengths

It is considered to merge and diverge the traffic easily. It is based on number of factors like total traffic at rotary, weaving section width, average width of entry and proportion of weaving traffic in it. The ratio between weaving length and weaving width must be high to avoid the traffic cuts at the intersection.

$$\therefore \text{Maximum ratio} = \frac{\text{Weaving length}}{\text{Weaving width}} = 4:1$$

6. Width of Carriage way both at Entry and Exit

The width of carriage way at the entrance and exit depends on the traffic at entrance and exit of intersection throughout the design year. The minimum width at both entry and exit is taken as 5 m.

7. Width of Rotary Carriage Way

Width of the weaving section is given as,

$$W = \frac{e_1 + e_2}{2} + 3.5$$

e_1 – Width at entry

e_2 – Width of non weaving section.

8. Angles at the Entrance and Exit

The angles at the entrance must be more than the angle at exit. The angle at the exit should be small. The suitable angles at the entry and exit are 60° and 30° as shown in figure.
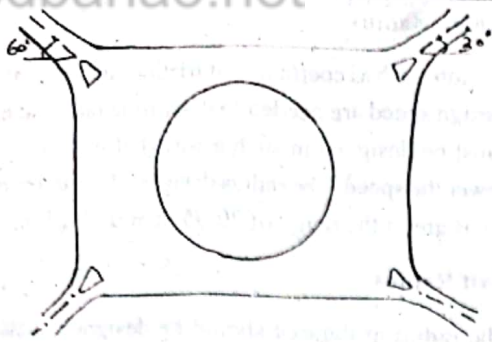
Figure: Angles at the entrance and Exit

9. **External Curb Line**

It is a curve generally straight and large which eliminates the waste area of weaving section not used by traffic.

10. **Super Elevation**

Since the elevation in two portions is opposite to each other at the entry and exit, cause trouble to the vehicles while changing from one cross slope to the other.

11. **Capacity**

Rotary capacity is determined by the weaving capacity at each section. Depending on the percentage of weaving traffic and the geometrical layout at the entrance and exit, the capacity of weaving section is obtained.

Wardrop formula is given by

$$Q_p = \frac{280W\left(1-\dfrac{P}{3}\right)\left(\dfrac{w+e}{w}\right)}{\left(1+\dfrac{w}{l}\right)}$$

Where,

Q_p – Capacity of weaving section

W – Width of weaving section

Average entry width, $e = \dfrac{e_1 + e_2}{2}$

l – Weaving section length

p – Proportion of weaving traffic.

Q20. Write an note about width of rotary roadway, sight distance and grade and provisions for cyclists and pedestrians, while designing a rotary.

Answer :

Width of Rotary Roadway

The width of rotary roadway or weaving section is the minimum width of the roadway that ranges from edge of the central island to the adjoining kerb. The actual width of the rotary roadway differ from section to section.

Sight Distance and Grade

There should exists maximum sight distance in the rotary. In the consideration of design speed, the sight distance should not be less than the safe stopping distance. For design speeds of 30 and 40 kmph, the minimum sight distance should be 30 m and 45 m respectively. It is desirable to select the rotary on ground level. The rotary can also be located on area which lies on an individual plane (i.e., slope < 1 in 50 with horizontal).

Provisions for Cyclists and Pedestrians

Traffic control and enforcement would become complicated when the pedestrians are permitted to enter the rotary intersection. In order to reduce such problems, crossing facilities such as subway or over bridge can be constructed for pedestrians. If the number of cyclists are more than 50/hr, then a separate track for cyclists is to be provided.

Therefore, pedestrians and cyclists should be secluded from the general traffic that uses the rotary intersection in order to achieve non-stop and uniform journey.

Q21. A carriage way approaching an intersection is given as 15 m. The entry and exit width at the rotary is 10 m. The traffic approaching the intersection from the four sides is given in the table. Find the capacity of the rotary using the given data.

Approach	Left turn	Straight	Right turn
North	408	450	375
South	420	350	370
East	250	500	600
West	400	505	510

Answer :
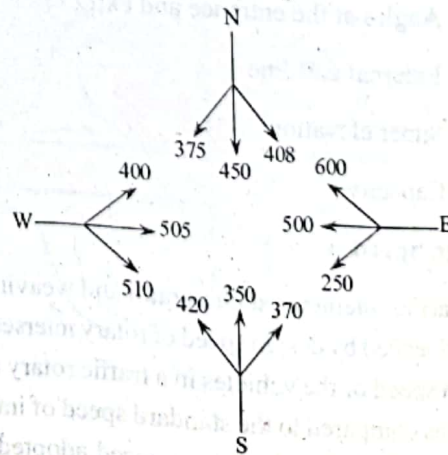
Given that,

The width of carriage way approaching an intersection,

$b = 15$ m

The width of entry at rotary, $e_1 = 10$ m

The width of exit at rotary, $e_2 = 10$ m

Figure

Weaving width, $W = \dfrac{e_1 + e_2}{2} + 3.5$

$$= \frac{10+10}{2} + 3.5 = \frac{20}{2} + 3.5$$

$W = 13.5$ m

Weaving length, $l = 4 \times W$

$$= 4 \times 13.5$$

$l = 54$ m

Let the proportion of weaving traffic to the non-weaving traffic in west-north direction be denoted as P_{WN}.

In north-east direction as P_{NE}

In east-south direction as P_{ES}

In south-west direction as P_{SW}

The weaving traffic movements in the east-south direction,

$$P_{ES} = \frac{W_R + N_s + E_s + E_R}{W_R + N_s + E_s E_R + E_L + N_R}$$

$$= \frac{510+450+500+600}{510+450+500+600+250+375} = 0.767$$

$$P_{WN} = \frac{E_R + S_S + W_S + W_R}{E_R + S_S + W_S + W_R + W_L + S_R}$$

$$= \frac{600+350+505+510}{600+350+505+510+400+370} = 0.718$$

$$P_{NE} = \frac{S_R + W_S + N_S + N_R}{S_R + W_S + E_S + E_R + N_L + W_R}$$

$$= \frac{370+505+450+375}{370+505+450+375+408+510} = 0.649$$

$$P_{SW} = \frac{N_R + E_S + S_S + S_R}{N_R + E_S + S_S + S_R + S_L + E_R}$$

$$= \frac{375+500+350+370}{375+500+350+370+420+600} = 0.6099$$

The capacity of rotary is given as,

$$Q_P = \frac{280 \times W \left(1 + \dfrac{e}{W}\right)\left(1 - \dfrac{P}{3}\right)}{\left(1 + \dfrac{W}{l}\right)}$$

The proportion of weaving traffic to non-weaving traffic is highest in east-south direction.

∴ The capacity of the rotary will be capacity of this weaving section.

$$Q_{ES} = \frac{280 \times 13.5 \left[1 + \dfrac{10}{13.5}\right]\left[1 - \dfrac{0.767}{3}\right]}{1 + \dfrac{13.5}{54}}$$

∴ $Q_{ES} = 3918.17$ PCV/hr

Q22. The width of approaches for a rotary intersection is 12 m. The entry and exit width at the rotary is 10 m. Table below gives the traffic from the four approaches, traversing the intersection. Find the capacity of the rotary.

Approach	Left turn	Straight	Right turn
North	400	700	300
South	350	370	420
East	200	450	550
West	350	500	520

Answer :

Given that,

The width of approaches for a rotary intersection, $b = 12$ m

The width of entry at rotary, $e_1 = 10$ m

The width of exit at rotary, $e_2 = 10$ m

Weaving width, $W = \dfrac{e_1 + e_2}{2} + 3.5$

$$= \frac{10+10}{2} + 3.5$$

$$= 10 + 3.5$$

∴ $W = 13.5$ m

Weaving length, $l = 4 \times W$

$$= 4 \times 13.5$$

∴ $l = 54$ m

Let the weaving traffic movements in the east-south direction be 'P_{ES}'

$$P_{ES} = \frac{W_R + N_S + E_s + E_R}{W_R + N_S + E_s + E_R + E_L + N_R}$$

∴ $$P_{ES} = \frac{520+700+450+550}{520+700+450+550+200+300}$$

$$= 0.816$$

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$$P_{WN} = \frac{E_R + S_S + W_S + W_R}{E_R + S_S + W_S + W_R + W_L + S_R}$$

$$= \frac{550 + 370 + 500 + 520}{550 + 370 + 500 + 520 + 350 + 420}$$

$$= 0.716$$

$$P_{NE} = \frac{S_R + W_S + N_S + N_R}{S_R + W_S + E_S + E_R + N_L + W_R}$$

$$= \frac{420 + 500 + 700 + 300}{420 + 500 + 700 + 300 + 400 + 520}$$

$$= 0.676$$

$$P_{SW} = \frac{N_R + E_S + S_S + S_R}{N_R + E_S + S_S + S_R + S_L + E_R}$$

$$= \frac{300 + 450 + 370 + 420}{300 + 450 + 370 + 420 + 350 + 550}$$

$$= 0.631$$

The capacity of rotary is given as,

$$Q_P = \frac{280 \times W \left(1 + \frac{e}{W}\right)\left(1 - \frac{P}{W}\right)}{\left(1 + \frac{W}{l}\right)}$$

The proportion of weaving traffic to non-weaving traffic in highest in east-south direction.

∴ The capacity of the rotary will be capacity of this weaving section.

$$Q_{ES} = \frac{280 \times 13.5 \left[1 + \frac{10}{13.5}\right]\left[1 - \frac{0.816}{3}\right]}{1 + \frac{13.5}{54}}$$

∴ Q_{ES} = 3832.192 PCU/hr

Q23. List and explain the various advantages and disadvantages of Rotary.

Answer :

For answer refer Unit-IV, Q3 and Q4.

Q24. Explain the design considerations for a rotary. Discuss the advantages of channelizing islands?

Answer :

For answer refer Unit-IV, Q19, Q3 and Q4.