

UNIT-III

Basic traffic characteristics

① Road Users characteristics :-

The human element is involved in all actions of the road users either as pedestrian, cyclist, car driver or motorist. The physical, mental and emotional characteristics of human beings affect their ability to operate motor vehicle safely or to service as a pedestrian.

② Physical characteristics:-

The physical characteristics of the road users may be either permanent or temporary. The permanent characteristics are the vision, hearing, strength and the general reaction to traffic situations.

③ Mental characteristics:-

knowledge, skill, intelligence, experience and literacy can affect the road user characteristics. Knowledge of vehicle characteristics, traffic behaviour, driving practice, rules of roads and psychology of road users will be quite useful for safe traffic operations.

④ Vehicular characteristics:-

It is quite important to study the various vehicular characteristics which affect the design and traffic performance, because, it is possible to design a road for any vehicle but not for an indefinite vehicle.

⑤ Braking characteristics:-

The deceleration and braking characteristics of vehicles depends on the design and type of braking system and its efficiency.

Speed

The actual speed of vehicles over a particular route may fluctuate widely depending on several factors such as geometric features, traffic conditions, time, place, environment and drivers.

→ Space-mean speed is calculated from

$$V_s = \frac{3.6 d n}{\sum_{i=1}^n t_i}$$

where

V_s = space-mean speed, kmph

d = length of road, considered, m

n = no. of individual vehicle observations

t_i = Observed travel time(sec) for the i^{th} vehicle
to travel distance d , m

→ Time-mean speed represents the speed distributions of vehicles at a point on the roadway and it is the average of instantaneous speeds of observed vehicles at the spot.

Time mean speed is calculated from:

$$V_t = \frac{\sum_{i=1}^n v_i}{n}$$

Where,

V_t = time-mean speed, kmph

v_i = Observed instantaneous speed of
 i^{th} vehicle, kmph

n = number of vehicles observed.

→ Speed Studies Carried out occasionally give the general trend in speeds.

Volume

→ Traffic volume is the numbers of vehicles crossing a section of road per unit time at any selected period. Traffic volume is used as a quantity measure of flow; the commonly used units are vehicles per day and vehicles per hour.

→ The objects and uses of traffic volume are:-

- * Traffic volume is generally accepted as a true measure of the relative importance of roads and in deciding the priority and improvement and expansion

- * Traffic volume study is used in planning, traffic operation and control of existing facilities

- * Volume distribution study is used in planning one-way streets and other regulatory measures.

- * Pedestrian traffic volume study is used for planning side walks, cross walks, subways and pedestrian signals.

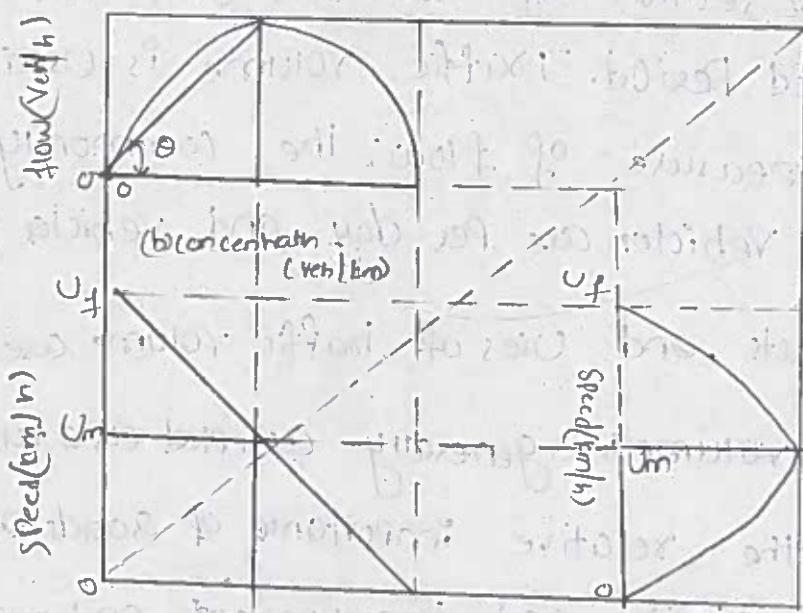
Concentration:-

Concentration is a traffic measure which explains the extent of usage of road space by vehicles.

→ It is a broader term encompassing both density and occupancy.

→ The first is a measure of concentration over space.

Relationship between flow speed and concentration



- Often the speed/flow data show a large amount of scatter and the corresponding speed/concentration plots show a marked tendency to which a downward straight line may be fitted.
- This straight line can be reconverted to a parabola on the speed/flow diagram, establishing a significant relationship between the two variables which are totally uncorrelated giving a false measure of capacity.
- Normally distributed random values of speed are used to illustrate the abuse of the relation.
- The shape and statistical significance of a speed/flow relation should not be inferred from a speed/concentration relation unless the latter is very clearly defined over a range of values.

Highway Capacity and level of service (los) concept:-

Highway Capacity

- The capacity of a facility defined as the maximum hourly flow rate at which the maximum numbers of vehicles, passengers or the like, per unit time, which can be accommodated under prevailing roadway, traffic and control conditions with a reasonable expectation of occurrence.
- Capacity is independent of the demand. It speaks about the physical amount of vehicles and passengers that a road can afford.
- Generally, the highway capacity depends on certain conditions as listed below:

1) Road way characteristics

2) Traffic conditions

3) Control conditions.

Level of Service:-

- The level of service concept was introduced in the 1965 HMA in a convenient way to describe the general quantity of operations on a facility with a defined traffic, roadway and control conditions.
- A term level-of-service closely related to capacity and often confused with a its service volume.

→ Level of Service (Los) Quantitatively measures both the operating conditions within a traffic system and how these conditions are perceived by drivers and passengers.

Factors affecting capacity

The factors affecting capacity fall under two heads

1) Roadway Conditions

2) Traffic Conditions.

1) Roadway Conditions:- lane width, lateral clearance, shoulders, horizontal alignment, gradient, Pavement surface condition, intersections at-grade.

2) Traffic Conditions:- The capacity is affected by the composition of different types of vehicles in the stream, variation of traffic flow, traffic interruption and lane distribution.

Factors affecting Level of service (Los):-

The factors affecting level of service can be listed as follows

1. Speed and travel time
2. Traffic interruptions / restrictions
3. Freedom to travel with desired speed.
4. Driver comfort and convenience
5. Operating cost.

Relation b/w V/C ratio and LOS

→ As the practitioners use V/C ratio as the prime indicator of intersection performance, an attempt was made to investigate the relationship between LOS and V/C ratio for Indian intersections and thereby proposing the V/C thresholds for each LOS category.

→ Initially, the V/C thresholds proposed by the Canadian capacity guide is revisited and thereafter the relationship between the LOS ranges imposed in the study based on the actual waiting time at the intersection and the V/C ratio is investigated.

→ For delay calculation, the model proposed by the manual has been used and the same is given by

$$d = d_1 \cdot PF + d_2 + d_3$$

$$d_1 = 0.50 C \left[1 - \frac{q}{C} \right]^V$$

$$\frac{\left[1 - \frac{q}{C} \times x \right]}{\left[1 - \frac{q}{C} \times x \right]}$$

$$d_2 = 1.5T \left\{ (x-1) + \sqrt{(x-1)^2 + \frac{240x}{C^2}} \right\}$$

Where

d = The average control delay in sec/veh

d_1 = The average uniform delay per vehicle

d_2 = The average incremental delay per vehicle

PF = the progression adjustment factor

T = Analysis Period in minutes.

Traffic volume and spot-speed studies

Traffic volume

- Traffic volume is the number of vehicles crossing a section of road per unit time at any selected period. Traffic volume is used as a quantity measure of flow.
- There are variation in traffic flow from time to time.
- Hourly traffic volume varies considerably during a day, the peak hourly volume may be much higher than average hourly volume.
- Daily traffic volume vary considerably from week and there are variations with season.
- Traffic volume ^{count} may be done by mechanical counters or manually

Spot-speed study

spot speed study may be useful in any of the following aspects of traffic engineering.

- * TO use in planning traffic control and in traffic regulation.
- * TO use in geometric design - for redesigning existing highway or for deciding design speed for new facilities.
- * TO use in accident studies.
- * TO study the traffic capacity
- * TO compare diverse types of drivers & vehicles under specified conditions.

Road Safety

- Never Drink & drive
- Always wear Seat Belt
- Keep a safe Distance from the Vehicle ahead.
- Always Avoid Distractions
- Never Break Red Signal
- Always Drive within SPEED limit
- Avoid the Drowsiness while Driving.
- Watch out for Drivers on the road.

Traffic Signals

→ A traffic signal is defined as any power operated traffic control device, or a sign by which traffic is warned or directed to take some specific action.

→ A traffic control signal is a signal, which through its indication, directs the traffic to stop and permits it to proceed alternatively. Typical details of a signal post and its foundation are depicted.

Types of Signals

Signals can be classified as follows:-

1. Traffic control signals

(a) Fixed-time signal

(b) Traffic Actual signal

- i) Fully actuated signal
- ii) semi - actuated signal
- iii, speed control signals.

2. Pedestrian signals

3. Special traffic signals.

Warrants for Signalization

→ Traffic control signals should not be installed unless one or more of the following signal warrants are met:

→ The necessary data should be collected by means of traffic engineering studies.

i) Minimum vehicular volume warrant specifies that the average traffic volume for eight hours on both approaches should be at least 650 motor vehicles per hour on major streets.

ii) Interruption of continuous traffic flow on the major street with 1000 to 1200 vehicles per hour that there is undue delay or hazard to traffic on minor road.

iii, Minimum pedestrian volume warrant of 150 or more pedestrians per hour cross a major street with over 600 vehicles per hour on both approaches.

iv, Accident experience warrant showing that other measures have failed to decrease the accident frequency.

v) Combination of warrants when no single warrant is satisfied but indicating two or more warrants.

Design of Isolated traffic signal by IRC method

- The Pedestrian green time required for the major and minor roads are calculated based on walking speed of 1.2 m/sec, and initial walking time of 7.0 sec.
- The green time required for the vehicular traffic on the major road is increased in proportion to the traffic on the two approach roads.
- The cycle time is calculated after allowing amber time of 2.0 sec. each.
- The minimum green time required for clearing vehicles arriving during a cycle is determined for each lane of the approach and assuming that the first vehicle will take 6.0 sec.
- The Optimum signal cycle time is calculated using Webster's formula. The saturation flow values may be assumed as 1850, 1890, 1950, 2250, 2550 and 2990 PCU per hour for the approach roadway width.
- The Signal cycle time and the phases may be revised keeping in view the green time required for clearing the vehicles and the optimum cycle length determined in steps.

Parking and Road Accidents

- In cities the problem of parking vehicles is becoming more and more acute day by day.
- As per IRC the standard dimensions of a car is taken as 5×2.5 m and that for a truck is 3.75×7.5 meters.
- When vehicles are parked on the road side, even for a short while there is restriction to other vehicles passing by, resulting in congestion and accidents.

Road accidents

- The problem of accident is a very acute in highway transportation due to complex flow pattern of vehicular traffic, presence of mixed traffic along with pedestrians.
- Traffic accident leads to loss of life and property. Thus the traffic engineers have to undertake a big responsibility of providing safe traffic movements to the road users and ensure their safety.

Types of Parking facilities

Parking facilities are broadly classified

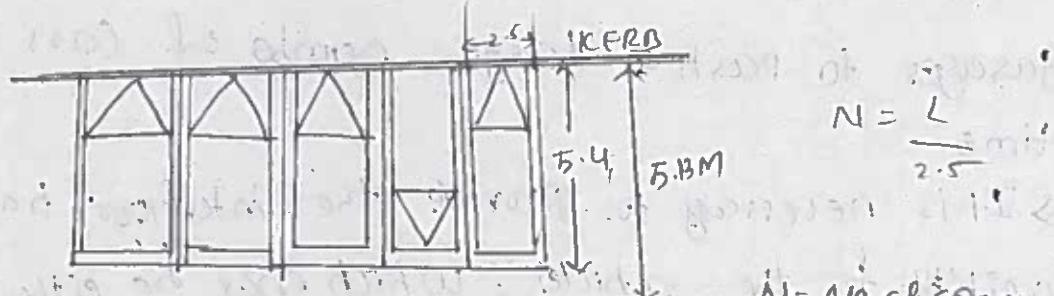
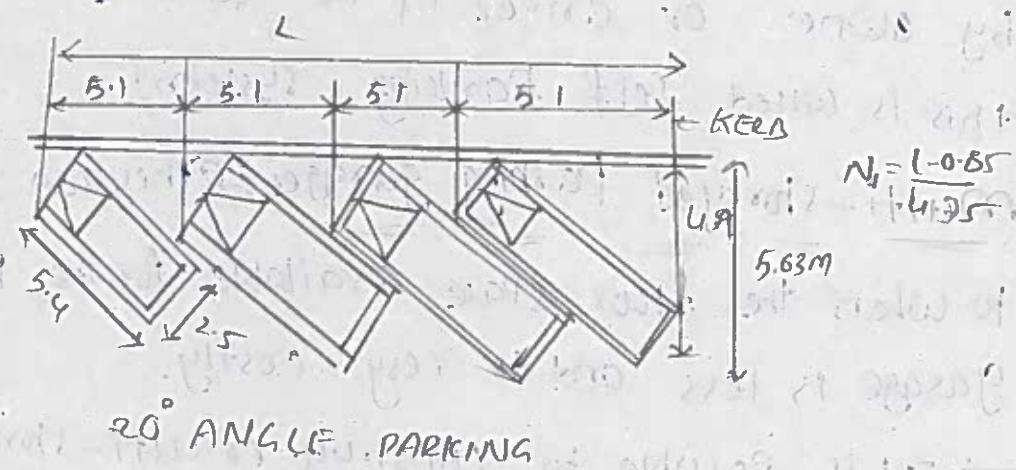
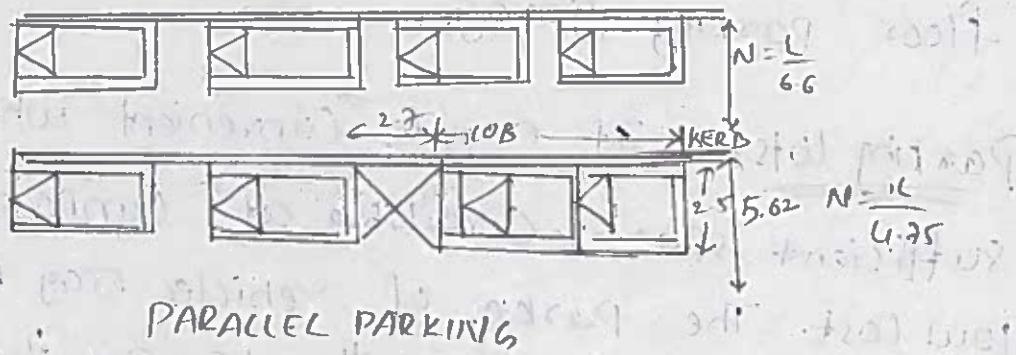
into two types

i) On-street or Kerb parking

ii) Off-street parking

On street or kerb parking

- In this type of parking, vehicles are parked on the kerb which may be designed for parking.
- Kerb parking is quite convenient for those who could find a suitable space to park their vehicles near the place they wish to stop.
- Unless kerb parking facility has been adequately designed in advance while planning a new town, it might lead to a lot of inconvenience and congestion due to decreased road capacity as well as increase in accidents.
- Angle parking or parallel parking may be allowed in the kerb parking.



$N = \text{No. of. Spaces}$
 $L = \text{Curb length}$
 $M_s = \text{manoeuvring space}$

Varieties Patterns of Kerb Parking UNPT-3 Pg-13/20

Off-street Parking

- when parking facility is provided at a separate place away from the kerb, it is known as off-street parking.
- The main advantage of this method is that there is no undue congestion and delay on the road as in Kerb parking.
- But the main draw back is some of the owners will have to walk a greater distance after parking the vehicle.
- Two basic types of off-street parking facilities are surface parking lots and multi-floor parking garages.

Parking lots:- It may be convenient where sufficient space is available at comparatively low cost. The parking of vehicles may be done by owners or drivers of the cars and then this is called self parking system.

multi-storeyed parking garages:- They are restricted to when the floor space available for the parking garage is less and is very costly.

- It is possible to construct multi-storeyed garages to park a large number of cars at a time.
- It is necessary to provide the interfloor travel facility for the vehicles, which may be either by elevators or by ramps.

Introduction to parking studies

Parking is one of the major problem that is created by the increasing road traffic. It is an import of transport development. The availability of less space in urban areas has increased the demand for parking space, especially in areas like Central business district. This affects the mode choice also. This has a great economic impact.

Accident studies

- The problem of accident is very acute in highway transportation due to complex flow pattern of vehicular traffic, presence of mixed traffic along with Pedestrians.
- Traffic accident leads to loss of life and property.
- The most important negative impact of transportation system, namely the accidents. This lecture first presents some introductory stuff including some salient accident statistics, causes of accidents, accident data collection, accident reconstruction, safety measures and safety audit.
- The objective of accident study to study the causes of accidents and suggest corrective measures at potential location.

Road Safety Auditing

- A Road Safety Audit (RSA) is defined as "the formal safety performance examination of an existing or future road or intersection by an independent multidisciplinary team."
- It Qualitatively estimates and reports on Potential road safety issues and identifies opportunities for improvements in safety for all road users.
- Road Safety audits differ from Conventional traffic Safety Studies in two key ways; road safety audits are often pro-active investigations, rather than reactive investigations of sites with histories of complaints or poor safety performance.

Introduction to Street lighting

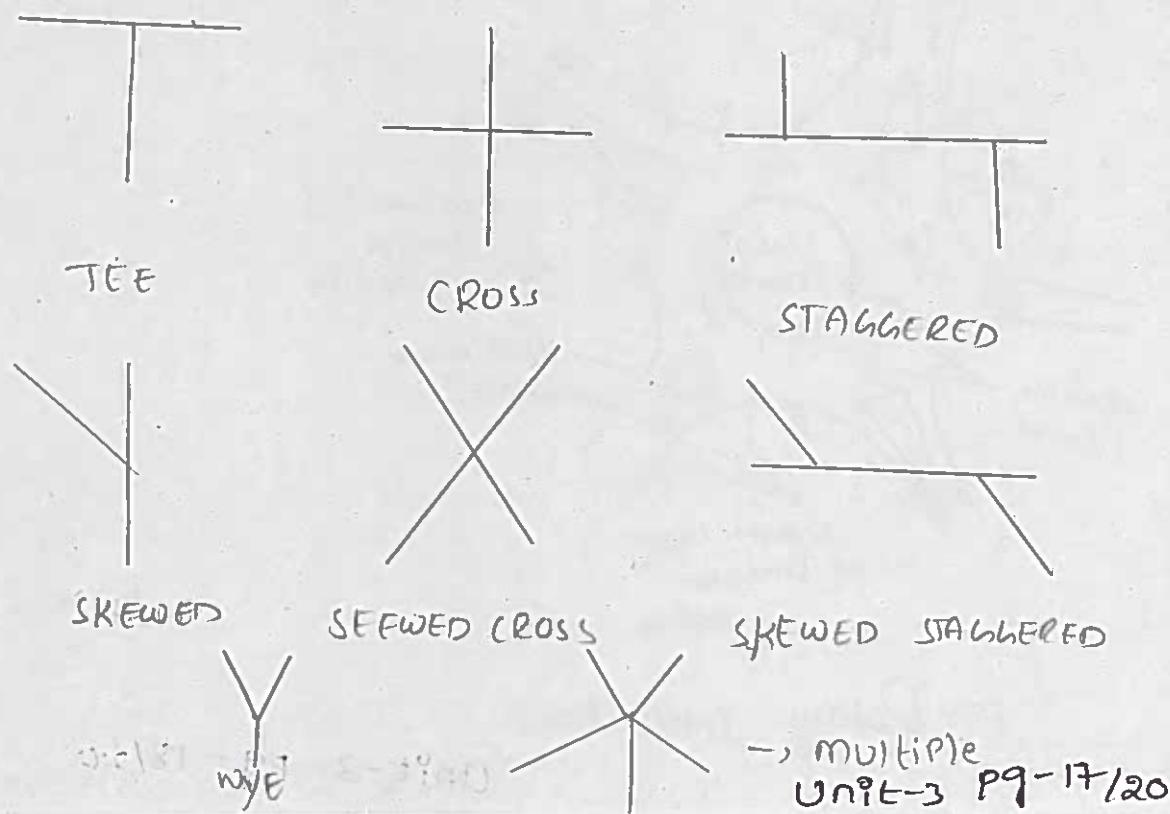
- In the old days when there was not much of fast moving traffic on the street in towns and cities, the ordinary oil lamps on the road side were more than sufficient for the Pedestrians moving at 3.5 km/hr and the slow moving traffic such as the horse-drawn vehicles.
- When the fast moving traffic on the streets and highways these days, not only the dusk and darkness increased the hazards of travel for both pedestrians and automobiles owing to impaired vision, but studies have shown that the fatalities attributable to this impaired visibility total to about 10,000 per year in the normal times over the above those that would be suffered.

Road Intersections

- Road intersection is where two or more road meet and/or are the points of potential vehicle conflict. They are critical element of a road section.
- They are normally a major bottleneck to smooth flow of traffic and a major accident spot.
- The general principles of design in both rural and urban areas are the same.
- The dangers to pedestrians and riders of two-wheeled vehicles are also great at intersections.

Design-considerations of at-grade intersections

- All road intersections which meet at about the same level allowing traffic manoeuvres like merging, diverging, crossing and weaving are called intersections at grade.
- These intersections may be further classified as unchannelized, channelized and rotary intersections.
- The forms of intersections are:



- There are 3 types of intersections
- 1) Unchannelized intersections
 - 2) Channelized intersections
 - 3) Rotary intersection.

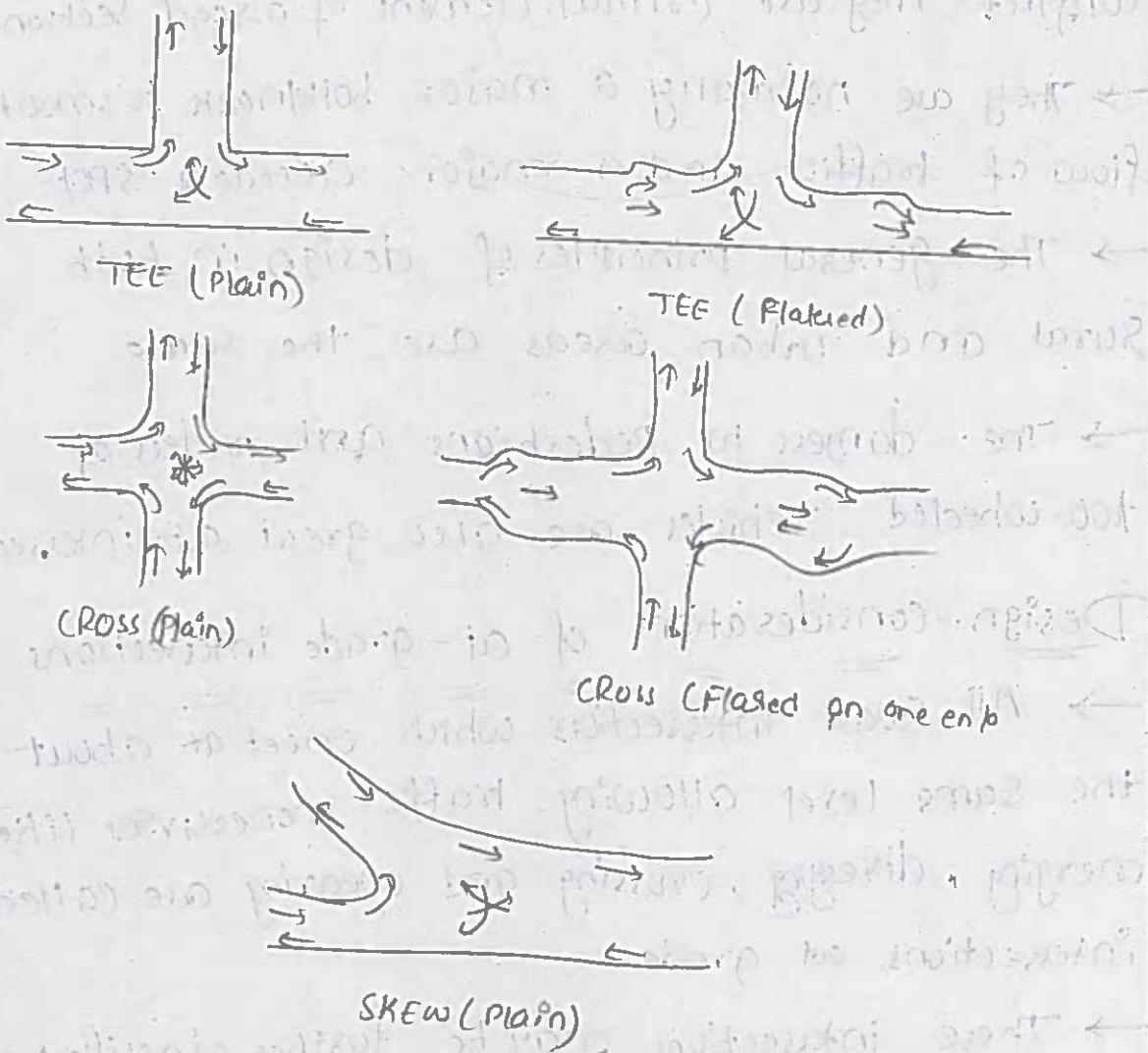


Fig Unchannelized Intersections.

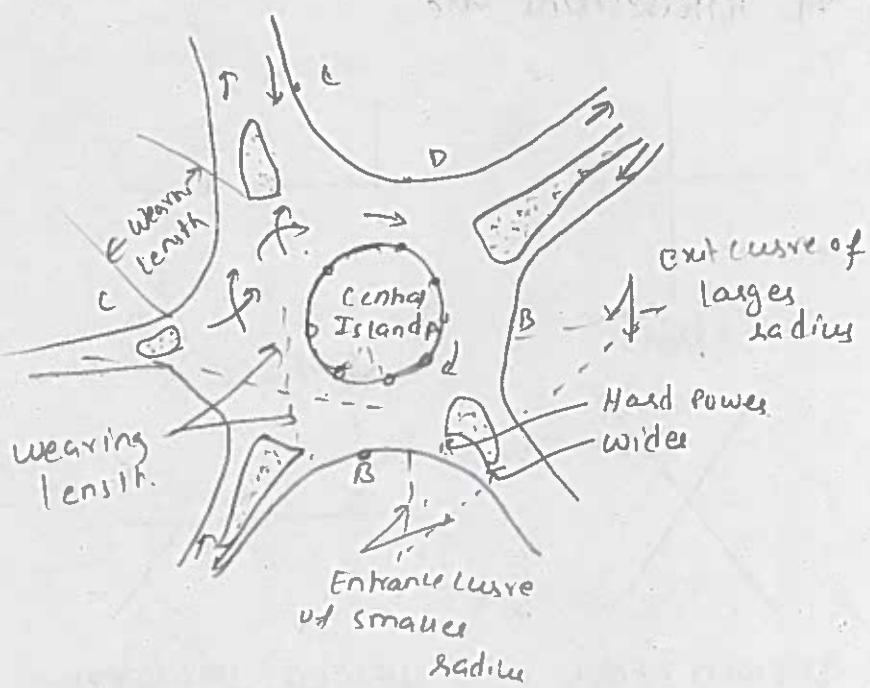


Fig Rotary Intersections.

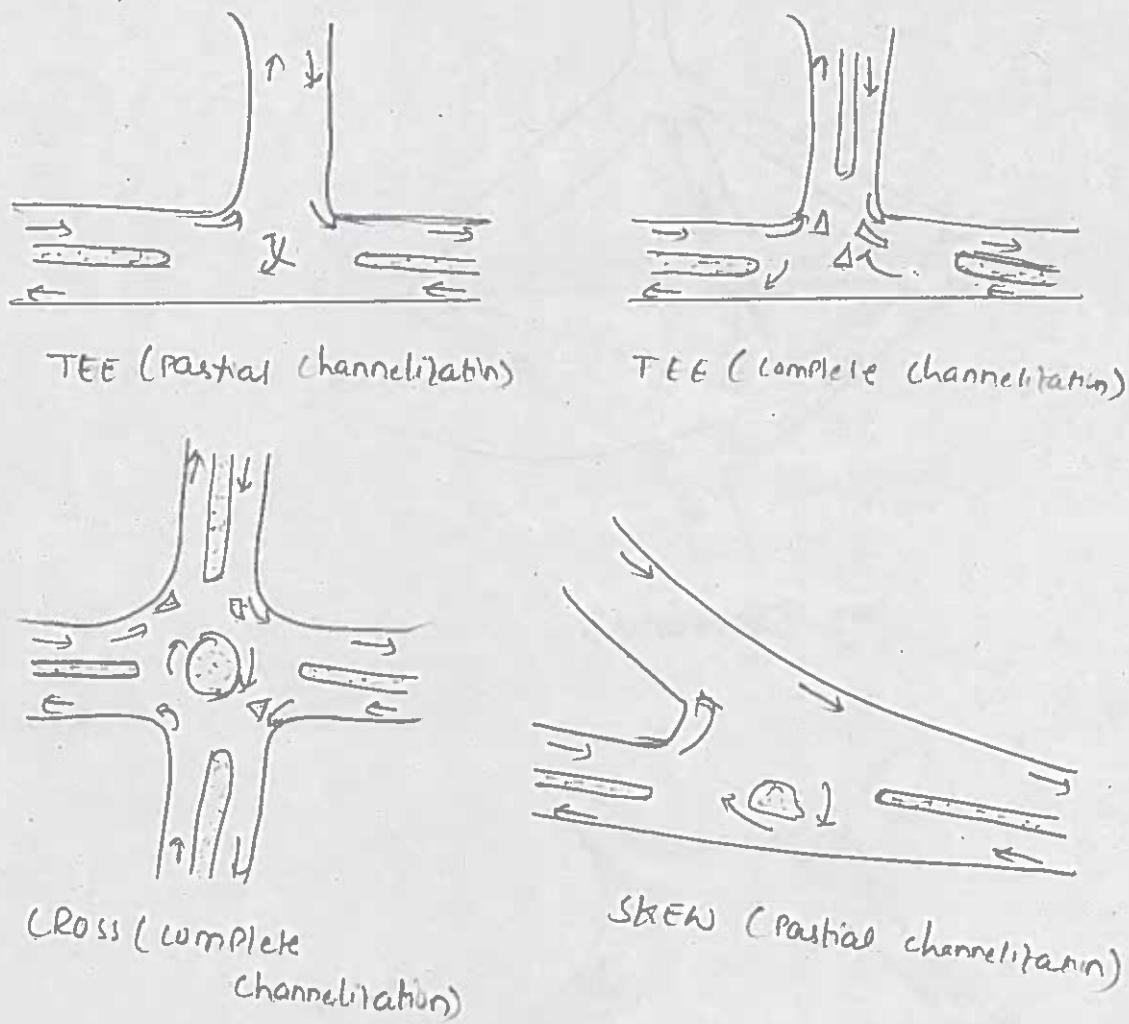


Fig. Channelized Intersection.

Introduction to Interchanges

- Grade Separated intersection with complete interchange facilities is essential to develop a highway with full control of access.
- When there is intolerable congestion and accidents at the intersection of two highway carrying very heavy traffic there is no better solution than to provide grade separated intersection.
- Of all these complete clover leaf fulfills all the requirements of turning traffic involving the simplest traffic maneuvers, viz., diverting to the left and merging from the left by providing four indirect ramps.

Fig. TYPES of INTERCHANGES

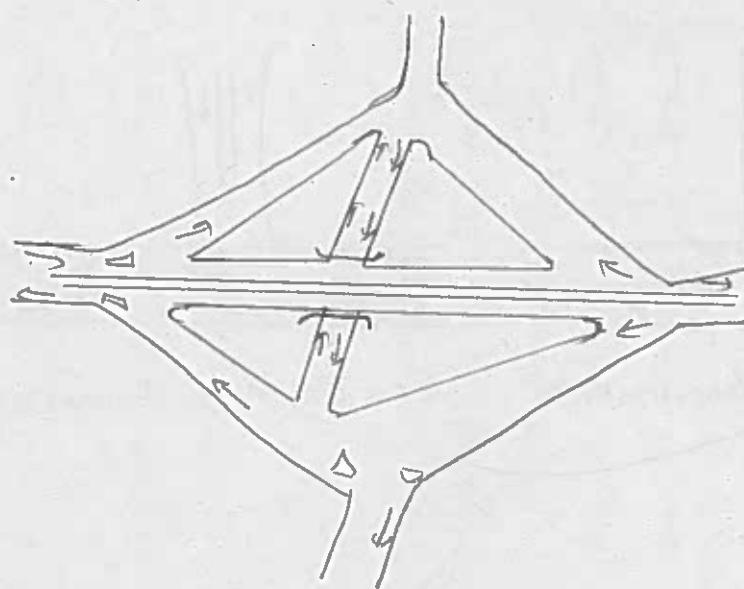
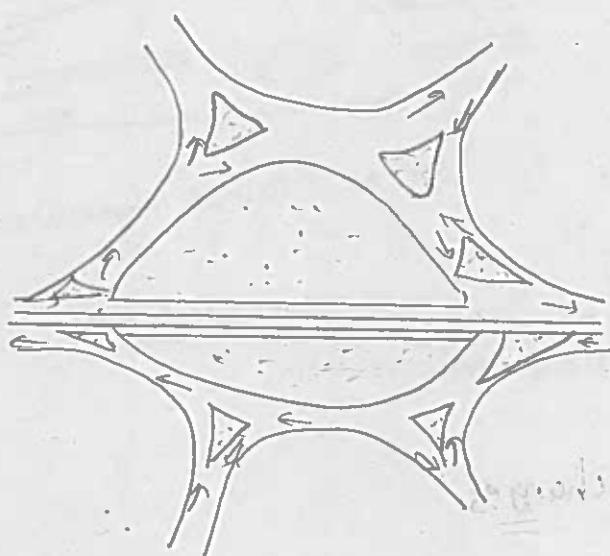


Fig. Diamond .



(b) "Rotary" Interchanges

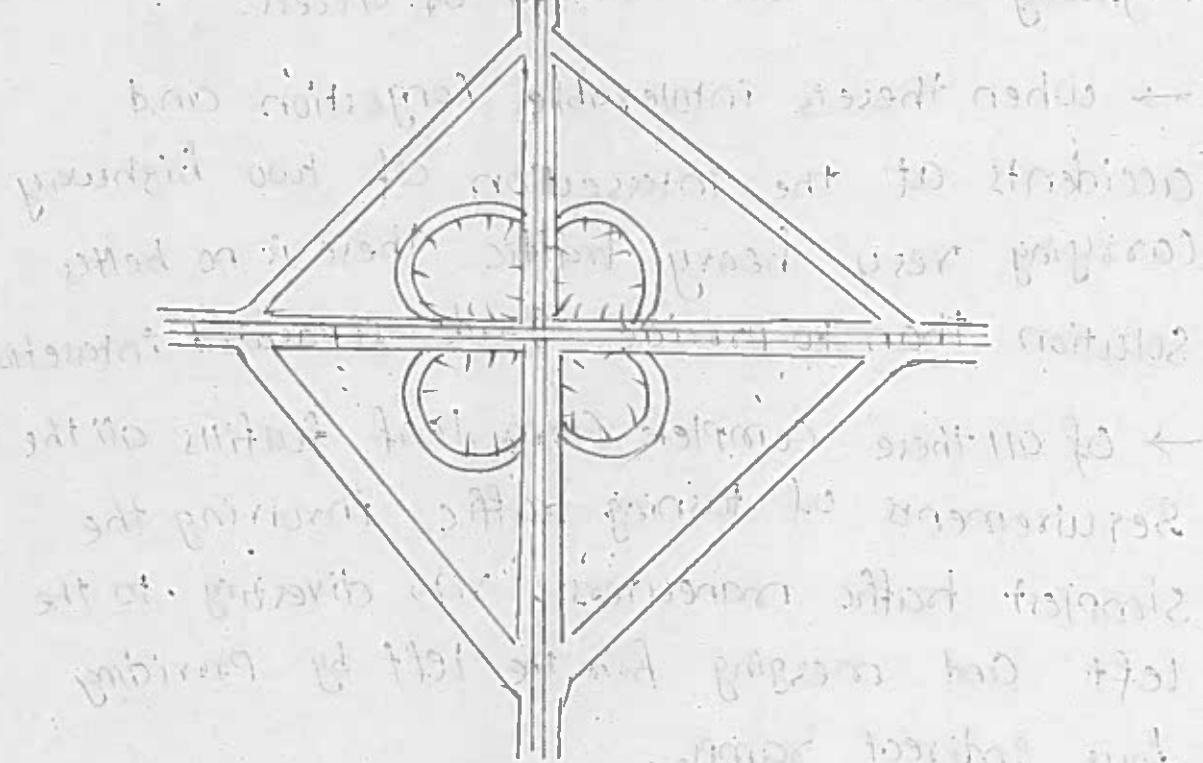


Fig Full covered leaf