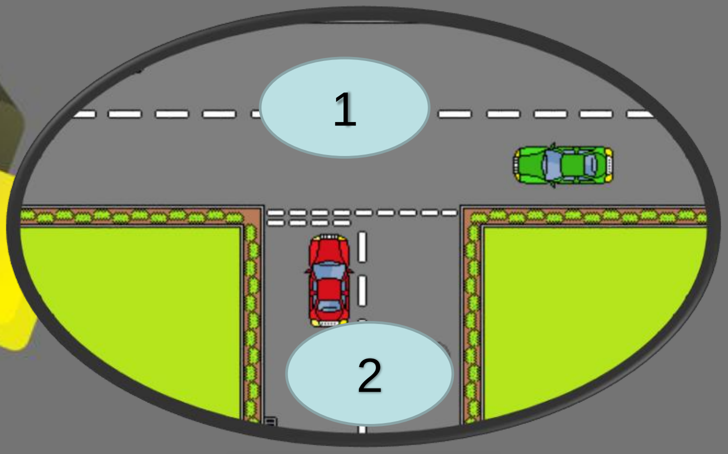
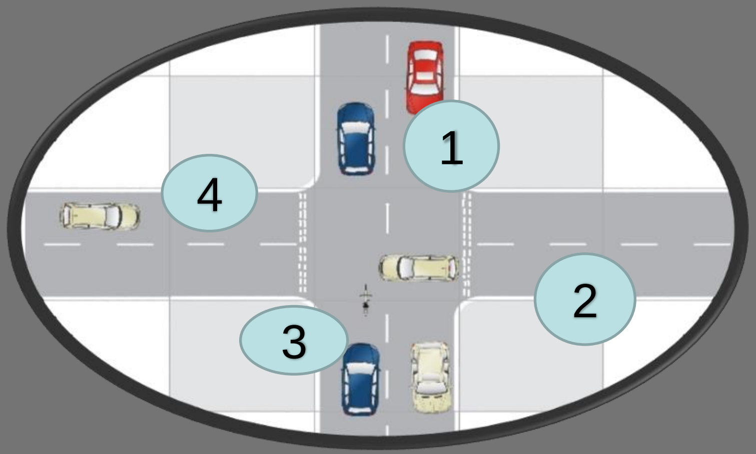
DEFINITION

Junctions or intersections refer to the land area where Two or more highways/roads





Either meet or intersect with or cross each other. (either at grade or separated grade)

Factors That Affect Junction Load

The physical characteristics of the road.

For example, road width , number of lanes crossing type, road surface, alignment of road, etc.

Composition of traffic and the capacity of the vehicle.

Examples: total of heavy vehicles, the type of vehicle .

Environmental conditions .

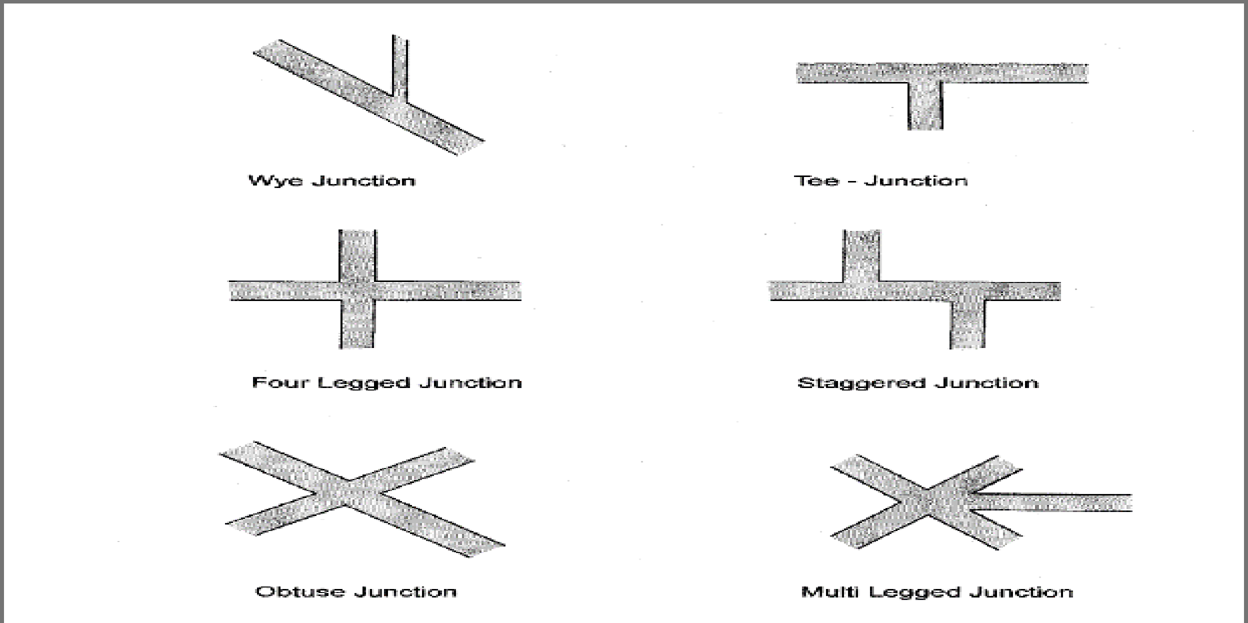
For example, weather , impaired pedestrian and parking , the physical characteristics of the driver and others .

8.2.2 Types of junction

- Grade Junction
- Interchange

Grade Junction

- When two road meet or cross at the same elevation, at-grade junctions are created.
- These junctions come in a variety of configuration and varying levels of complexities. Nevertheless, all junctions evolve from six basic shapes
- Figures below show basic shapes of at – grade junctions



- There are many varying junction types, in detail, but they can be categorized into six basic types.

1. Uncontrolled non-priority junctions.
2. Priority junctions.
3. Priority junctions with traffic islands.
4. Roundabouts.
5. Traffic signals.

Interchange/Grade separation

- Grade separated intersection or interchange is characterized by the absence of crossing conflicts since traffic streams cross each other at different elevations and hence provides the highest level of traffic safety at junctions.
- The basic elements of an interchange are shown in figure .

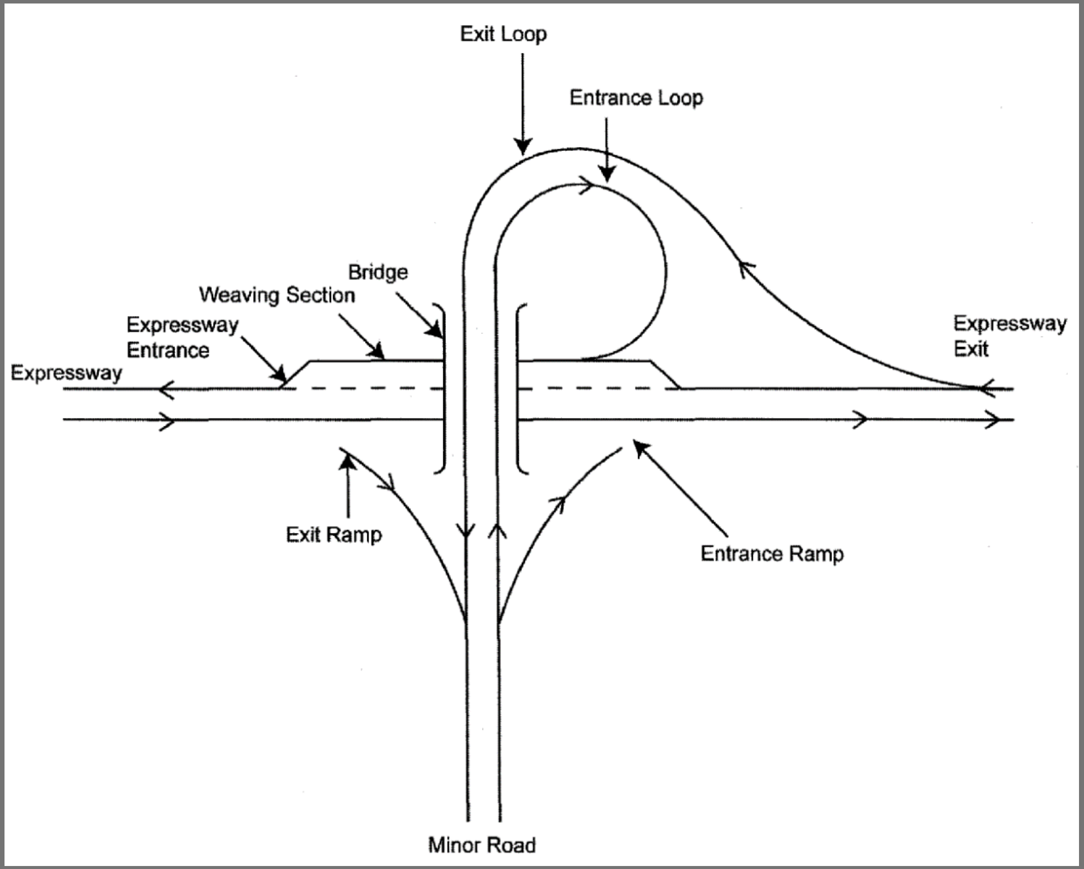


Figure : Basic elements in an interchange.

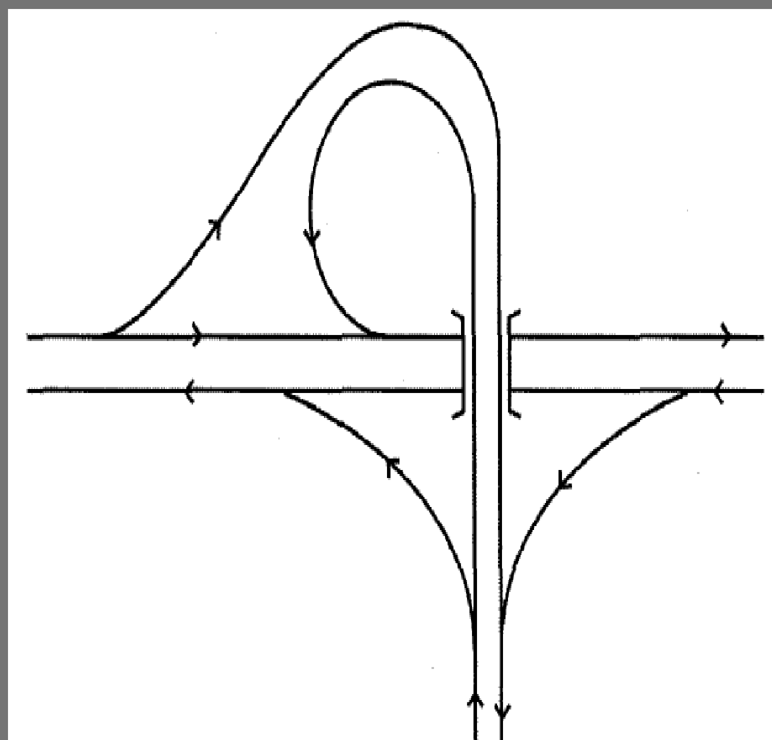
- Grade separated intersections are primarily built to satisfy the requirements of full access control especially on expressways. Traffic delay is virtually eliminated except when the interchange itself has reached capacity.

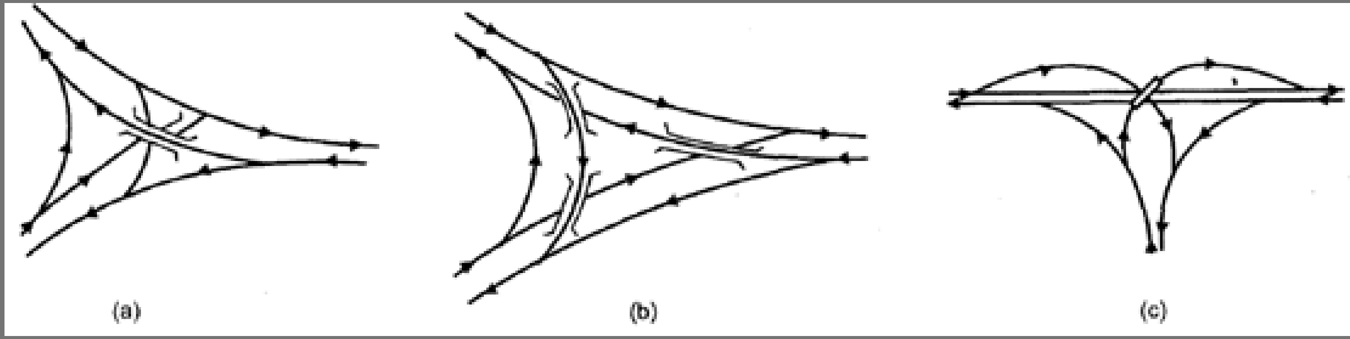
- Vehicles merge and diverge on speed change lanes. Despite it’s high capacity and excellent traffic safety records, they are expensive to build, take up huge land space and require physical structures such as bridge, ramps and embankments.

- Their layout can be confusing to motorists unless backed up with adequate road signage. A complete guide on the fundamentals and design of interchanges is available in a JKR publication (JKR 1987).

- In general, the basic interchange type and forms can be categorized into the followings :

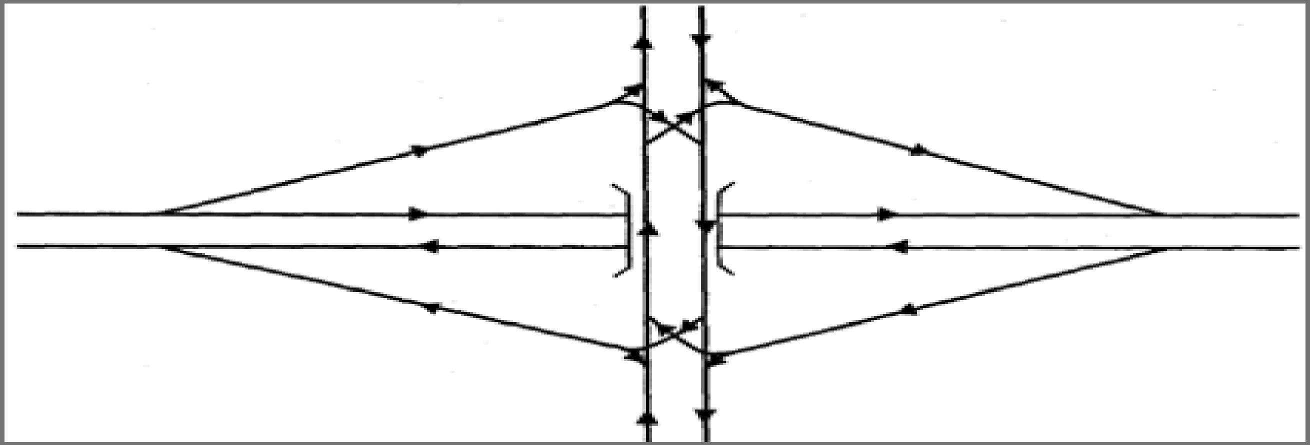
(a) Trumpet or Tee-interchange

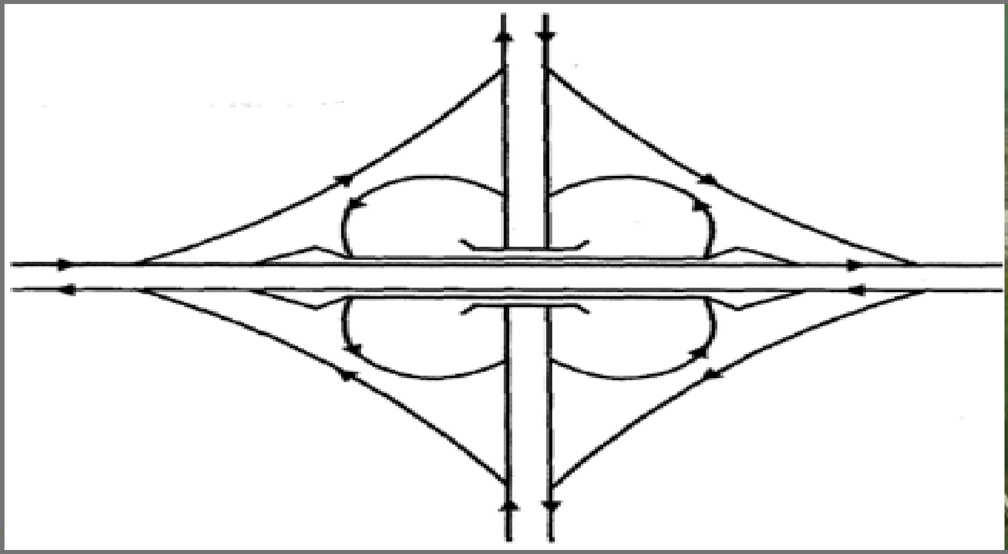




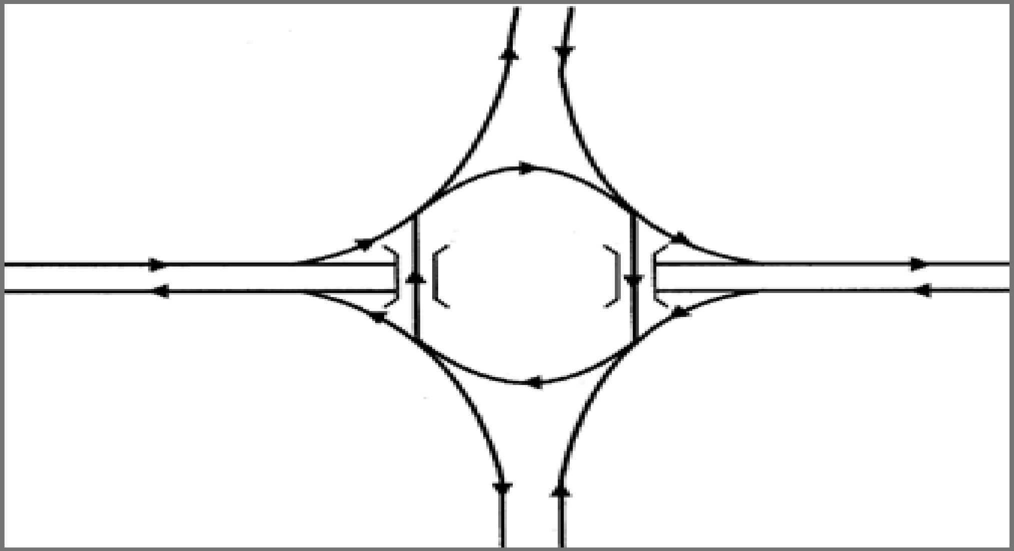
Directional Interchange

(a) 4-legged interchange / Diamond interchange



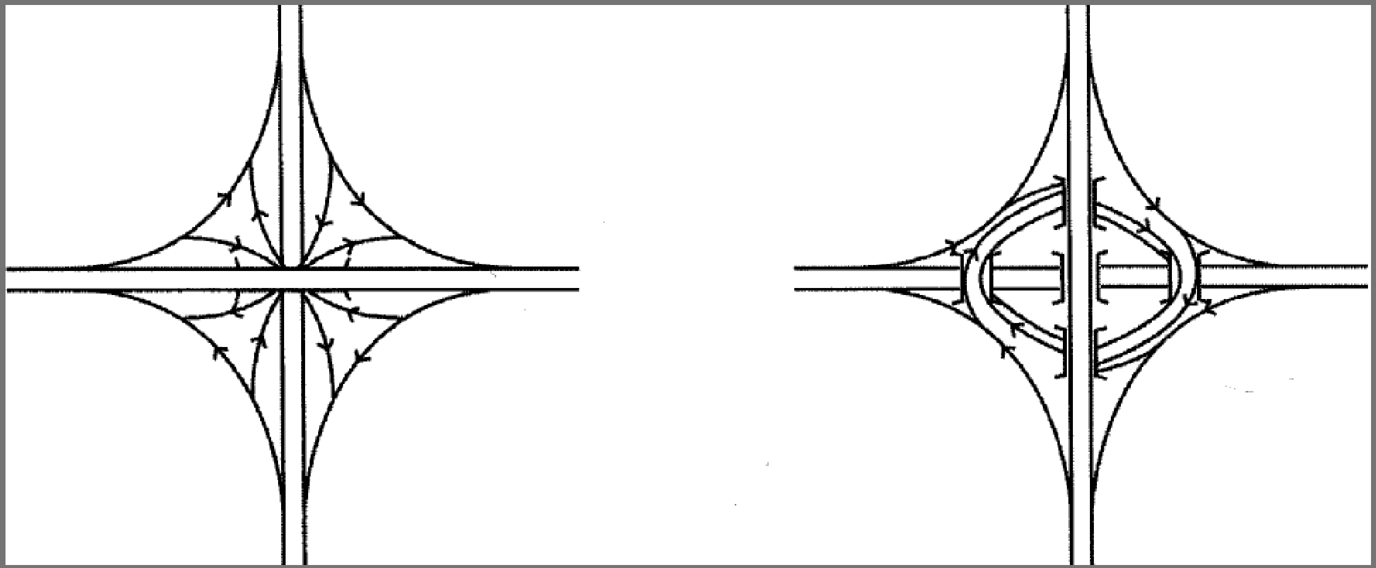


Cloverleaf interchange.



Directional interchange

(c) Multi-legged Interchange:



Rotary interchange

Selection Factors of Junction Types

i. **Volume, composition and speed** of traffic in each stream

ii. **Hierarchy of roads** that intersect with each other

iii. **Clarity of vision** in different **weather condition**

iv. Type and rate of control of **traffic entering**

v. Area and the cost of **land use**

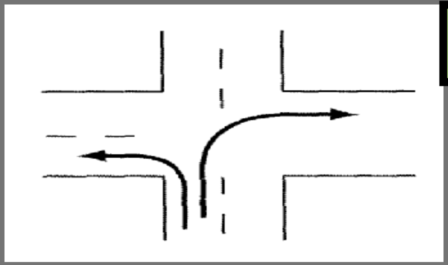
vi. Total **conflict** at intersection

vii. Construction and maintenance **cost**

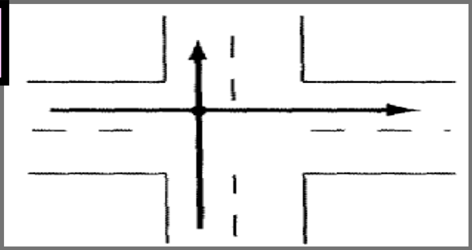
viii. **Accident data** (to be used for intersection's planning)

TYPES OF MOVEMENT AT A JUNCTION

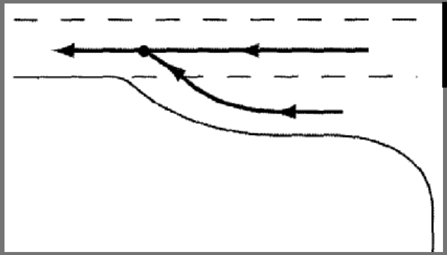
TURNING



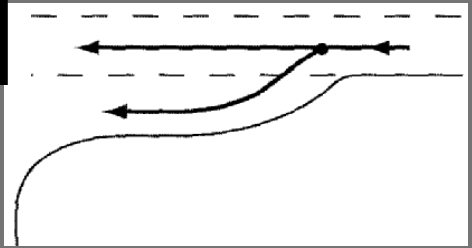
CROSSING



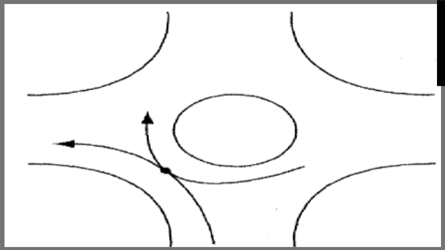
MERGING



DIVERGING

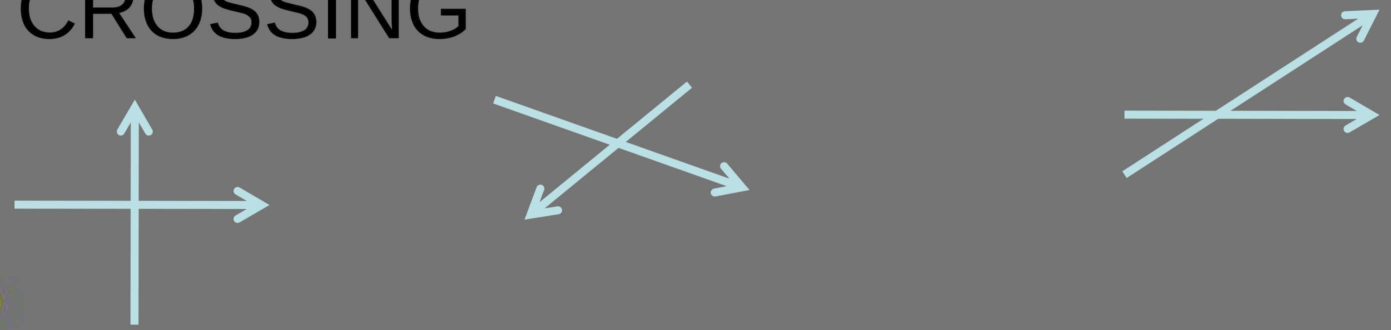


WEAVING

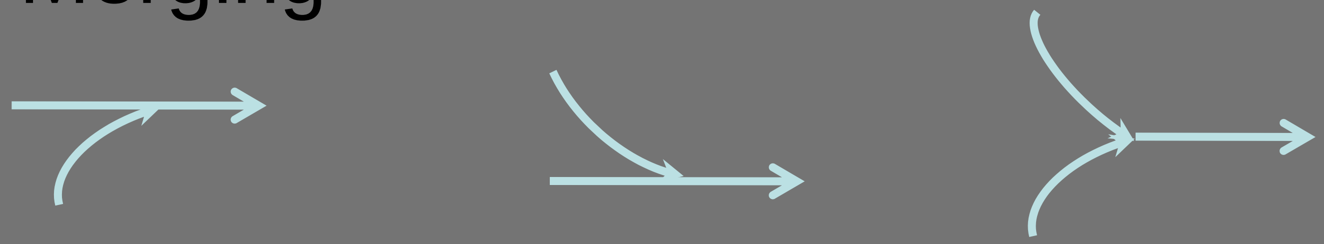


TYPE OF MOVEMENT

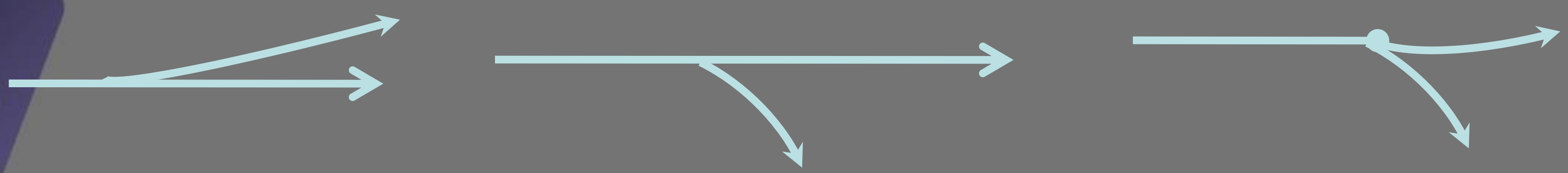
- CROSSING



- Merging



- Diverging



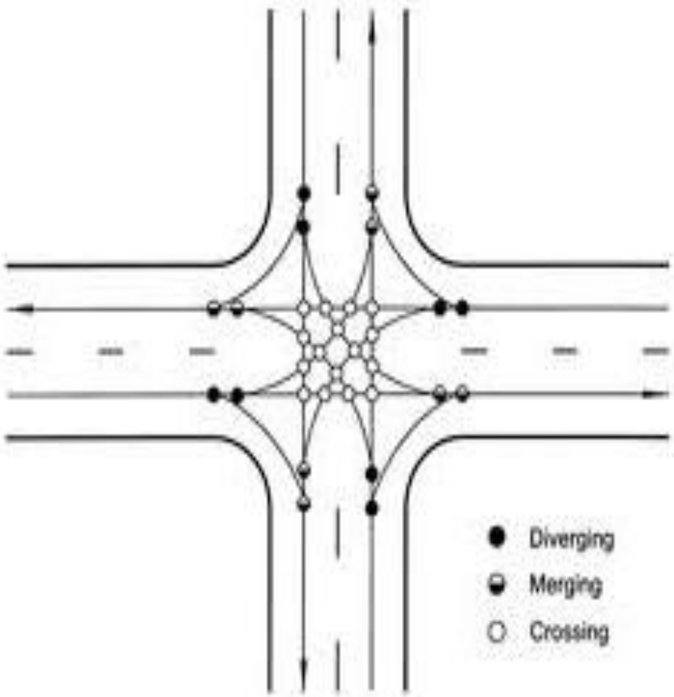
Conflict point and the conflict area at the junction

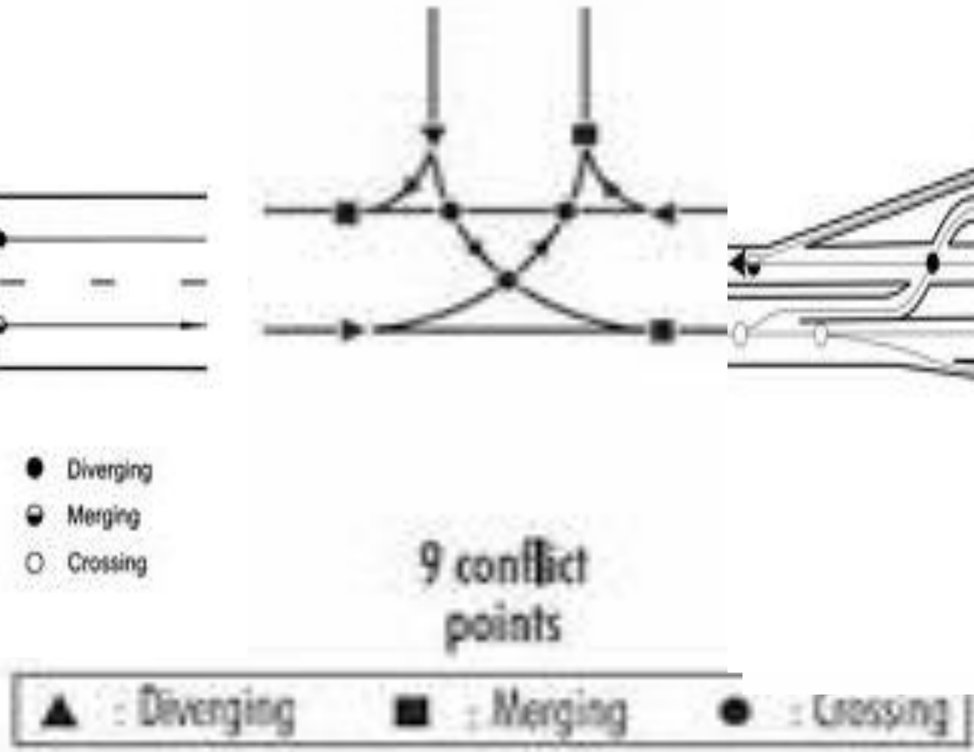
Conflict is a possibility of a collision between vehicles.

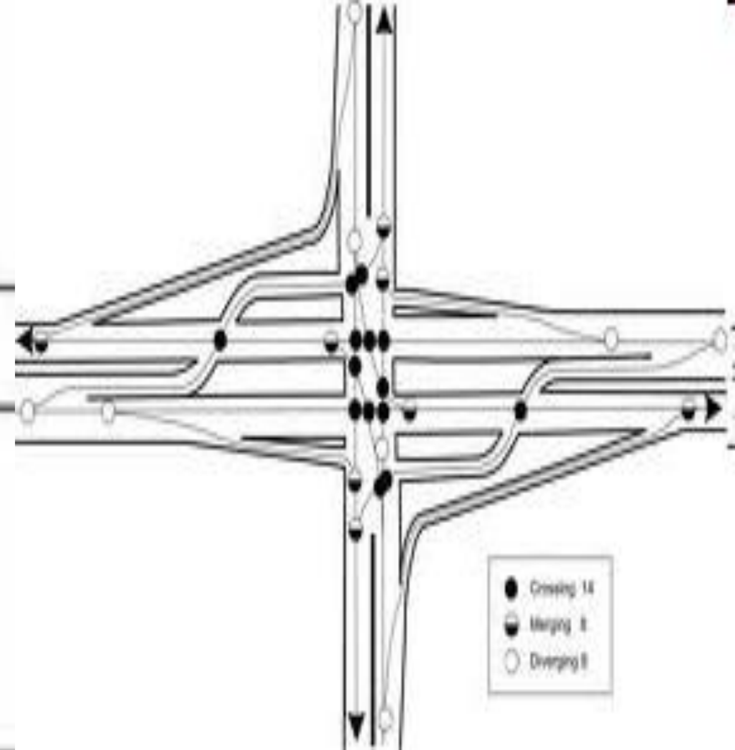
Conflicts in an intersection is dependent on the movement of traffic and vehicle speed.

The combination of movements (movements merge, split/diverging and crossing) this creates confusing at the intersection of movement and lead to conflicts following:

1) Merging conflicts
2) Split/diverging conflict
3) Cross Conflict
4) The conflict of the above merge conflict







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CONFLICT POINT & CONFLICT AREA AT INTERSECTION

NO.OF BRANCH	CROSSING CONFLICT	MERGING CONFLICT	DIVERGING CONFLICT	NO.OF CONFLICT
3	3	3	3	9
4	16	8	8	32
5	49	15	15	79
6	124	24	24	172

8.3 Concept Of Conflict in Reducing The Conflict At The Junction

- Potential conflicts of intersection depends on:

  i. The approach road crossing

  ii. The lanes behind the stop line

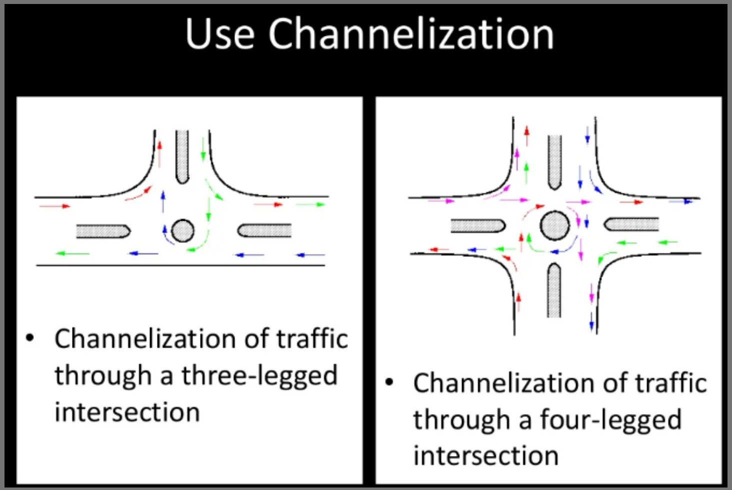
  iii. type of traffic control

  iv. channelling rate

  v. traffic movement allowed

Reducing The Conflict At The Junction

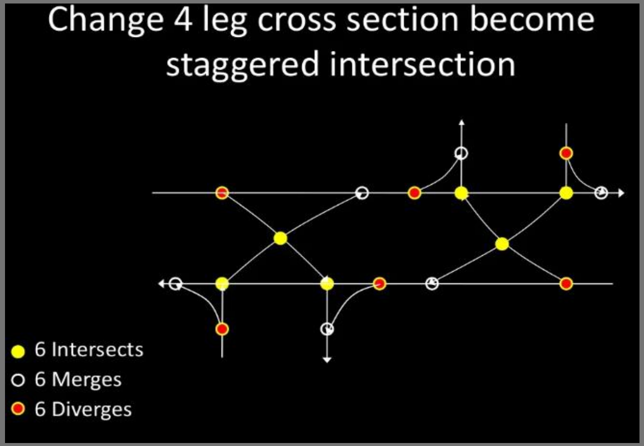
- Conflicts can also be minimized by using channelized. In the roundabout , avoid direct conflict with channel vehicle in certain lanes and enforce the rules GIVE RIGHT OF WAY TO THE VEHICLE.



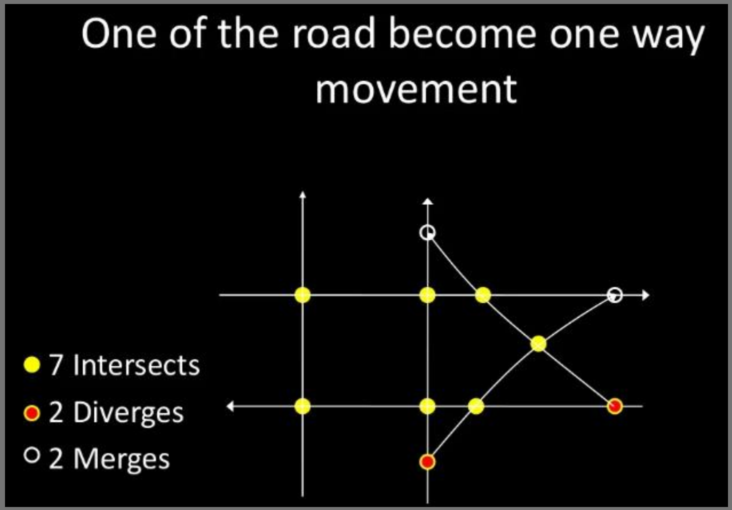
- At signalized intersections, conflicts are minimized through appropriate arrangement of phase.

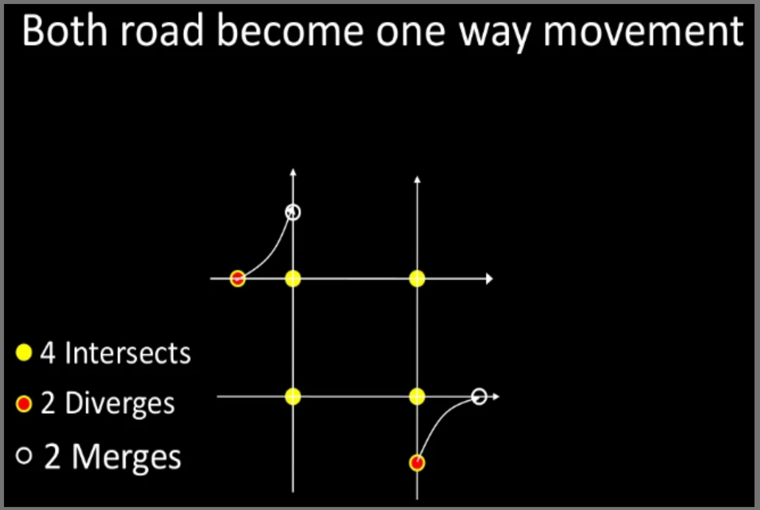
Reducing The Conflict At The Junction

- Converts crosses the intersection of four to staggered intersection.



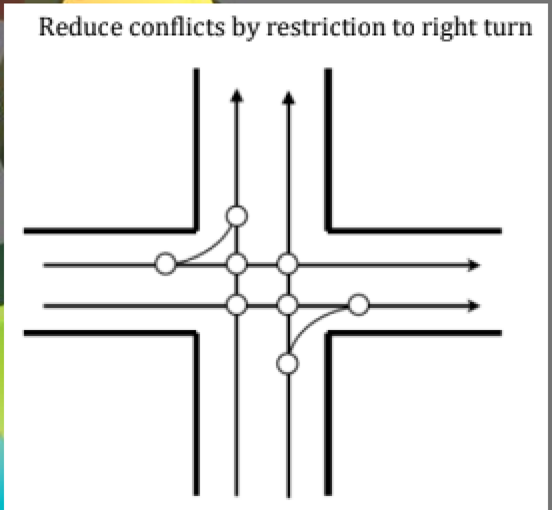
- Change the road to one-way movement.





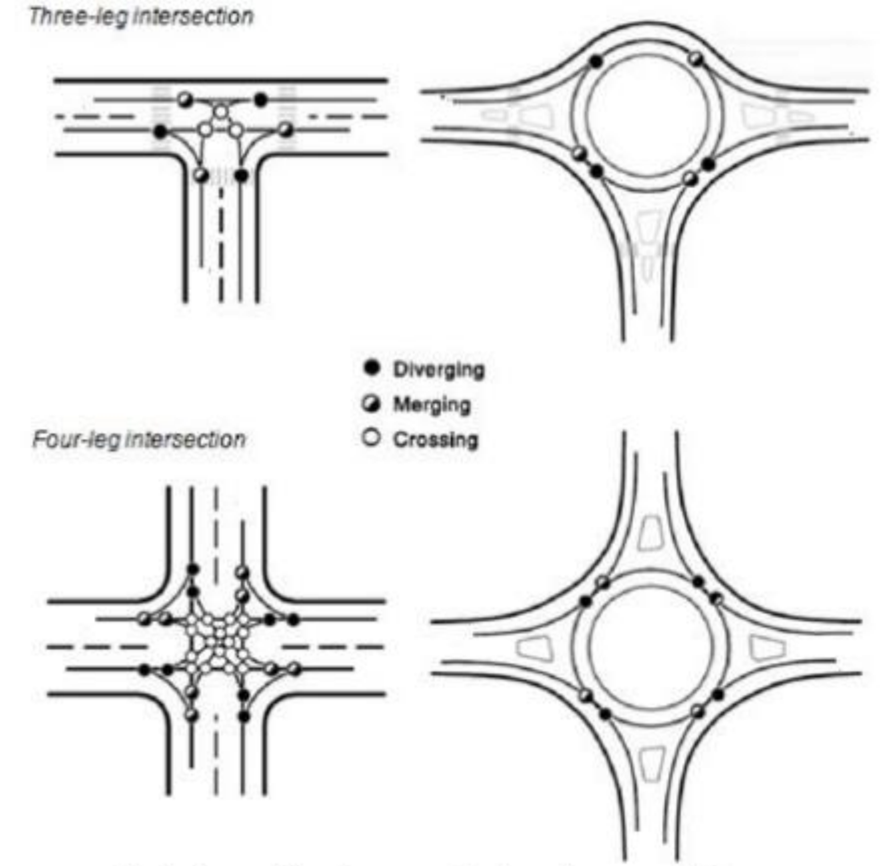
Reducing The Conflict At The Junction

The number of conflicts that so many very dangerous, but can be reduced by means of traffic management, such as:



- No right turn - Do not allowed vehicles to turn to the right direction of a road (when crossing the junction). left turns are high risk movements on a level junction.
- Minor road traffic makes a right turn followed by a U-turn at a designated location—either signalized or unsignalized—to continue in the desired direction.

i. A common method of controlling conflict is through priority control by directing vehicles on the road STOP or GIVE WAY to traffic on major roads.



Reducing conflicts by converting junction to roundabout

- If a large volume of vehicles on the roads is very high, as a great delay Promoting techniques to reduce conflict by providing a roundabout and traffic lights.

all mechanical or electrical–controlled devices used to control, direct, or warn drivers or pedestrians

Main function of an installation of a traffic light/signal at an intersection is to provide right–of–way to vehicles on each approach to increase traffic handling performance – i.e., for efficient traffic movement, safety, reduced traffic conflict points, reduced traffic delay, etc.

Traffic Light Design & Phases

Traffic light types

- Pre time/ Fixed Time Signal
- Vehicle Actuated Signal

The method of determining the period

- Sequences
- Phases
- Factors that should be considered to determine the time period .

Phases

- Time cycle 2 phases
- Time cycle 3 phases
- Time cycle 4 phases

TRAFFIC LIGHT TYPES

Fixed Time Signal Features:

The electronic control circuits provide a repetitive cycle and split (cycle division among the conflicting movements) timing

The timing is repeated over and over regardless of the presence or absence of traffic demand.

Optimum cycle time, Co = (1.5L + 5)/(1- y).Minimum cycle time of 25 seconds, maximum 120 seconds

Vehicle Actuated Signal Features

The timing is varied for some or all controlled conflicting movements dependent upon vehicular and/or pedestrian demand

Demand is determined from detectors placed in or near the roadway of pedestrian crossing

Delay is minimized, especially during non-peak

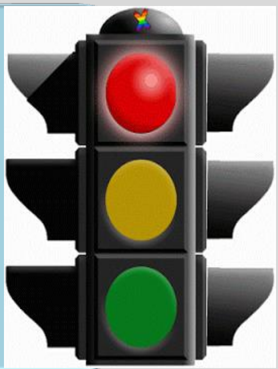
Junction capacity can be increased because the arm junction that has a number of high traffic demand will be given the green time is longer.

Effective use of the crossing which required more than two phases

THE METHOD OF DETERMINING THE PERIOD

Sequences

- The sequence or sequences common in Malaysia

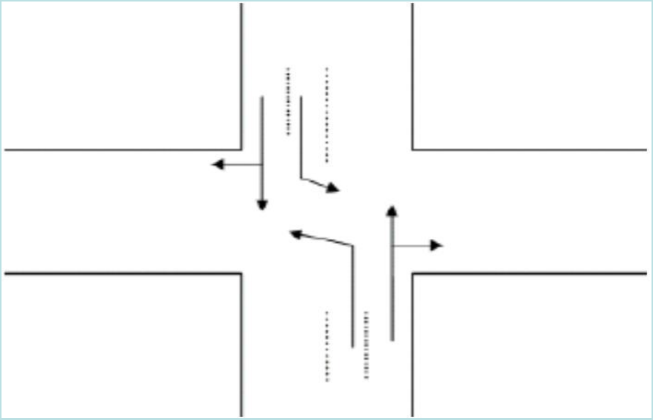


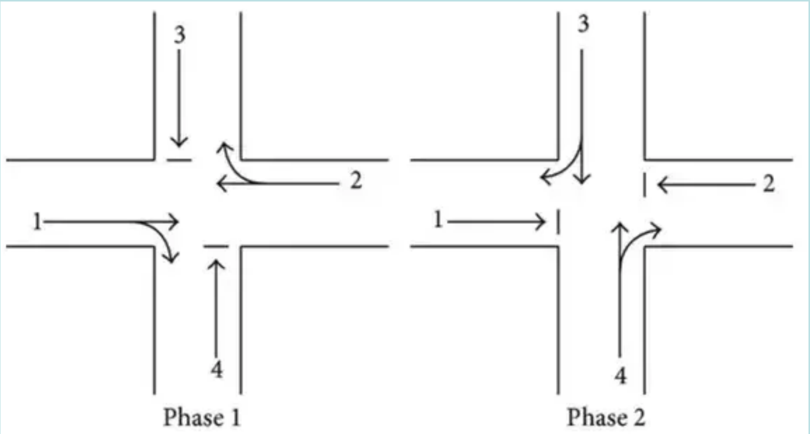
Phase

- Methods of controlling traffic through the traffic lights at the time of separation can avoiding traffic conflicts.
- Separation of conflicting traffic flow in accordance with the specified time is known as a phase.
- Phase traffic is part of the cycle time allocated to one or more eligible traffic flow through the intersection.

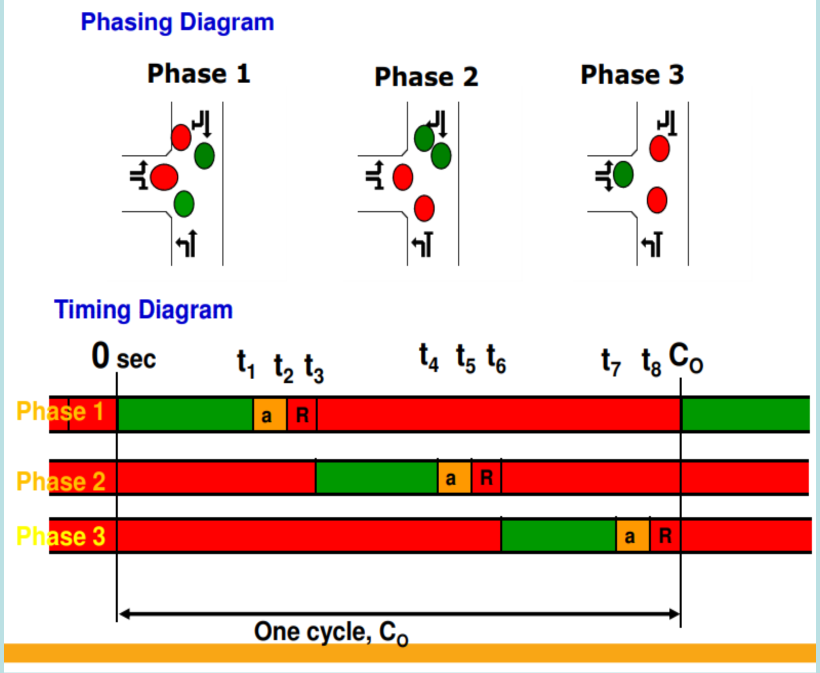
PHASES

Time cycle 2 phases

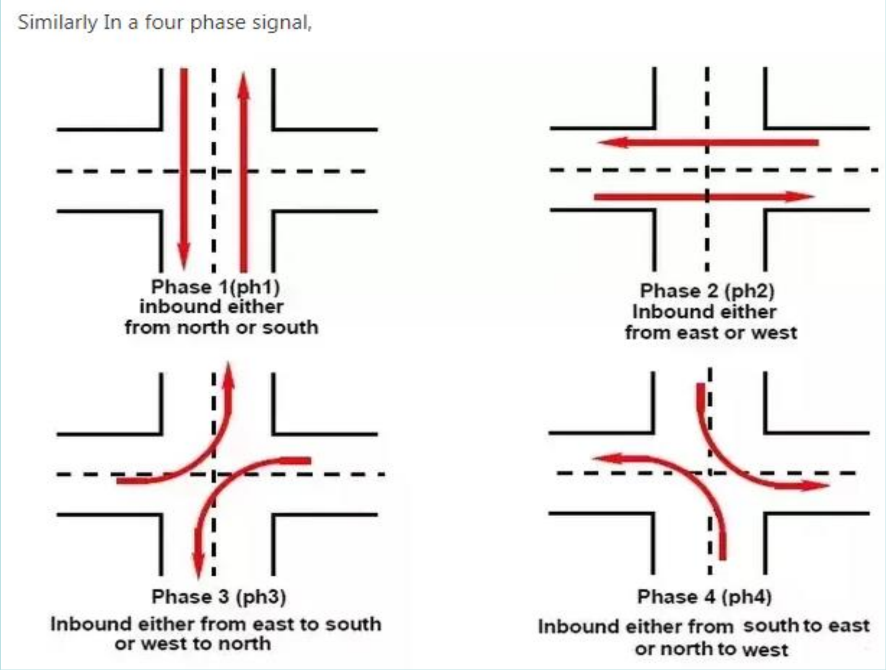




Time cycle 3 phases



Time cycle 4 phases



Factors that should be considered to determine the time period

1. The composition of traffic

- Because of the various sizes of vehicles using the crossing, then it must be synchronized with the passenger vehicle unit (PCU-passenger car units).

  The table shows the various types of vehicles Coefficient Factors Relative to Vehicle Passengers

Vehicles Type	**Coefficient Factors (pcu)**
1 Motorcycle	0.33
1 Car	1.00
1 Heavy Vehicle	1.75
1 Light Vehicle	2.00
1 Bus and lorry	2.25
1 Bicycle	0.22

2. Saturated Flow (S)

- Saturated flow is the maximum number of vehicles that can cross the stop line without breaking the driveway intersection during a green signal to continue. Saturated flow unit is a passenger vehicles per hour (pcu / hour).
- **For saturated flow value (S)**
  - **When the road width (w) > 5.5 m, S = 525 W**
  - **When the road width (w) < 5.5 m, refer table below**

Schedule determine Saturated Flow, S

Road width (m)	3.00	3.50	4.00	4.50	5.00	5.50
Saturated Flow ,S (pcu/hr)	1850	1875	1975	2175	2550	2900

3. Interchange Rates (Y)

- To get the intersection utilization rate (Y), the flow rate versus saturated flow in a phase (y) shall be calculated first.

- **$y = q / S$**,

where,

y = the flow rate versus saturated flow

q = actual flow of traffic (pcu / hr)

S = Saturated Flow (pcu / hr)

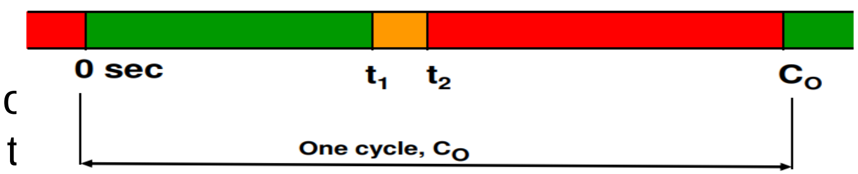
- Y value for a given phase is a the largest y_{max} than any branch in that phase. Therefore,

Value Y = ymax phase A + B + ymax phase ... .. <0.85 (ok)

Definitions

- Optimum cycle time (Co) – the total time for the signal to complete one sequence of signal indication cycle; eg: start of green indication to the end of the red indication.

$$Co\ (sec) = \frac{1.5L + 5}{1 - Y}$$



Where; Y = maximum value of the ratic r all lane groups using phase L = total lost t

- Lost time (ℓ) – time during which the intersection is not effectively used by any movement; this time occurs during the change interval and at the beginning of each phase.

WHERE:

$$L = \sum_{i=1}^{n}(I - a) + \sum_{i=1}^{n} l \quad \text{and} \quad Y = \sum_{i=1}^{n} y_i$$

- Intergreen (I) – the time between the end of a green indication for one phase and the beginning of a green indication for another. An amber indication shown through the intergreen period followed by red (consists of both the yellow (amber) indication and the all-red indication)

.

- Effective green time (g_N) - the length of time that would be required to get a given discharge rate over the stop line if the flow commenced and finished simultaneously and instantaneously on the change of colour as displayed on the signal head.

Actual green time = Effective green time - amber time + lost time

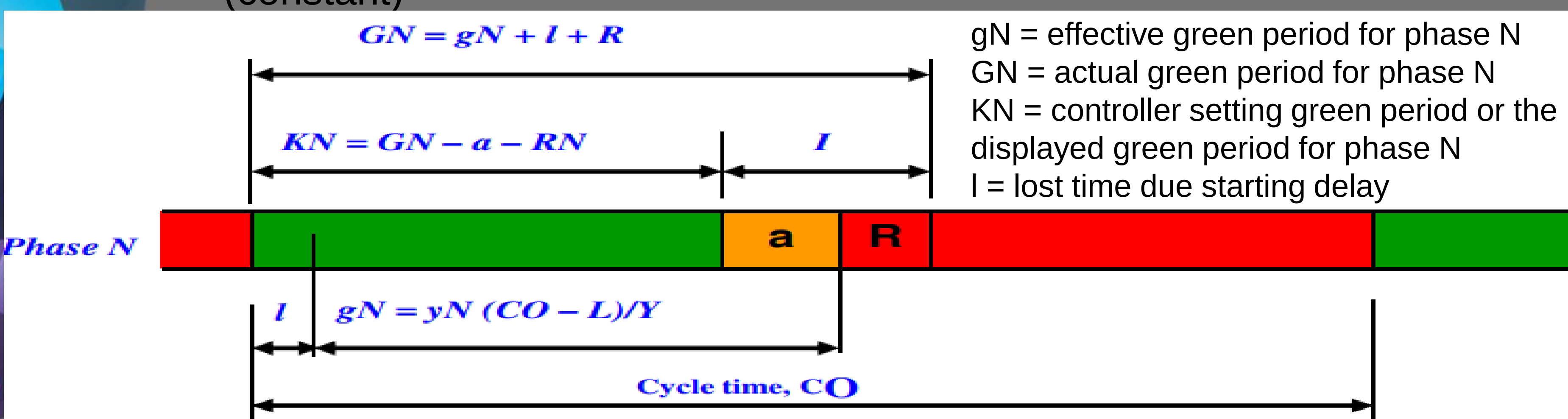
Actual green time = Effective green time - 3 s. + 2s.

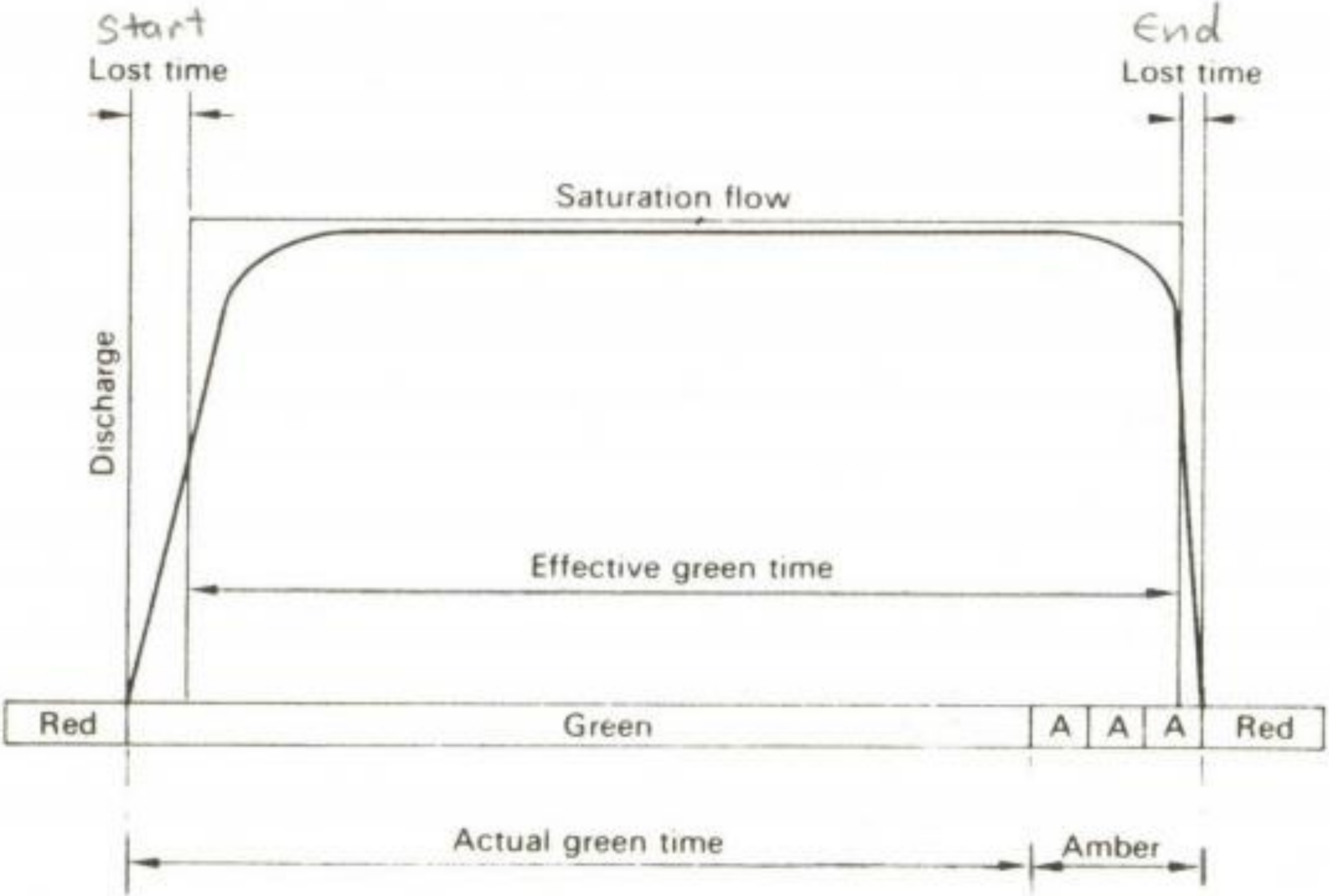
- Actual Green (G_N) - actual number of vehicle through = k + a = g + l k = actual green time a = amber time g = effective green time l = lost time

G_{fasa} = (y Critical/Y) X G

- Green time (K_N) - the time within a given phase during which the green indications is shown

- Interval – a period of time during which all signal indications do not change (constant)





Start
Lost time
End
Lost time
Saturation flow
Discharge
Effective green time
Red
Green
A
A
A
Red
Actual green time
Amber

8.2.1 Describe term of traffic light circulation phase design

2. Actual Green Time (g_{fasa})

- Actual green time is allocated in phases based on the critical flow ratio of each of 'y'
- Effective green time of each phase is given by

  G_{fasa} = (y Critical/Y) X G
- Actual green time for the phase is regarding to

  $g_{fasa} = G_{fasa} + (\ell - k)$
- When actual green time of each phase was determined the time division green, yellow and a red time for each phase can be shown in time diagram.

3. Effective Green Time (G)

- This is the time available for moving traffic, taking into account the time that was stolen from the yellow time and lost time to start moving. The value of effective green time can be obtained by, G for each round is

  G = Co - L

4. Red Time (r).

Time signal is indicated by the traffic light make a movement to stop the vehicle.

5. Amber/Yellow Time (k).

Yellow is the time allocated to vehicle acquire traffic light for drivers to be prepared to stop or start the movement of the vehicle. Usually the yellow time is 3 seconds.

6. 7. Interval Green Time (I)

This is the time between the end of the green in one phase and the start of the green in the next phase. Usually the minimum green time is between 5 seconds or 4 seconds if using modern lighting controller. If there is high pedestrian flow at the intersection, the time between the green can be extended.