INTERSECTION

What Is An Intersection?

- Is an area **shared by two or more roads** whose main **function is to provide for the changes of route direction.**

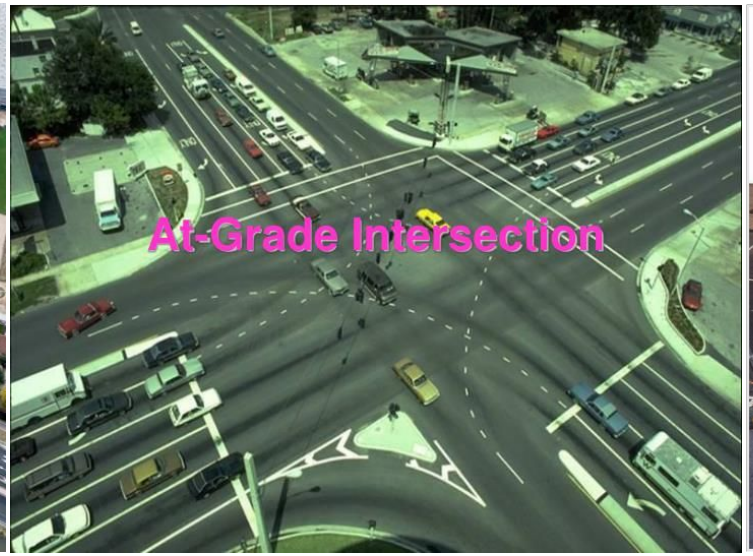
- May be **simple or complex** depending on the no of roads crossing each other.

- **Overall traffic flow on any highway depends to great extent on the performance of intersection** since they operate at lower capacity than through traffic.

INTERSECTION - *Classification*

1. At Grade intersection
2. Grade separated intersection with ramp that is Interchange
3. Grade separated intersection without ramp







INTERSECTION - *Classification*

Grade separated intersection without ramp







INTERSECTION - *Classification*

Grade separated intersection with ramp that is Interchange





Basic Elements to be considered in intersection design

1. **Human factors** (approach speed, user expectancy, decision and reaction times, etc.
2. **Traffic considerations** (appropriate capacity, distribution of vehicle types and turning movements, **approach speeds**, special treatments for **transit vehicles**, pedestrians, and bicycles)
3. **Physical elements** (abutting properties, traffic movements generated by them, intersection angle, existence and location of traffic control devices, sight distances, specific geometric characteristics)
4. **Economic factors** (cost of improvements, effects of improvements on the values of abutting properties, the effect of improvements on energy consumption
5. **Functional intersection area** (operational intersection area including deceleration and acceleration zones as well as queuing areas)

Objectives of Intersection Design

Main objective:

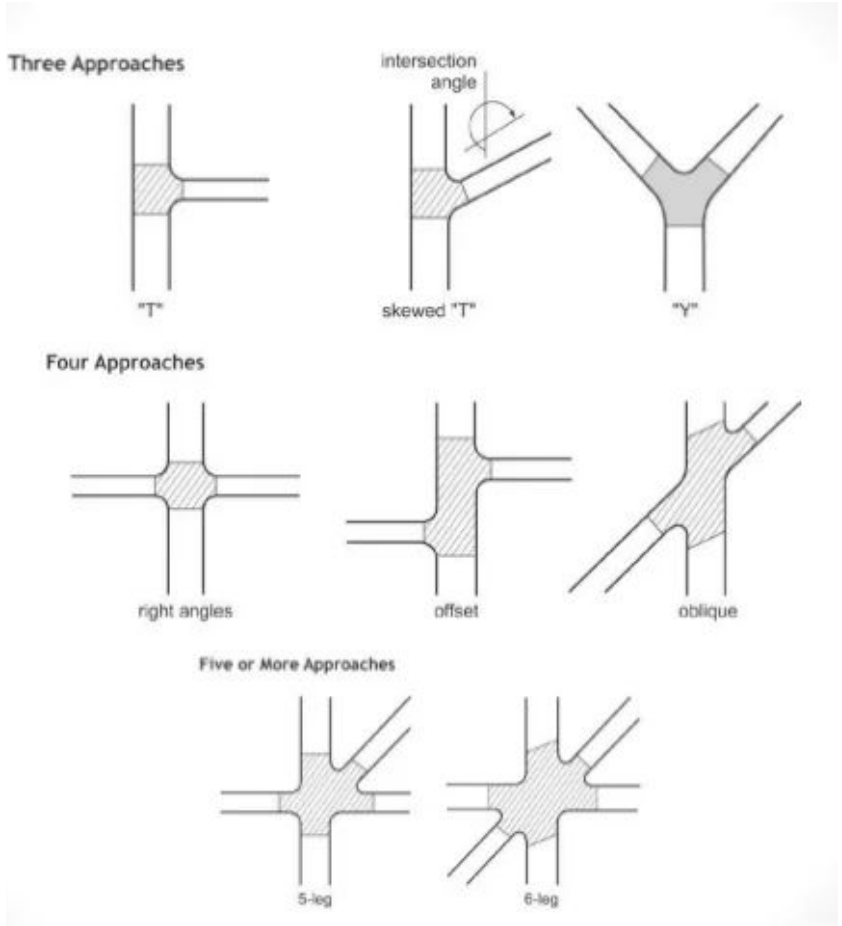
Facilitate the convenience, ease, and comfort of people traversing the intersection while **enhancing the efficient movement** of motor vehicles, buses, trucks, bicycles, and pedestrians.

Need to meet two conflicting objectives:

- **Minimize the severity of potential conflicts** among different streams of traffic and between pedestrians and turning vehicles.
- **Provide for the smooth flow of traffic** across the intersection

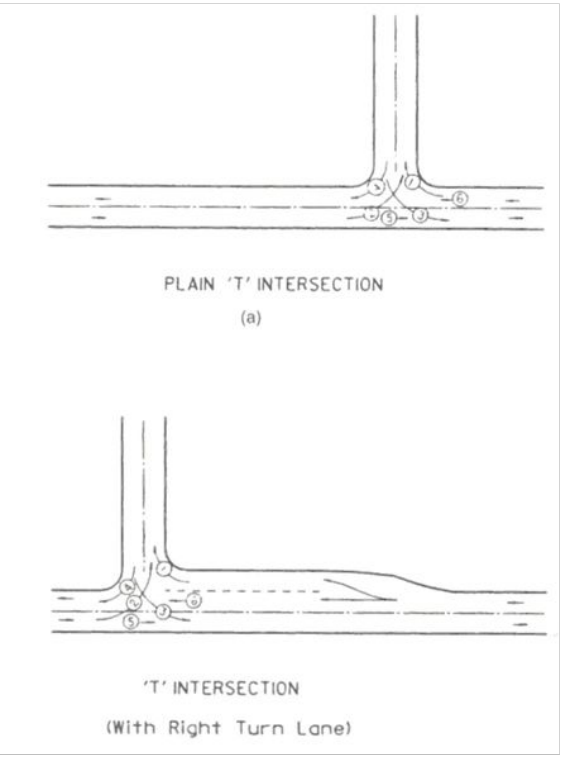
At Grade Intersection

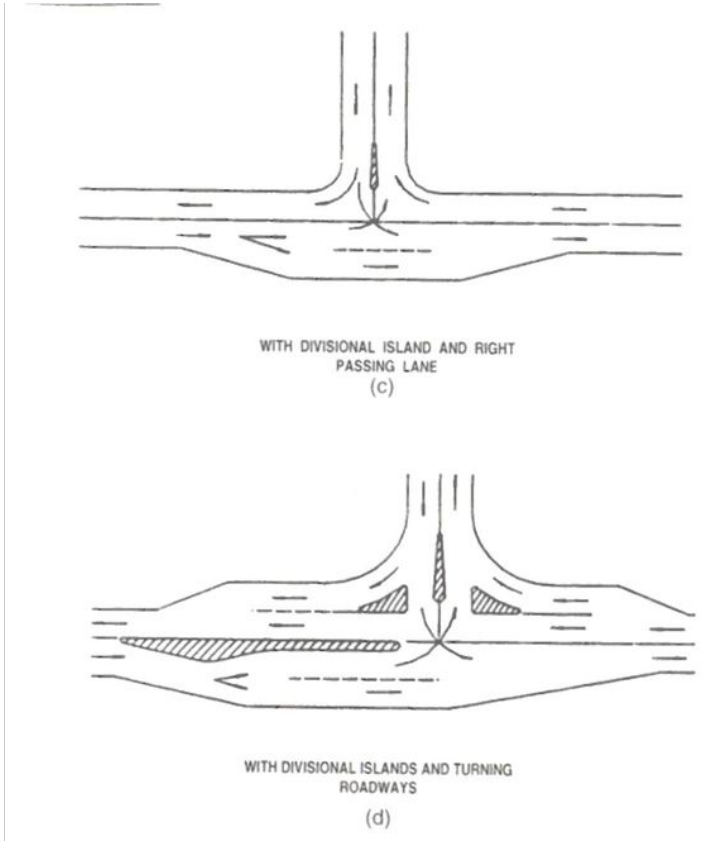
- **All road joins or crosses at the same level**
- **Conflict exist** between intersecting stream of traffic
- Should be designed to provide **adequate turning and crossing mov**, with due consideration to SD, signs, grades and alignments.
- Emphasizes on both **access and mobility function**.
- Types:
  - Three legs (T or Y),
  - Four legs or crossing,
  - multileg and
  - round about intersection.

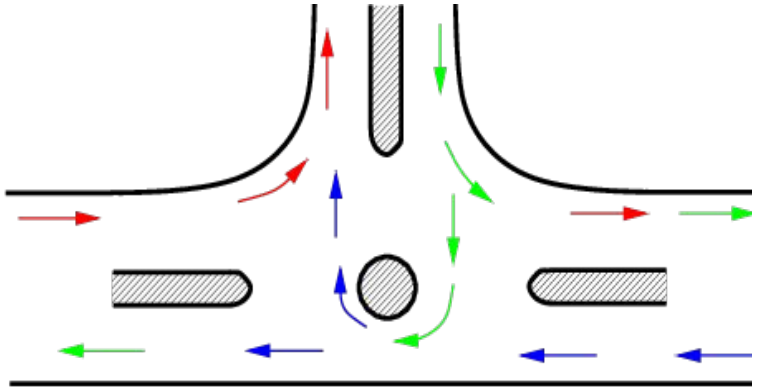


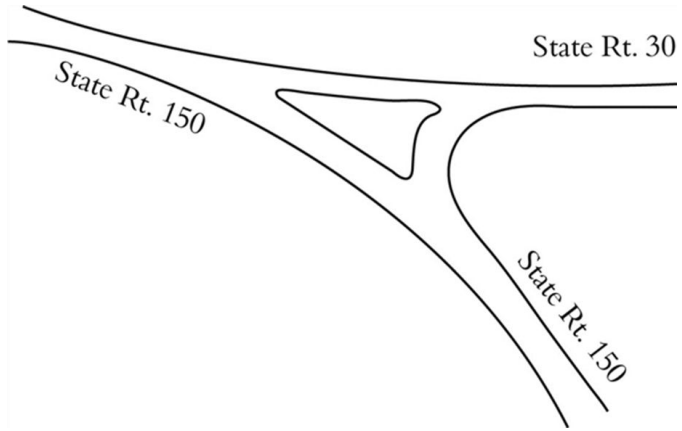
At Grade Intersection - Types

- ***Three legs (T or Y):***
  - ***T Intersection***: Two app to form a continuous line of HW and third app intersect at or nearly at rt angle.
  - ***Y Intersection***: three apps intersect at or nearly at equal angles.





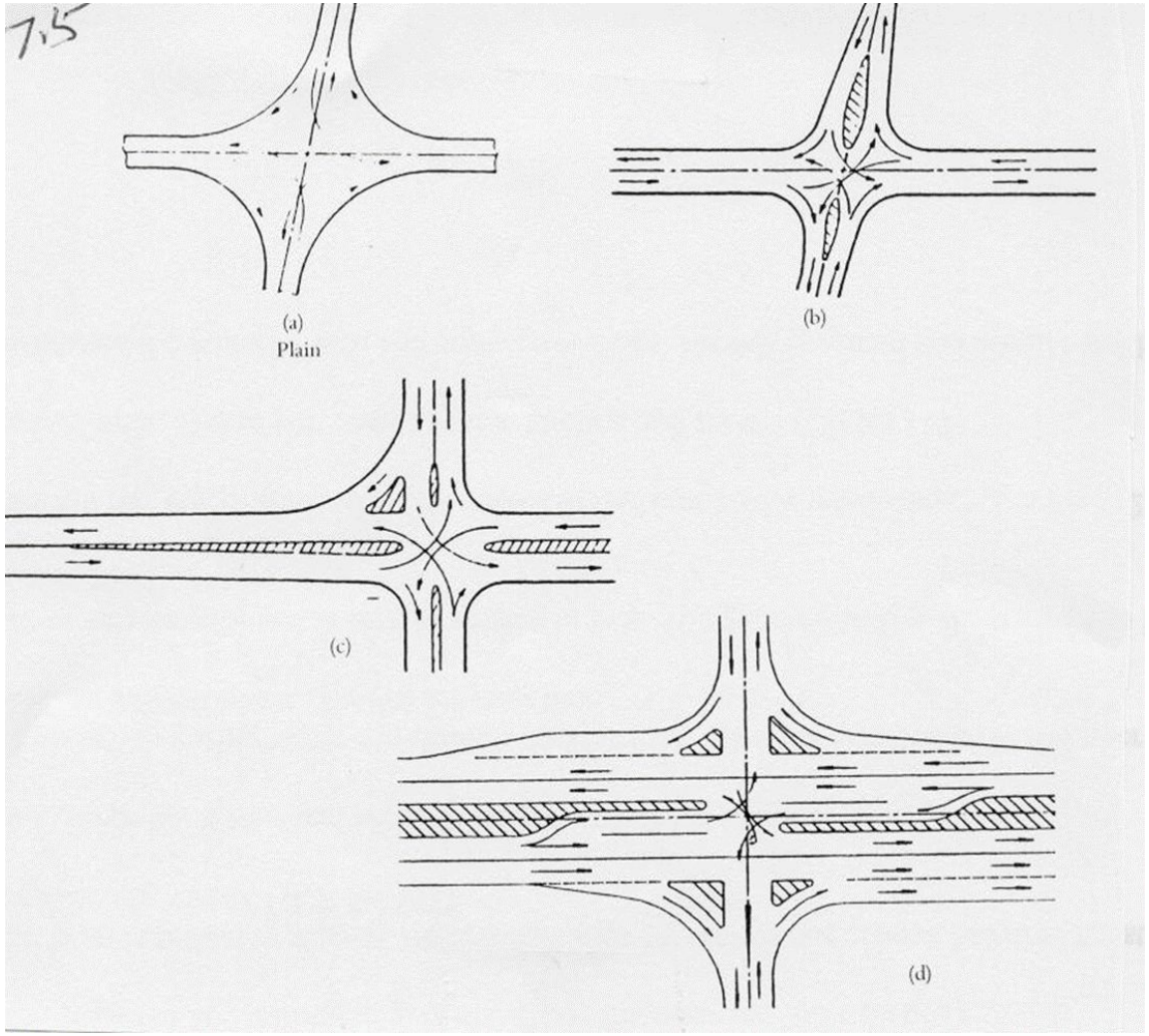




At Grade Intersection - Types

Four or Multileg intersections

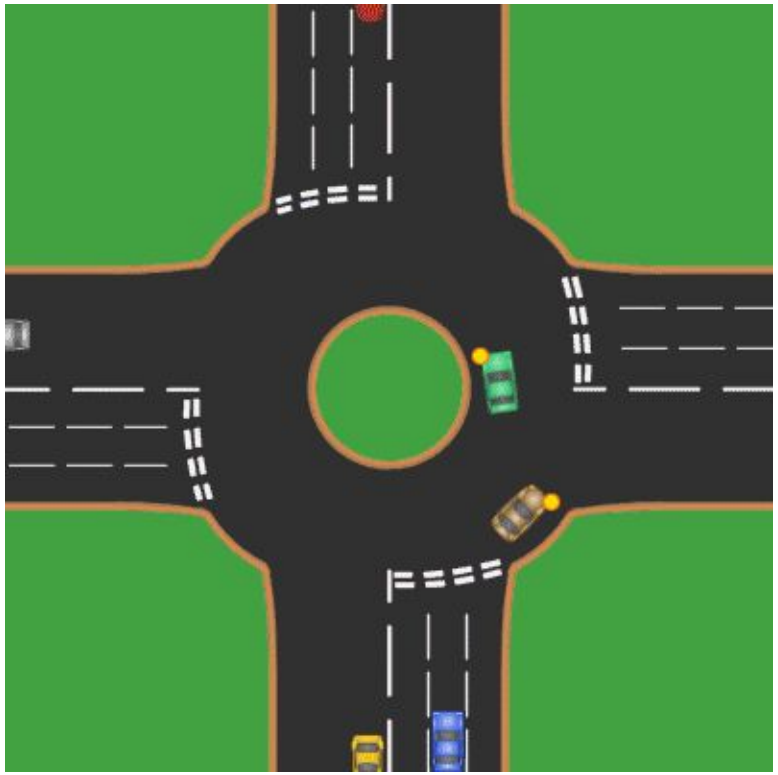
Flared Intersection: Additional pavement width or addl tfc lane at intersection area.

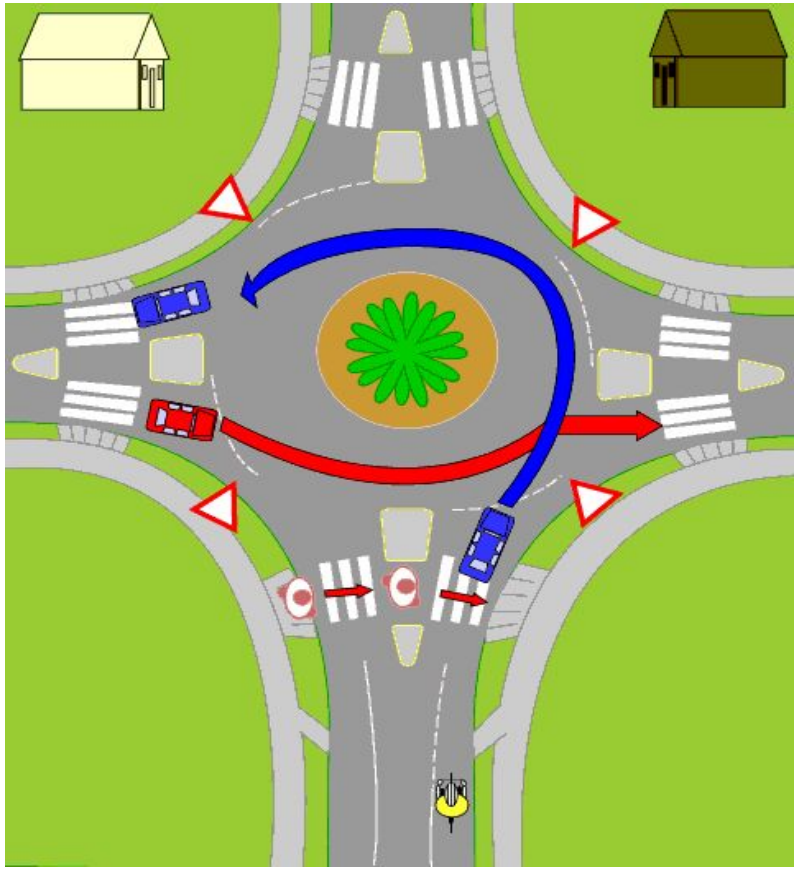




Round about or Rotary Intersection

Roundabout or Rotary intersection is one in which all tfc merges into and emerges from a one-way rd around a central island





Typical markings for roundabouts with one lane

Round about or Rotary Intersection

Advantages:

- Continuous traffic movement at reduced speed, at low vol
- Acidents are less serious (X-ing movement eliminated)
- Simplified design layout (for more than four approaches)
- Cost less than at grade intersection.
- Esthetically appealing
- Function as a traffic calming measure

Disadvantages:

- Can’t handle more traffic than an adequately designed canalized layout.
- Definitely NOT for high volume intersections,
- Too many weavings
- Unsatisfactory functioning occurs when two or more legs app design capacity.
- Extensive area is required .
- Channelization is required if large pedestrian traffic is expected.
- It functions at low speed.
- Proper functioning demands for adequate lighting and proper access con, otherwise may cause serious safety hazards.

General Rules for Driving a Roundabout?

Slow down upon approach to the roundabout.

Watch for traffic signs (one way and yield signs).

Yield to pedestrians and bicyclists as you enter and exit the roundabout.

Look to the left for traffic.

Enter when it is safe.

Keep your speed low within the roundabout.

Exit carefully to your destination.

Design Principle of At Grade Intersection

- Design should incorporate the op characteristics of both veh and pedestrian using the intersection.
- Corner radius $\not<$ either turning radius required by design veh or design speed of the rd.
- Should ensure adequate pavement width and approach Sight distance.
- Should not be located at or just beyond the sharp crest vertical curve or sharp hor curve.
- Rd ways or approach should intersect at an angle $\not>$ 30 degree from the normal.
- The design involves:
  - Design of alignment
  - Design of a suitable channeling system
  - Determination of min reqr rd way width for turning when veh mov at > 15 mph.
  - Ensure that the SD are adequate for the type of control at the intersect.
  - SD at an approach of intersection can be improved by : flattering the cut slope, lengthening vertical and hor curves.

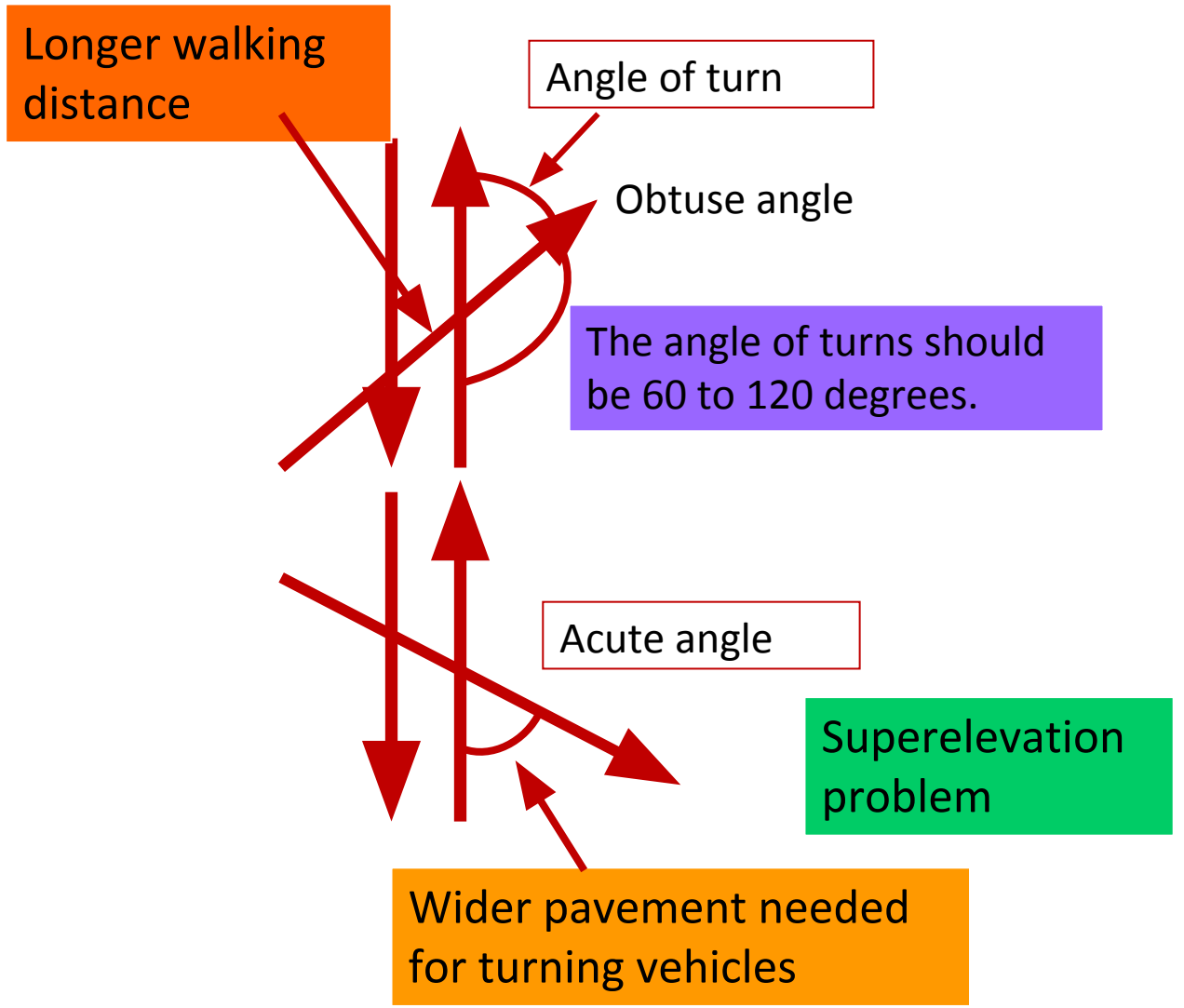
Alignment of At Grade Intersection

Best alignment when intersecting roads **meet at or nearly at right angles**.

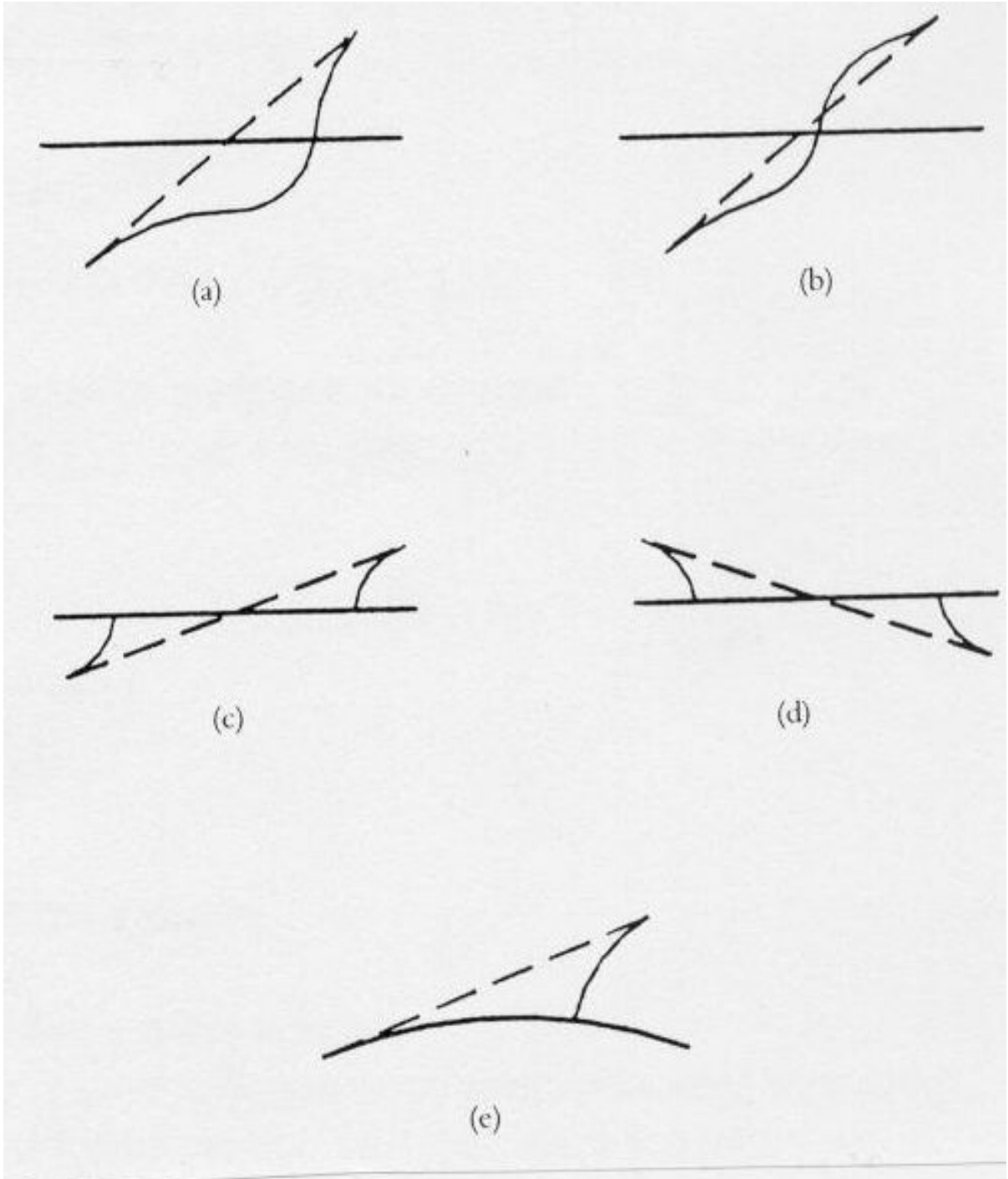
This is **superior to acute angle intersection because:**

- Less road area is reqd for turning
- Lower exposure time for veh Xing main flow
- Minimizes conflict area
- Visibility limitation are not serious i,e suitable SD are aval/ possible to provide
- Speed judgments will be easier.

Possible Method of Alignment

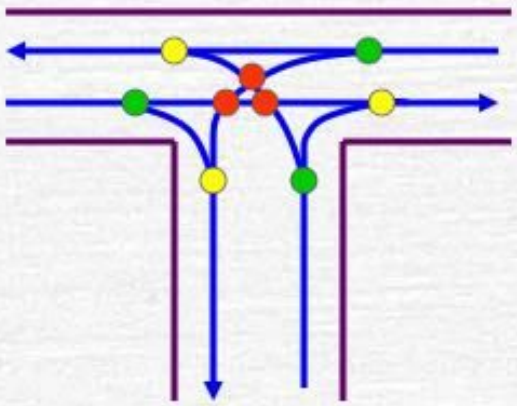


Suggested improvements to intersections with acute “angle” problems



Conflict points at Unsignalized intersection

T intersection



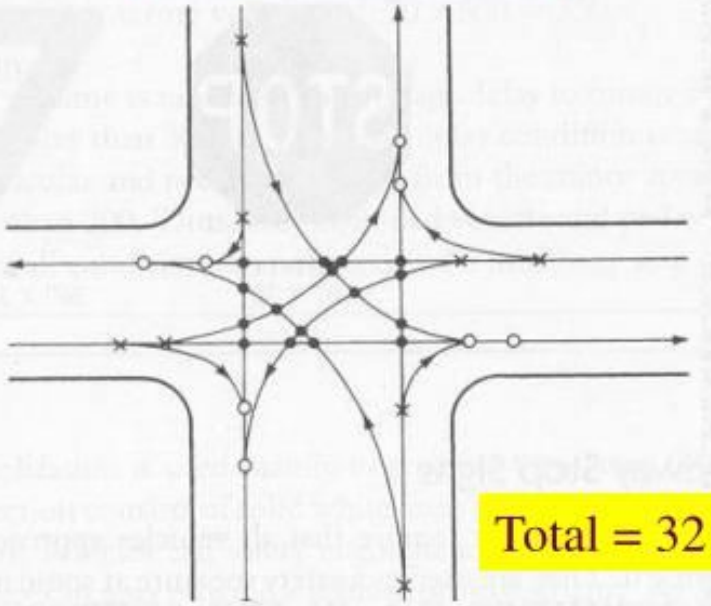
Crossing = 3

Merging = 3

Diverging = 3

Total = 9

4-leg intersection

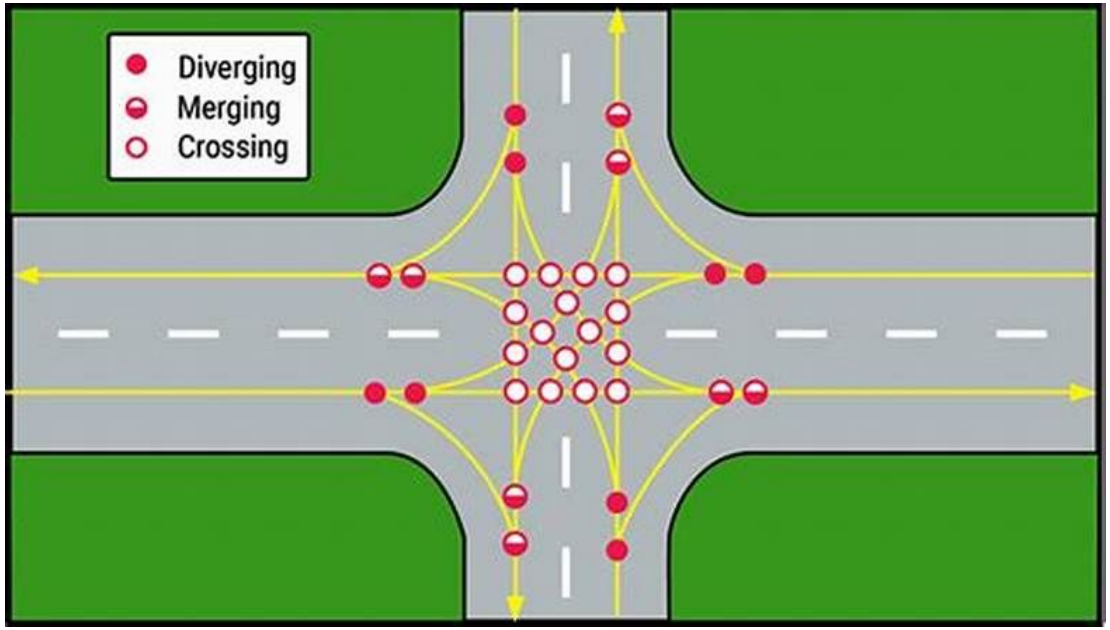


Total = 32

Merging conflict points = 8

Diverging conflict points = 8

Crossing conflict points = 16



Control of at grade intersection

- **No con**
- **Yield con**
- **Stop con**
- **Signalized con**

Yield con Intersection

Minor rd is con by yield sign. SD provided on minor rd must be sufficient for the dvr to see a veh approaching from either the left or rt of the major rd and to be able to stop the veh before reaching the intersecting road way.

Stop con Intersection

Minor rd is con by stop sign. Veh on minor rd must be provided sufficient SD to allow for a safe departure from the stopped position for the three basic maneuver that occur at an intersection. These are crossing the intersection, turning left onto the cross rd and turning the rt on to the cross rd.

Signalized con

The basic principle of signalized intersection is to provide SD that will enable the dvr to see the signal early enough to take the nec action indicated by the signals.

TRAFFIC ISLAND

Is the area between the traffic lanes to regulate the movement of vehicle and serve as a pedestrian refuge.

TRAFFIC ISLAND

Purpose or Objectives: May serve one or more of the fol purposes:

- Separation of conflicts i,e dir the path of the veh.
- Control the merging, diverging and Xing angles.
- Decrease veh wander and conflict areas among veh by reducing the amount of paved area.
- Provide a clear indication of the proper path for different mov.
- Give priority to the predominant mov.
- Provide ped refuge.
- Provide separate storage area for turning veh.
- Provide space for tfc con devices.
- Control prohibited turn.
- Restrict the speed of the veh.

How Formed/ Types of Traffic Island based on Formation

a. Curbed Island: Island Formed by the construction of concrete curbs

- Curb are of two types: Mountable and Barrier or non mountable curbs.
- Because of glare, difficult to see at ni, so fixed sources of light should be provided.
- Preferred in urban HW where Speed is not excessively high and Ped vol is relatively high.

b. Flushed Island: Island Formed by Pavement Marking

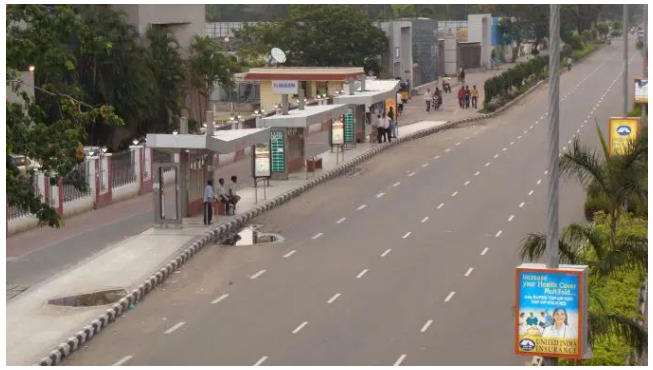
- Marks incl paints, thermoplastic stripping, raised retro reflective markers etc.
- Preferred where:Approach speed are relatively high, Ped tfc is low, Sig or sign need not to be loc on island.

c. Unpaved Island: Island Formed by Pavement Edges

- Used at rural intersection and rural areas where sufficient space are available.

How Formed/ Types of Traffic Island based on Formation

Curbed Island: Island Formed by the construction of concrete curbs





Unpaved Island: Island Formed by Pavement Edges





Flushed Island: Island Formed by Pavement Marking





Types of Traffic Island based on Functional Classification

Channelized Island

- Also known as directional island
- Used mainly to con and dir tfc by indicating the intended route.

Divisional Island

- Mainly to divide opposite or same direction traffic stream.
- Mostly used at undivided HW approaching intersections.
- Particularly advantageous for rightt turning tfc.

Refuge/ Pedestrian Island

- Mainly to provide refuge for pedestrians and wheel chairs Xing the intersec.
- May also be used on wide streets for loading and unloading of transit passengers.

Types of Traffic Island based on Functional Classification

Channelized Island





Divisional Island



Types of Traffic Island based on Functional Classification

Refuge/ Pedestrian Island







Channelization of at grade intersections

- Channelization is the **separation of conflicting tfc mov** into definite paths of travel **by tfc island or pavement markings** to **facilitate the safe and orderly mov of both veh and ped**,

- A properly channelized intersection will result in **increased capacity, decrease conflict and accdts** thus enhance safety and increase dvr confidence.

- An improper Channelization may have opposite effect.

- **Over Channelization should be avoided** as this **creates confusion** and may **lower the op level** than that for an intersection without any Channelization.

Shape and Size of Islands

- Should be large enough to command attention
- Should be visible to dvrs for a sufficient dist to allow appropriate response.
- **Area** at least 75 sft, preferably 100 sft.

- **Sides:** Triangular islands at least 12 ft, preferably 15 ft after rounding corners.
- Elongated or div island 20-25 ft long.
- Median curbed island 100 ft or more, 2-4 ft offset and then gradually to the full width.
- Small (side length near min length), intermediate and large (100 ft >)

- **Width:** at least 4 ft wide, can be reduced to 2 ft when space is limited.
- When signs are to be placed, the width of those to be considered to select the width of islands.

Grade Separated Intersection without Ramp

- Consists of structure that **allow traffic to cross at different level, but not between level (**without a provision for an interchange between levels)**, without interruption**.
- Designed in such a way that at **no point a vehicle has to face traffic from opposite dir**.
- **Often constructed in urban areas** because of high land price and non availability of adequate space.
- **Based on mobility function**.
- May be an over bridge, under pass/tunnels or fly over/ overpass etc

Grade Separated Intersection without Ramp

Adv over At Grade Intersection

- freedom from cross interference
- eliminates conflicts and safety
- minimize delay, saving time
- increasing capacity.

Disadv over At Grade Intersection

- More expensive (reqr very large area and constr of br or ramps etc)
- Drainage problem (under pass)
- Speed reduction (over br) than at grade intersection.

Interchange (Grade Separated Intersection with Ramp)

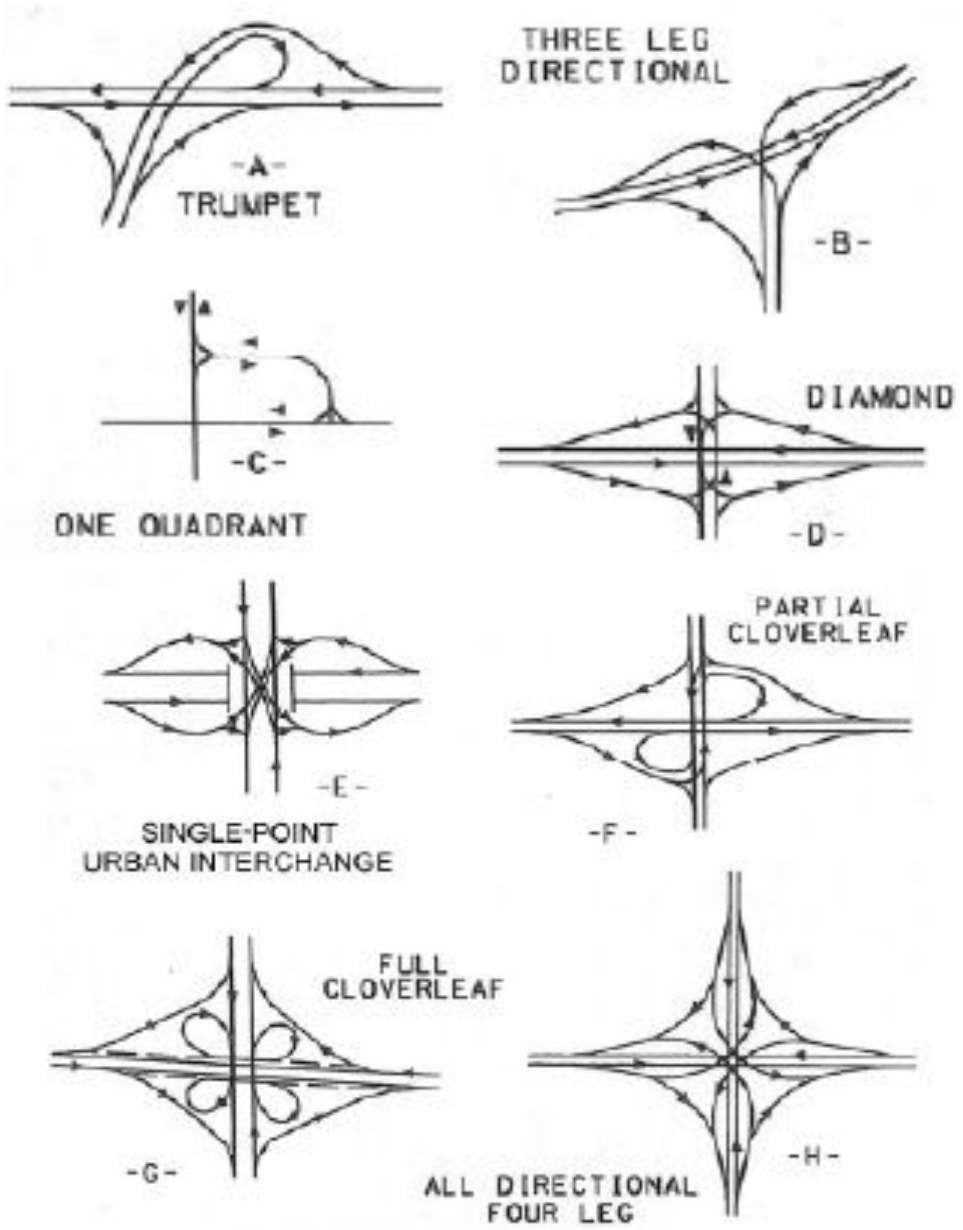
- An interchange is a grade separated intersection with the provision of ramp whereby facility is provided for mov of traffic between two or more rd ways at different level.
- The transfer of traffic from one dir / level to other is provided by the facility known as ramps or access or slip or link rds. They connect two or more legs at an intersection and are generally a one-way rd.
- Usually constructed at open areas where land price is relatively very low.
- Mobility function.

Warrant for Grade Separations and Interchanges

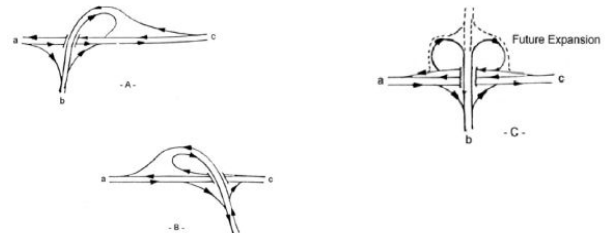
- When sufficient discharge capacity of a junction cannot be achieved by the use of conventional treatments.
- Where congestion and accident records are very high and expected cost savings in delay and accident is significant
- To eliminate bottlenecks and to prevent accidents.
- Where topography does not permit other types of design.
- When traffic on intersecting roads is very high.
- When there is a need to construct expressway to provide high speed and uninterrupted flow.

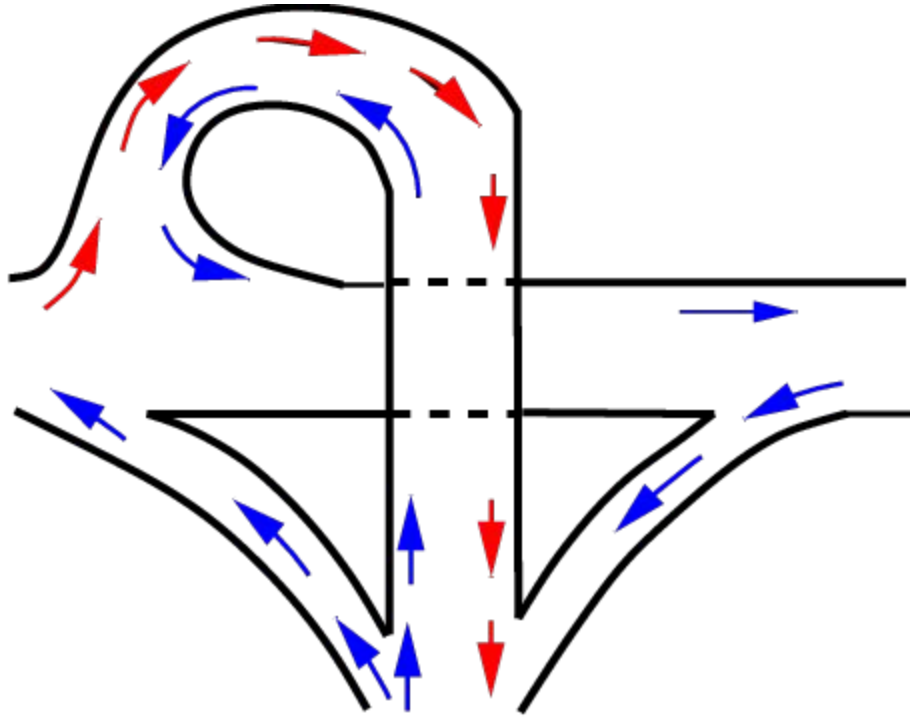
Common Types of Interchanges

- Three-Leg Designs – (a) and (b)
- Four-Leg Designs
- Ramps in one quadrant (c) – Not Suitable for Freeway Systems
- Diamond Interchange (d)
- SPUI (e)
- Partial Cloverleaf (f)
- Full Cloverleaf (g) – Generates Weaving Maneuvers
- All Directional Four Leg (h)

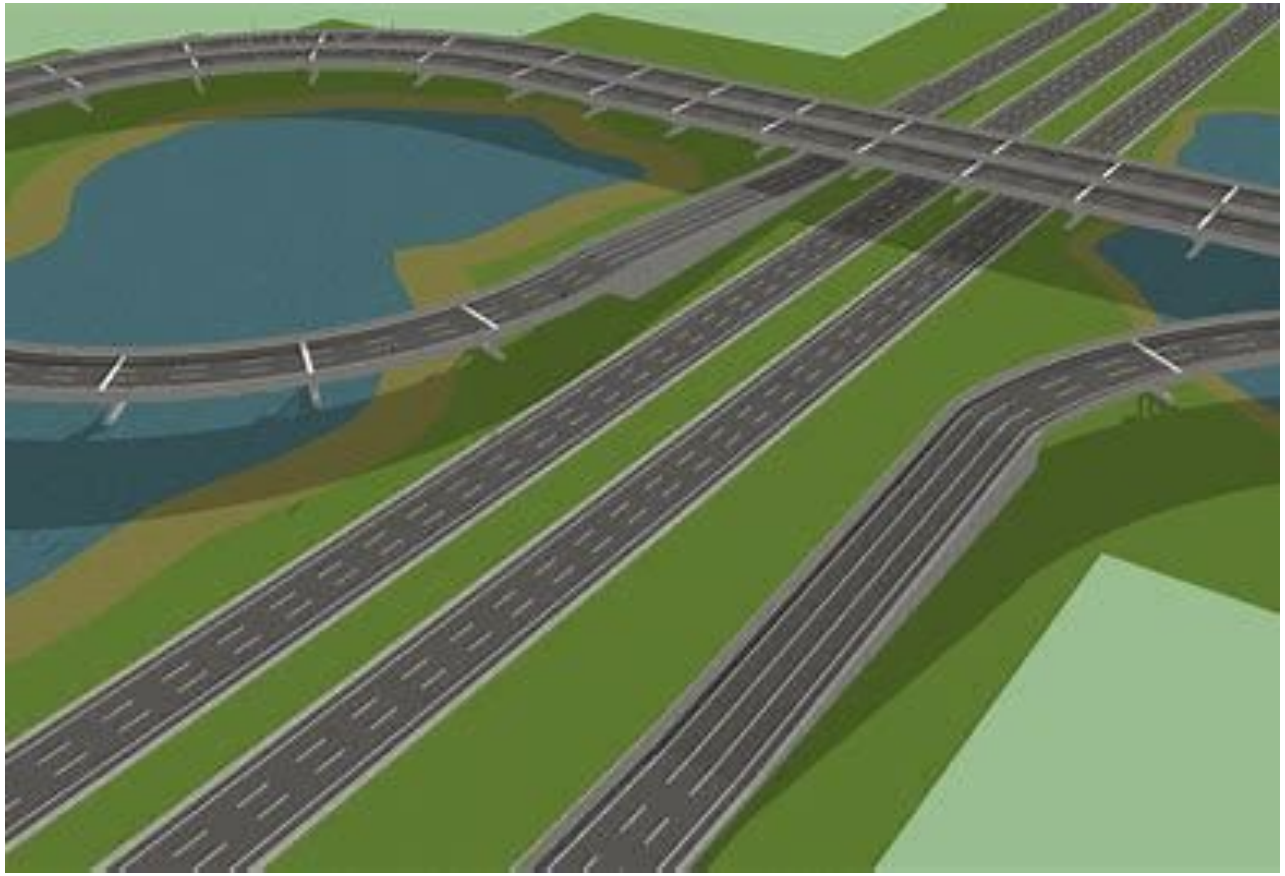


Three-Leg Interchanges





Trumpet



Four Leg Interchange Designs

- Ramps in One Quadrant
- **Diamond Interchanges**
- SPUI (Single Point Urban Interchange)
- **Full or Partial Cloverleaf**
- Direction and Semi-Direct Connections

Four Leg Interchange – Diamond Type





Four Leg Interchange – Diamond Type







Four Leg Interchange – Cloverleafs Type







Partial Cloverleafs

Four-Leg Interchanges: Single Point Urban Interchange (SPUI)

Most recent

- Advantages
  - Narrower ROW
  - Paths of Left Turning vehicles do not intersect
  - Right turn movements are free flow
  - Only one traffic signal is used; lower delay and Greater Capacity
  - Curve radii are flatter; turns made at higher speeds
- Disadvantages
  - High construction costs
  - Overpasses need long bridges to span large intersection below
  - Left-turn movement path is normally quarter of a circle, but in SPUI – half an ellipse