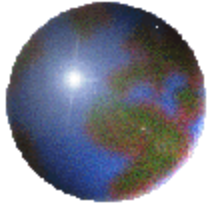




AAiT

Addis Ababa Institute of Technology
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***SCHOOL OF CIVIL AND ENVIROMENTAL
ENGINEERING***

***HIGHWAY ENGINEERING I
CENG 3202***

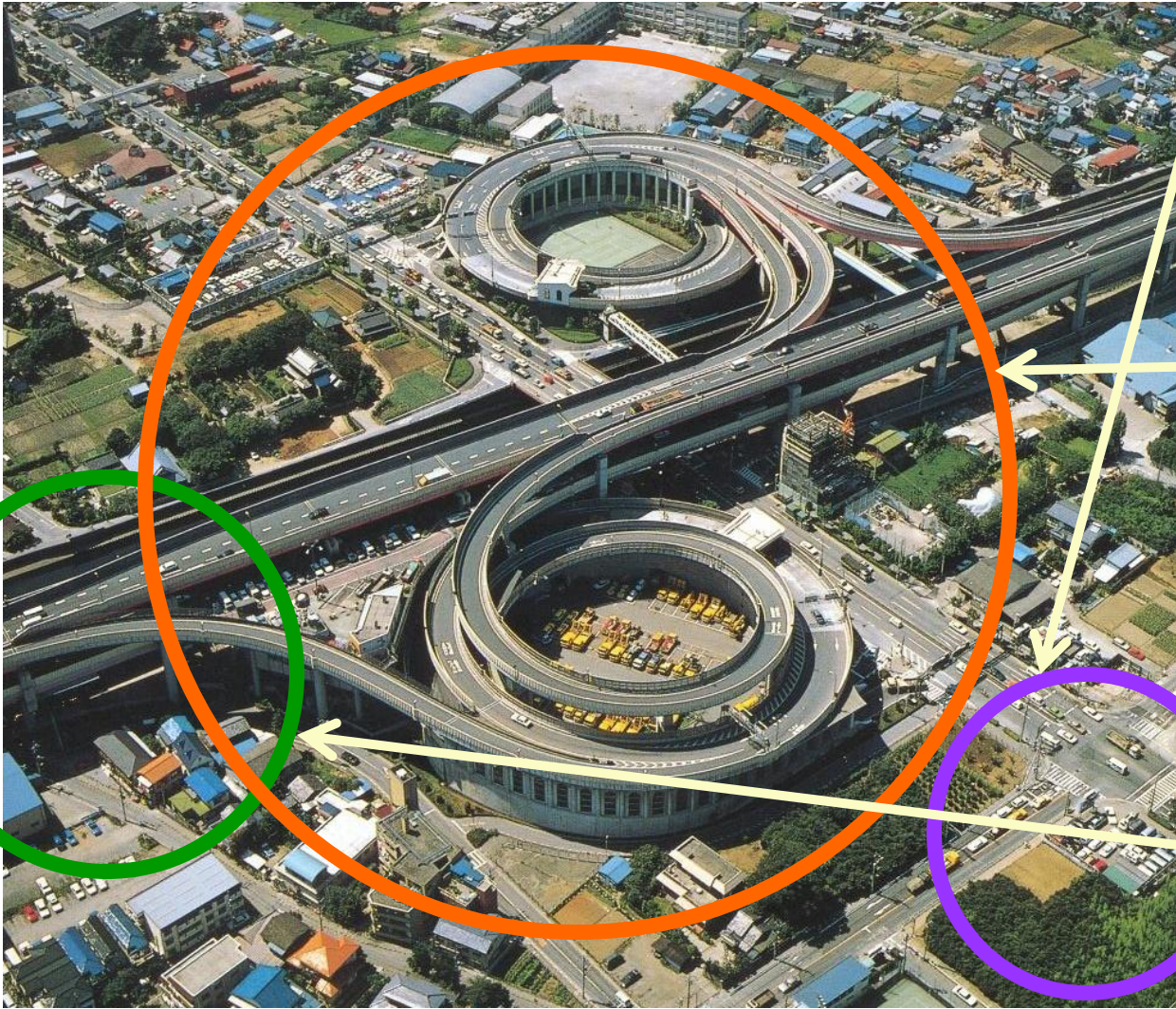
***Chapter VI
Highway Intersection and
Interchanges***

2012EC (2019/20) 2nd Sem

Tamru T.



At-grade



Grade separated

With ramps (Interchanges)

Without ramps (meaning no connection between the intersection roads!)

intersection roads!)



Intersection

- **A junction, or intersection, is the general area where two or more roads join. (ERA GDM 2002)**
- **An intersection is defined as the general area where two or more highways join or cross, including the roadway and roadside facilities for traffic movements within the area. (AASHTO, 2001)**



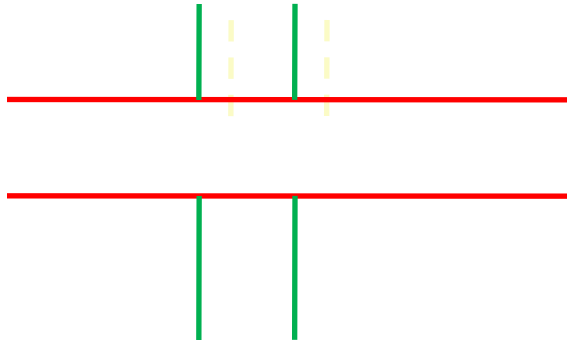
Types of Intersection

- **At-grade intersection**

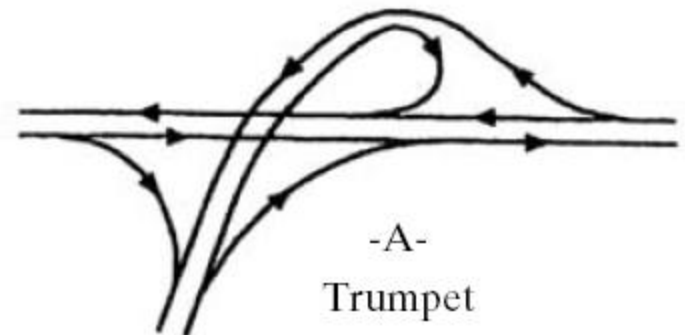


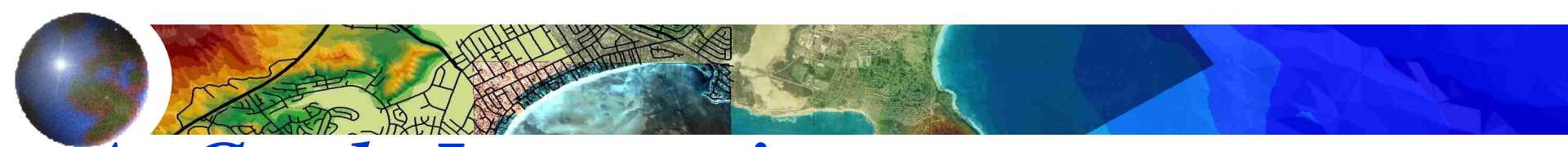
Simple T-junction

- **Grade separated without ramps, and**

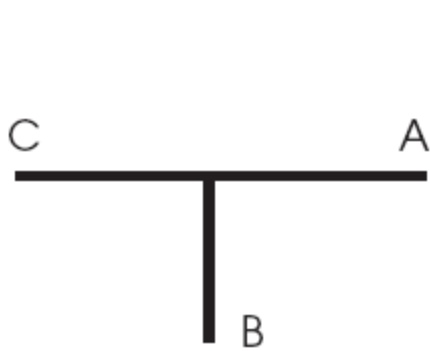


- **Interchanges**

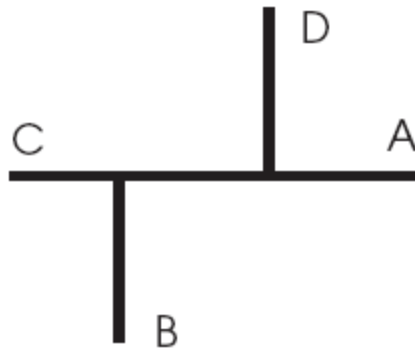




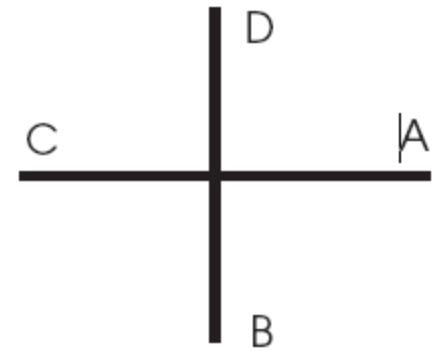
At Grade Intersection



Simple T-junction

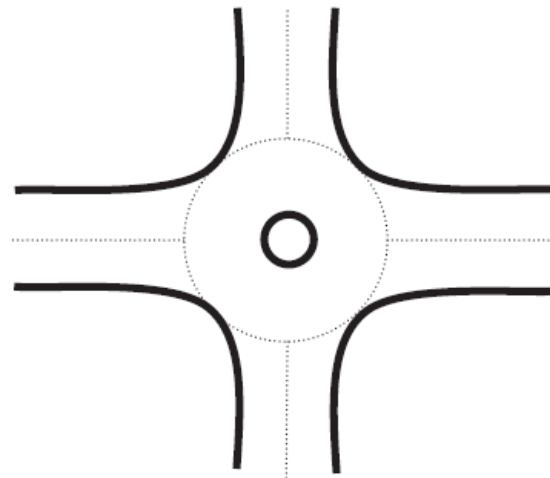


Staggered T-junction

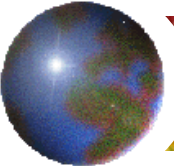


Crossroads junction (not recommended)

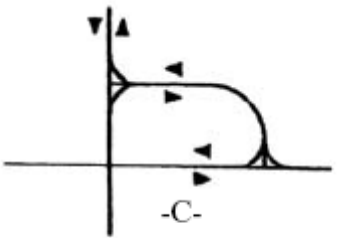
Three forms of priority intersection



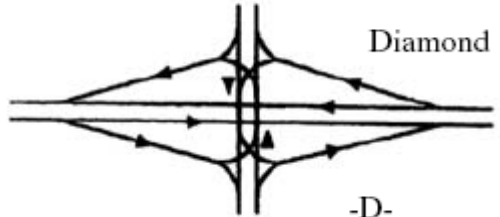
Roundabout



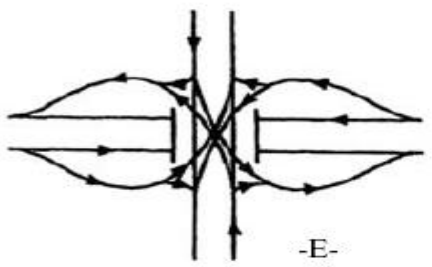
Interchanges



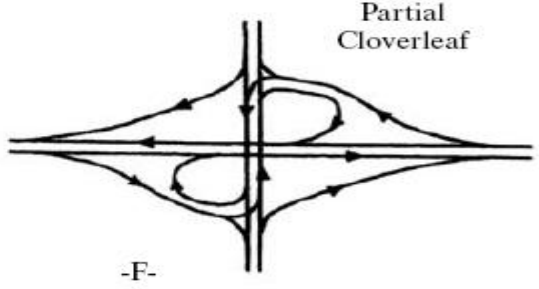
One Quadrant



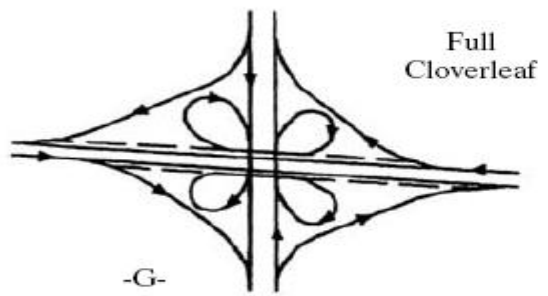
-D-



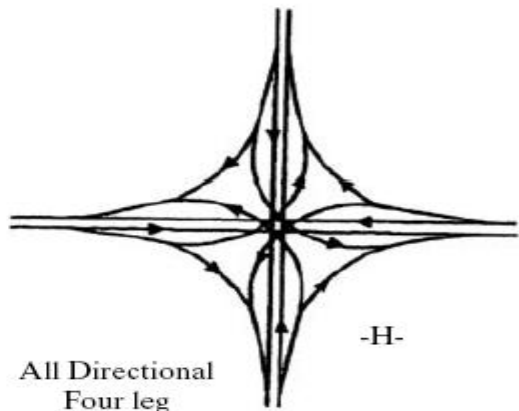
Single-Point
Urban Interchange



-F-



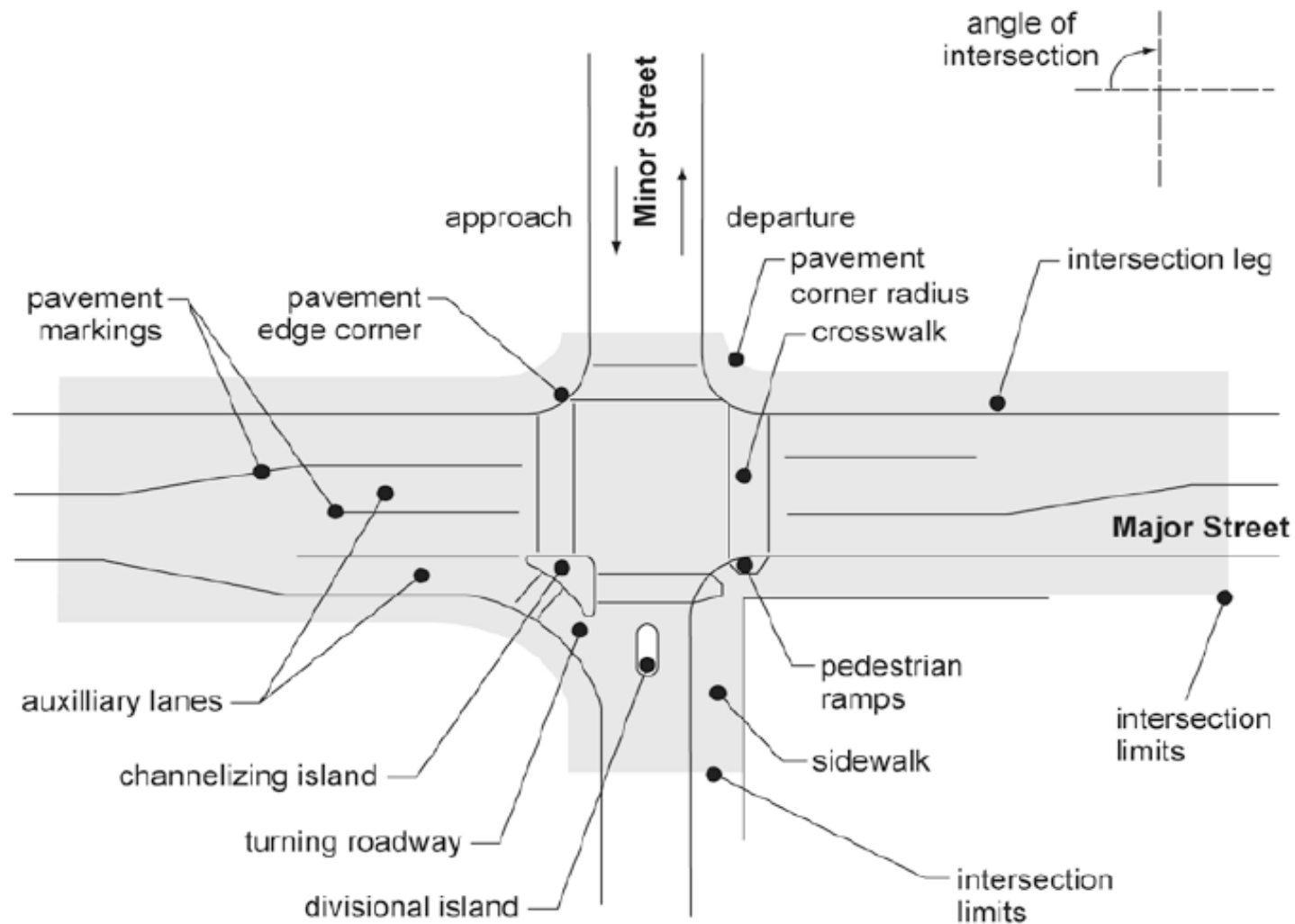
-G-



All Directional
Four leg



Intersection Terminologies





Design Considerations at-grade intersection

- **Human factor:** such as driving habits and decision and reaction times
- **Traffic considerations:** such as capacities and turning movements, vehicle speeds, and size and distribution of vehicles
- **Physical elements:** such as characteristics and use of abutting property, sight distance, and geometric features
- **Economic factors:** such as costs and benefits and energy consumption



Intersection Design – Operational Requirements

- Provide adequate **sight distance** – for approach and departure maneuvers
- Minimize turning and through **conflicts**
- Provide **natural paths** for permitted movements
- Avoid geometry (**sharp curves/steep grades**) that complicates the driving task and adversely impact acceleration/deceleration

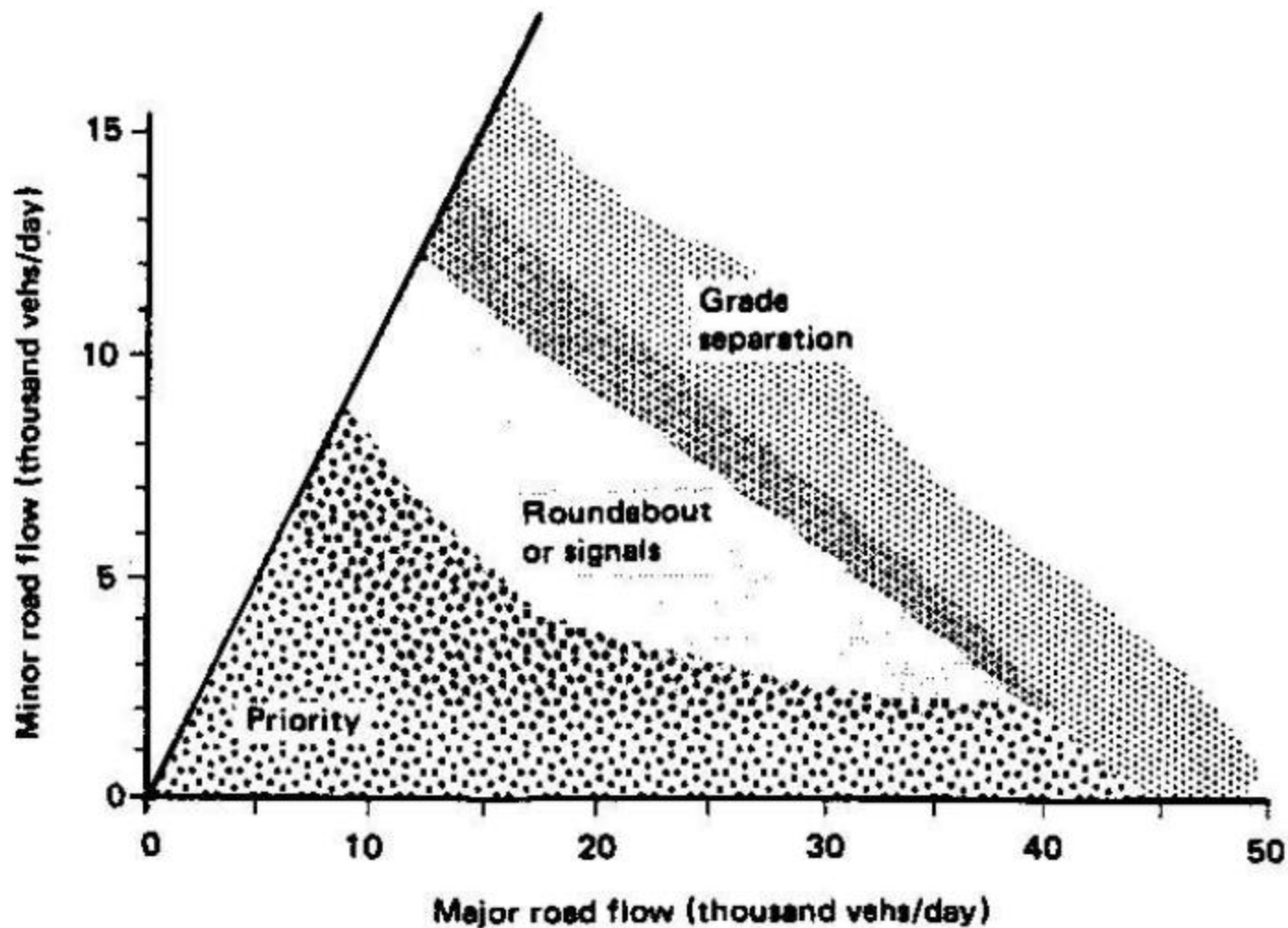


Design Requirement - Safety

- **Visibility:** angle not greater 20 degree from perpendicular.
- **Comprehension:** similar types of junction, road sign and markings
- **Maneuverability:** adequate lane width, turning radius, marking edge of traffic lanes.

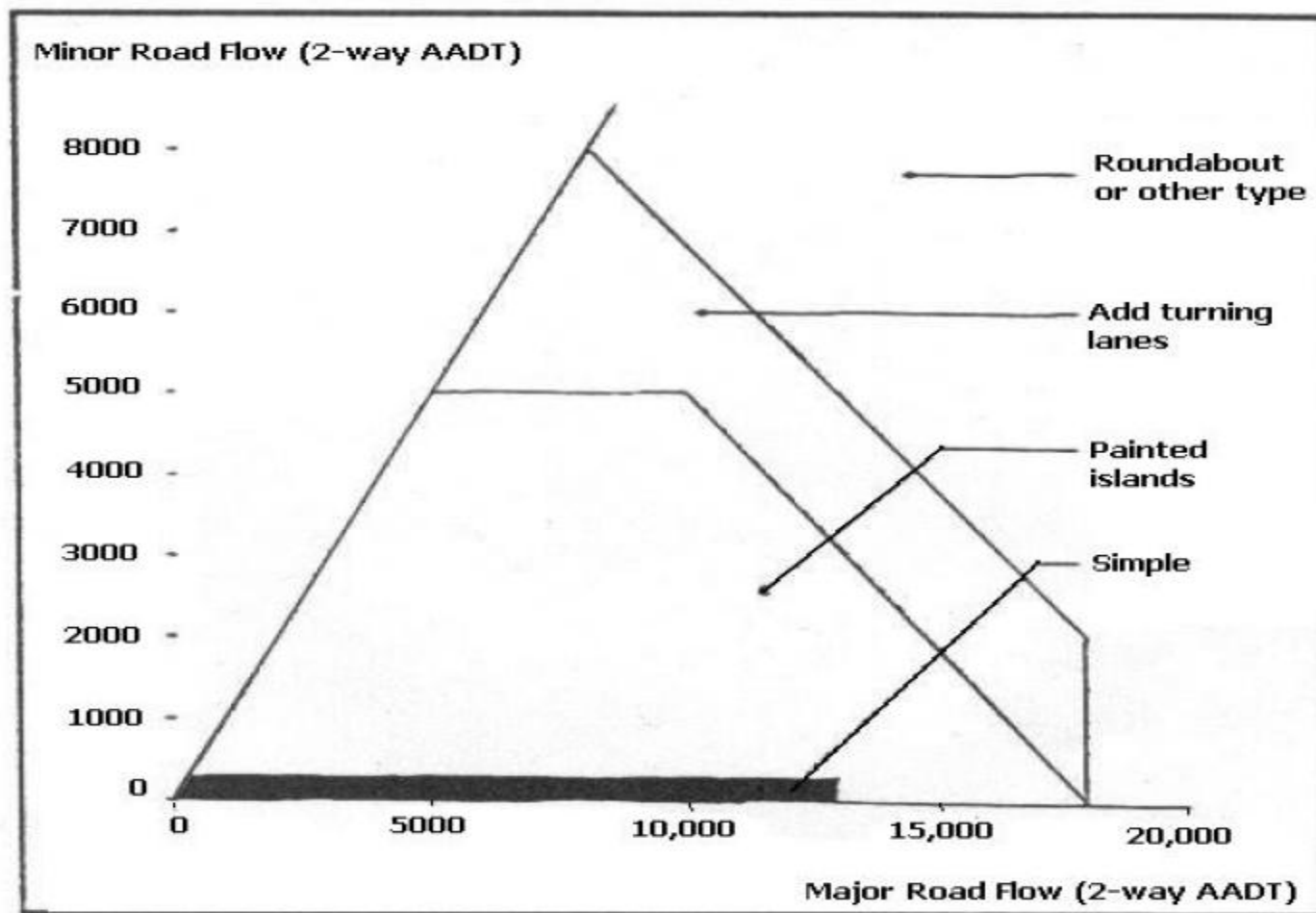


Selection of Junction Type





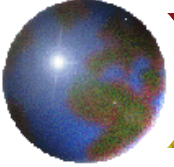
At-Grade Junction Selection





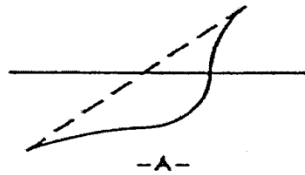
Advantages and disadvantages

- **Priority (T-Junction, Cross-Junction).** For low flows. Can cause long delays. Requires sufficient stopping sight distance. Delays can be improved by signal installation.
- **Roundabouts.** For low to medium flows. Minimal delays at lower flows. Shown to be safer than priority junctions. Requires attention to pedestrian movements and accommodation of slow-moving traffic.
- **Grade-Separation.** For high flows. Results in minimal delays. Expensive.

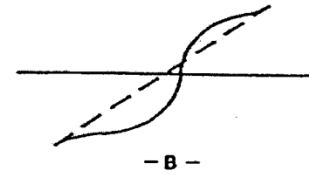


Alignment

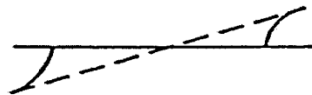
- **Regardless of the type of intersection, for safety and economy, intersecting roads should generally meet at or nearly at right angles.**



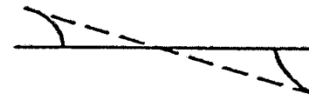
-A-



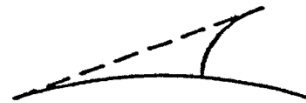
-B-



-C-



-D-

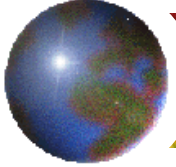


-E-

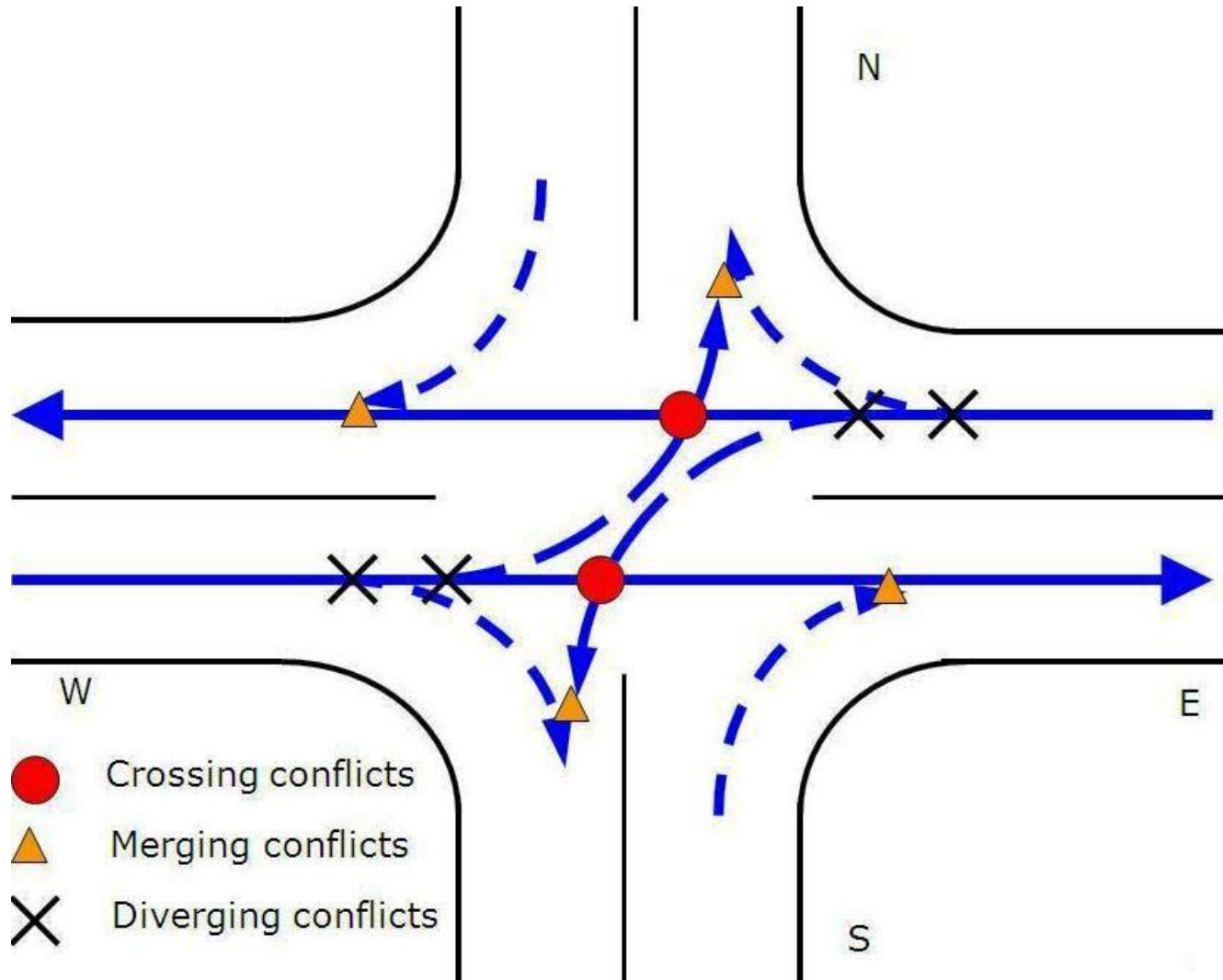


Profile

- **Should facilitate driver's control of vehicle**
- **Avoid significant changes in grade**
- **Typically $\leq 3\%$**
- **Continue major street grade through intersection**



Conflict Areas at Priority Intersections





Type of Intersection Control

- **No control**
- **Yield or stop signs,**
- **Channelization,**
- **Roundabouts and**
- **Traffic signals.**



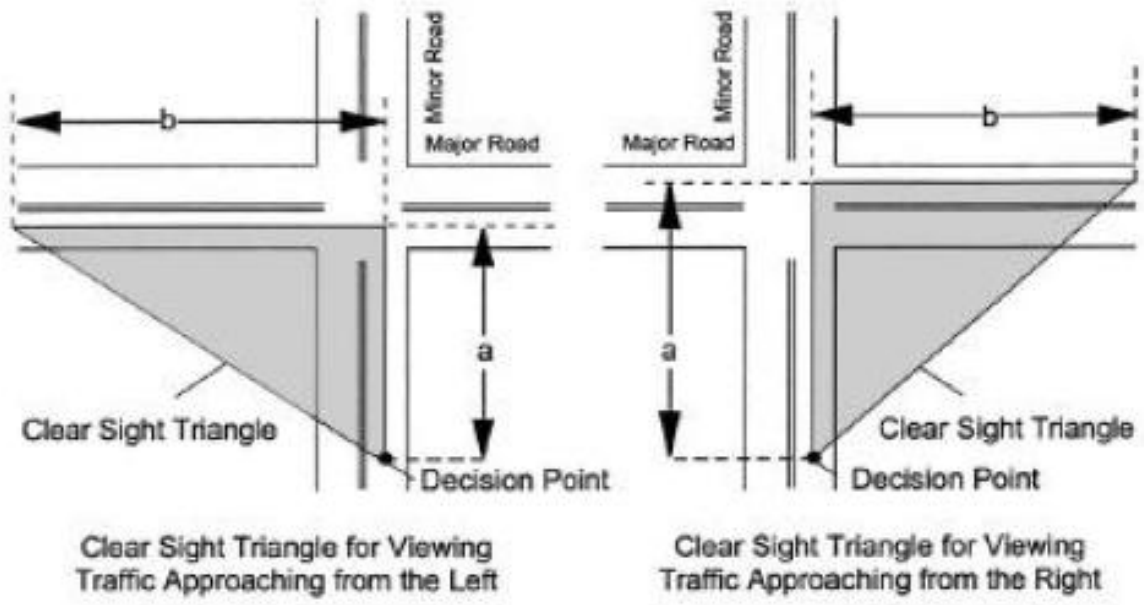
Uncontrolled Intersections

- **Vehicles adjust speed**
- **Driver should perceive a hazard in sufficient time before reaching the intersection.**
- **The safe stopping distances applied the same as those used for designing any other section of highway.**
- **Provide control if sight triangle not available**

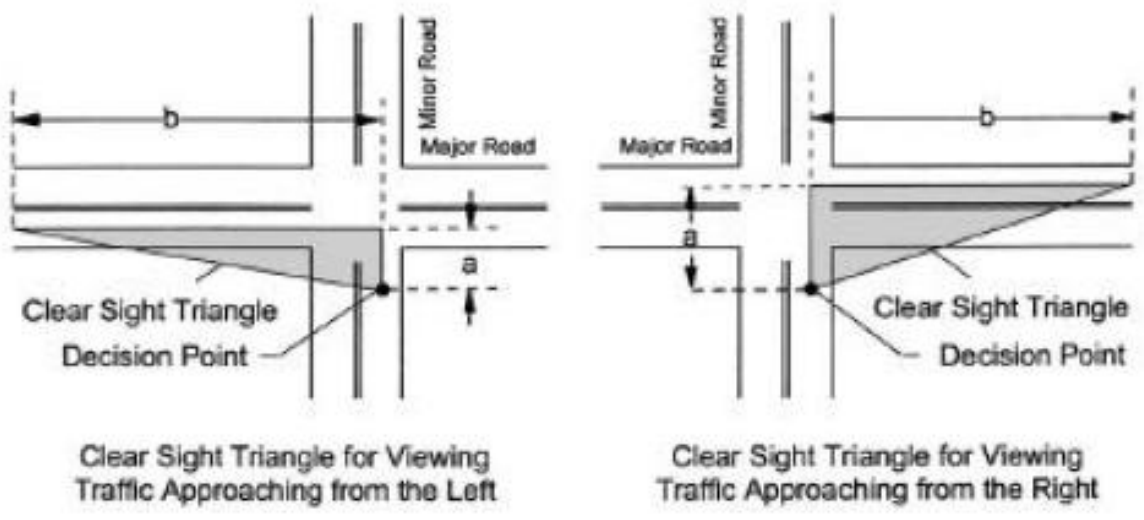


Sight Triangles

area free of obstructions necessary to complete maneuver and avoid collision – needed for approach and departure



A – Approach Sight Triangles



B – Departure Sight Triangles



Yield or Stop signs

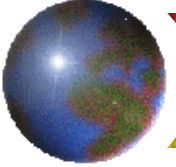


**vehicles on minor roadway
must yield to major roadway
traffic**

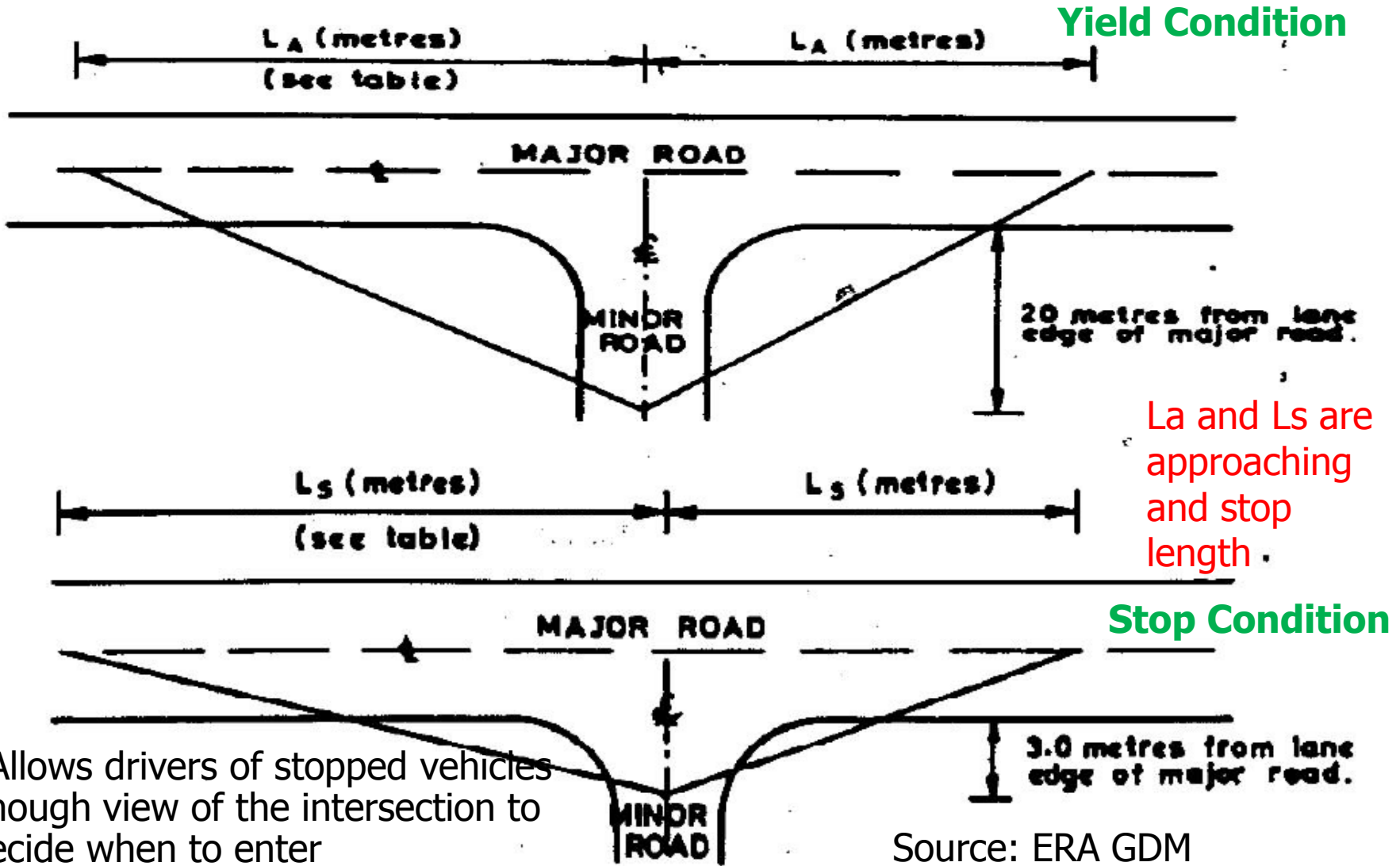
Give Way



**where traffic on minor
roadway must stop prior
to entering major
roadway**



Visibility Splay





Stop Control Case

- **Eliminates crossing & merging conflicts**
- **Three Sub Cases – Maneuvers**
 - **Turn left** on to major roadway (clear traffic left, enter traffic right)
 - **Turn right** on to major roadway (enter traffic from left)
 - **Crossing** (clear traffic left/right)



Yield Control Case

- **Eliminates crossing conflicts**
- **Used at major road-minor road intersections**
- **Minor Roadway Yields – must be able to see left/right – adjust speed – possibly stop**
- **Sight distance exceeds that on stop control**
- **Similar to no-control**



Intersection Channelization

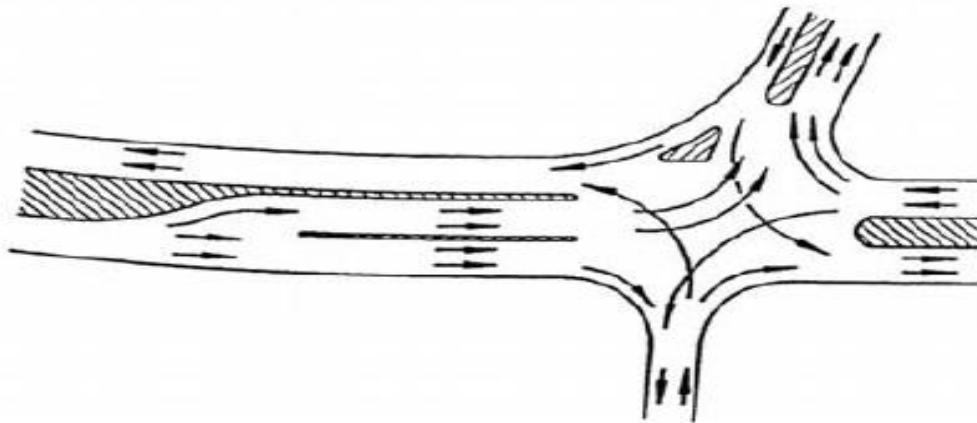
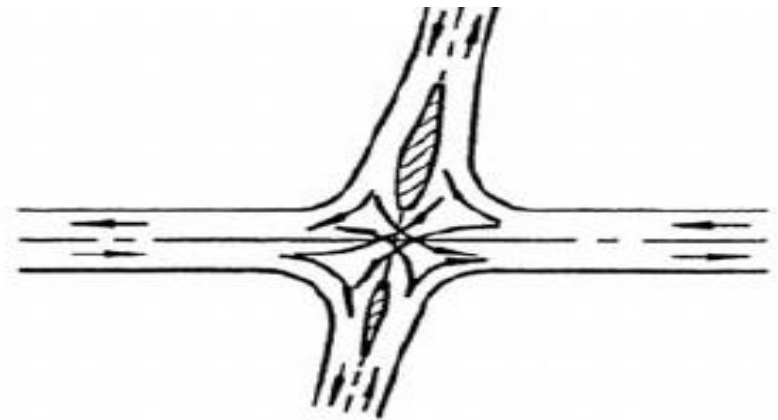
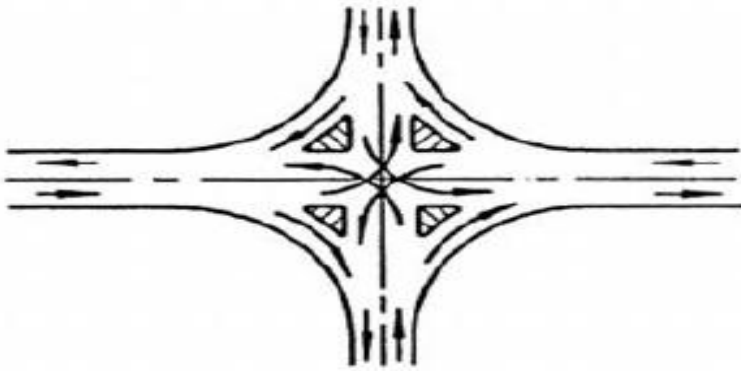
- Provides clear path for different movements
- Gives priority to dominant movements
- Provides pedestrian refuge
- Provides storage area for turning vehicles
- Controls prohibited turns
- Restricts speed
- Increases capacity, improves safety, provides maximum convenience, and increases driver confidence.

**Raised Island or
Pavement Markings**





Examples of Channelization



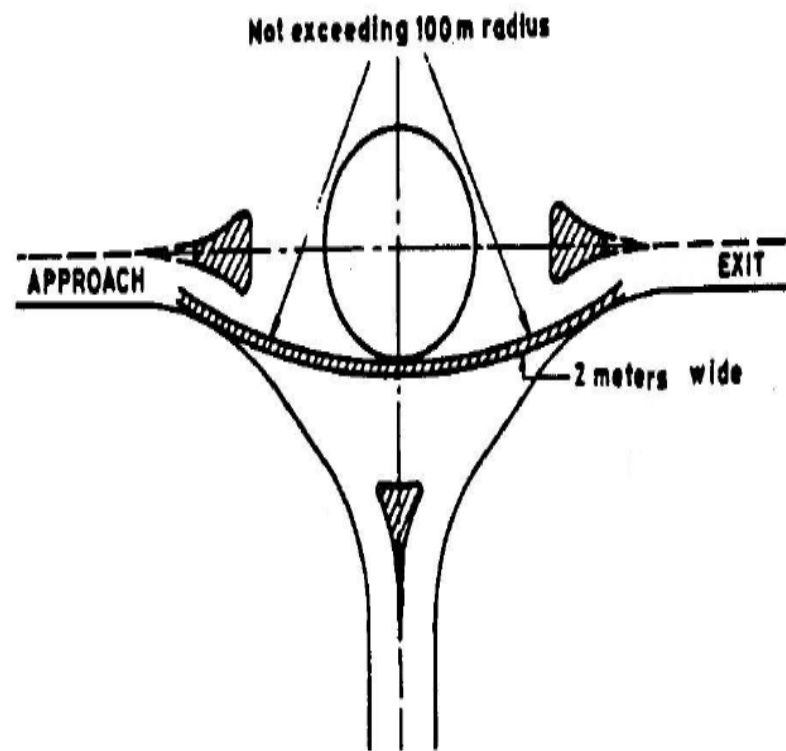
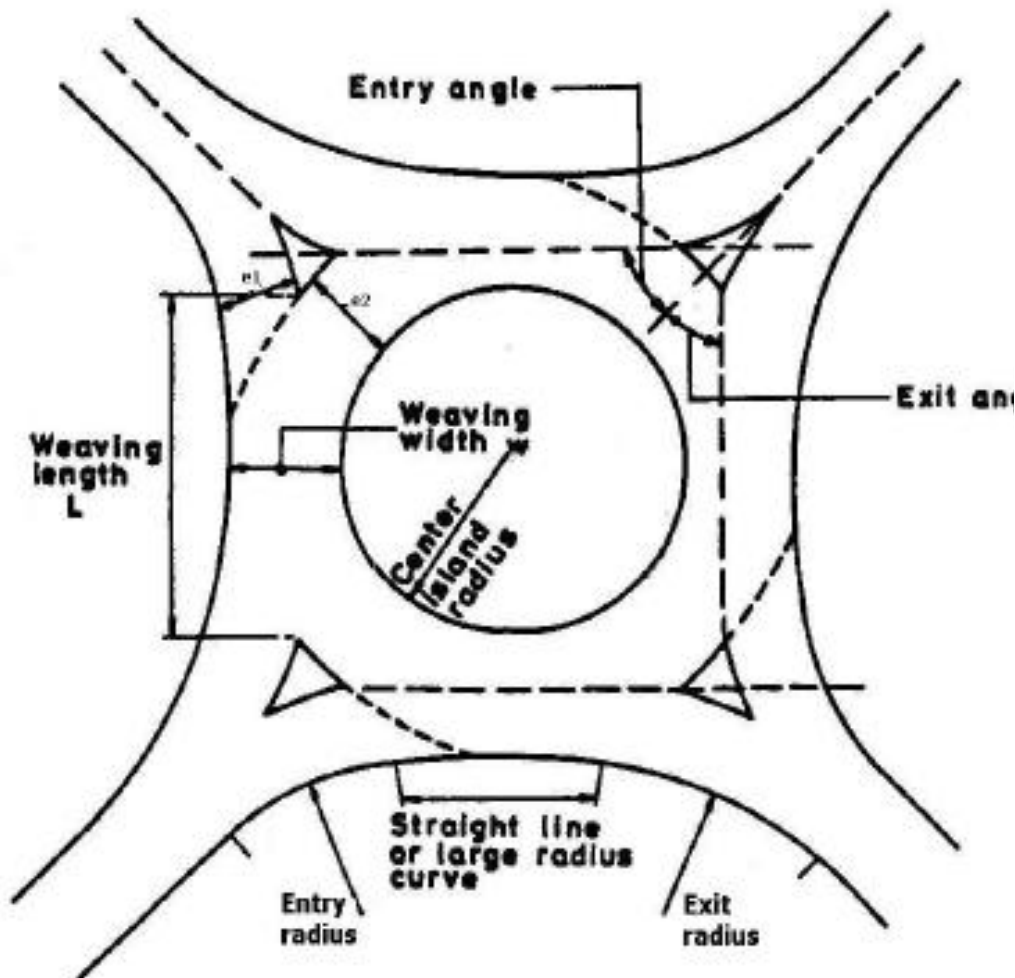


Roundabouts

- **Roundabout** are channelized intersections comprising a **central circle** surrounded by a one-way roadway.
- Naturally, in the case of roundabouts, entering traffic yields to traffic within.
- Generally have good safety record



Roundabout



Vehicle Path Through Roundabout



Roundabout Design

- **Select the general design criteria to be used**
- **Select the appropriate design vehicle for the site. DV4 for all design standards.**
- **Adopt a minimum design vehicle turning radius. This will generally be 15m radius.**
- **Determine from traffic flows the number of lanes required on entry, exit and circulation**
- **Identify the needs of pedestrians**
- **Identify the location of controls such as right-of-way boundaries, utilities...**
- **Layout sign plan.**



Roundabout Design

- **Check the achievement of adequate deflection (Figure 12-11). Adjust as required.**
- **Check site distances at approaches and exits.**
- **Layout lane and pavement markings.**
- **Layout lighting plan**
- **Layout sign plan.**



All Way stop

- **Used when traffic volumes on all approaches are approximately equal**
- **Stopped major roadway **left-turn** vehicles – must **yield** to oncoming traffic**



Traffic signals

When minor road traffic suffers excessive delays

- where vehicles on all approaches are required to stop by either a stop sign or traffic signal

Minimizes the following:

- Excessive delays at stop signs and yields
- Problems caused by turning movements
- Angle and side collision
- Pedestrian accidents





Curb Radius

- **Factors of influence:**
 - **Design vehicle**
 - **Intersection angle**
 - **Approach width and parking**
 - **Channelization**
 - **Pedestrians**
 - **Allowable speed reduction**



Interchanges

We use interchanges if

- **An at-grade junction has insufficient capacity**
- **The junction is justified economically from the savings in traffic delays and accident costs**
- **Grade separation is cheaper on account of topography or on the grounds that expensive land appropriation can be avoided by its construction**
- **For operational reasons**
- **Where roads cross motorways**



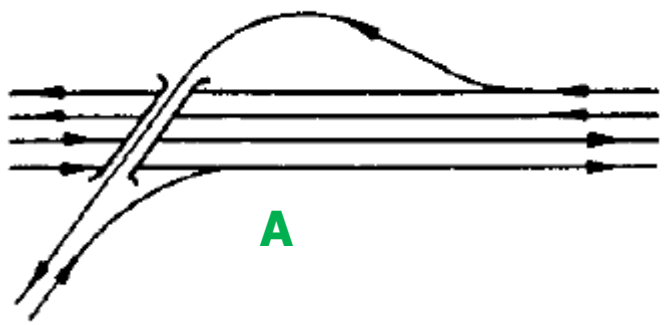
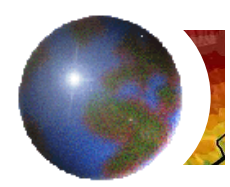
Factor for location of interchanges

- **Trip length (travel distance)**
- **Size of urban areas**
- **Predicted traffic volumes**
- **Cost of junction**
- **Congestion control**

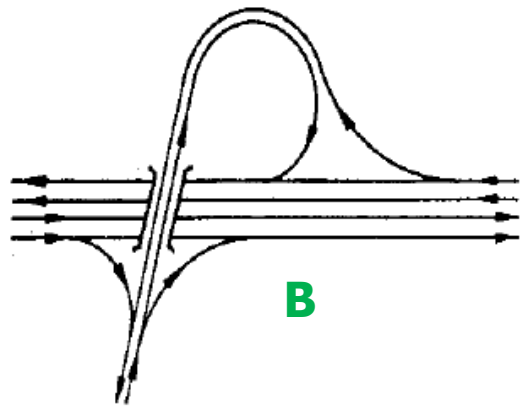


Types of Grade-Separated Junctions

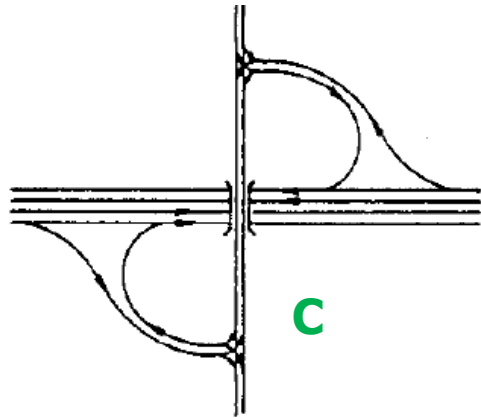
- **Three-way junctions; (A & B)**
- **Junctions of major/minor roads; (C & D)**
- **Junctions of two major roads; and (E & F)**
- **Junctions of more than two major roads.**



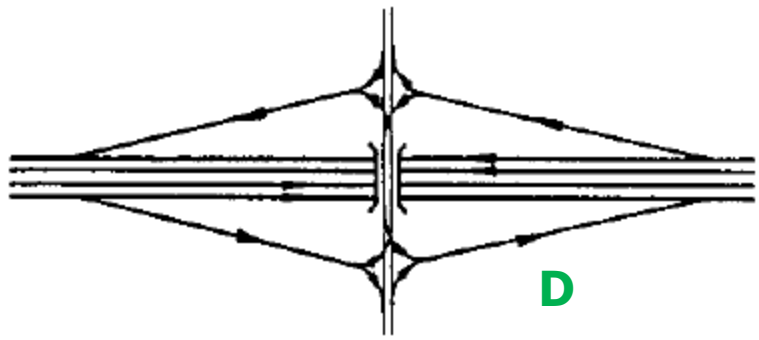
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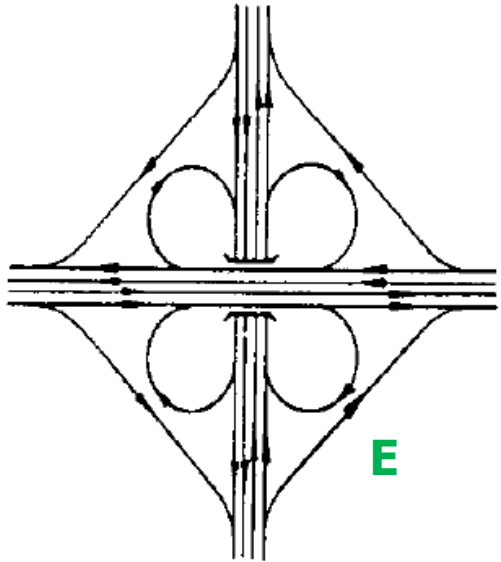
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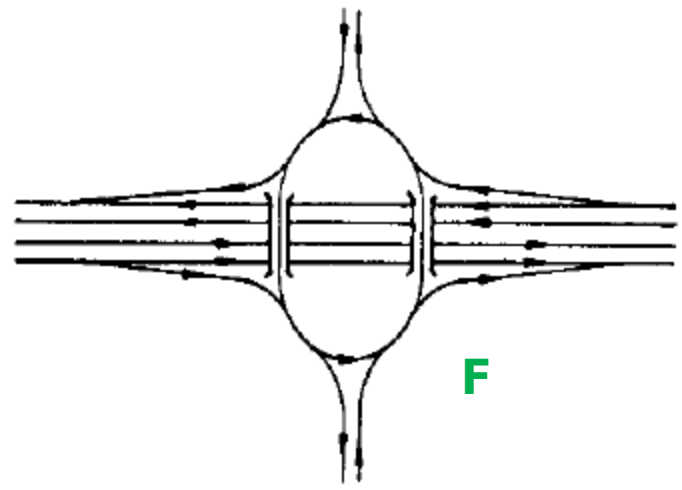
C



D



E



F



End of the Course



Thank you!