Outline: Chapter 4

4.1 Types and Design of At Grade Intersections

4.2 Geometric Design Principles of At-Grade Intersections

Intersection Design

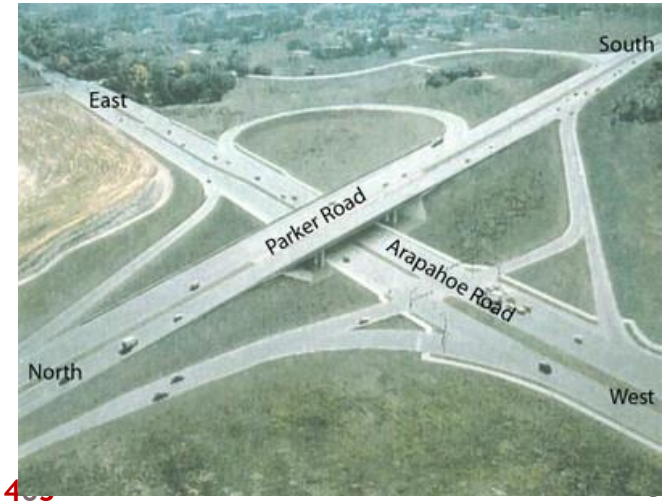
- **An intersection** is an area, shared by two or more roads, whose main function is to provide for the change of route directions.
- Intersections tend to have a high potential for crashes, because Drivers have to make decisions concerning which of the alternative routes they wish to take.
- The overall traffic flow on any highway depends on the performance of the intersections, since intersections usually operate at lower capacities.

Intersection Design

- **Intersections are classified into:**

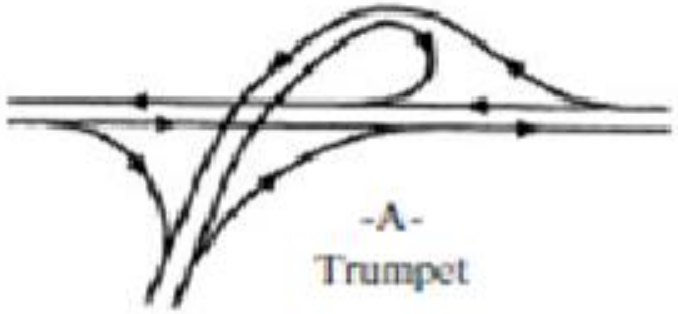
1. **Grade-separated without ramps**: these intersections consist of structures that provide for traffic to cross at different levels (vertical distances) without interruption.

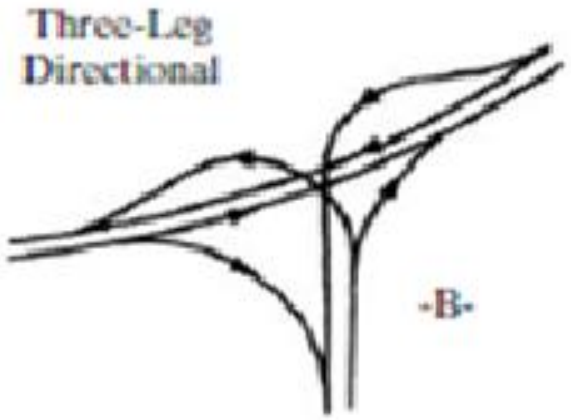
2. **Grade-separated with ramps:**
   comonly known as interchanges.

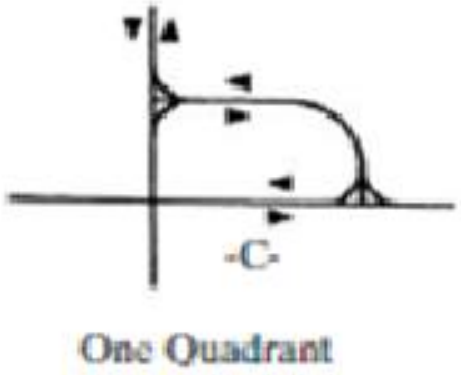


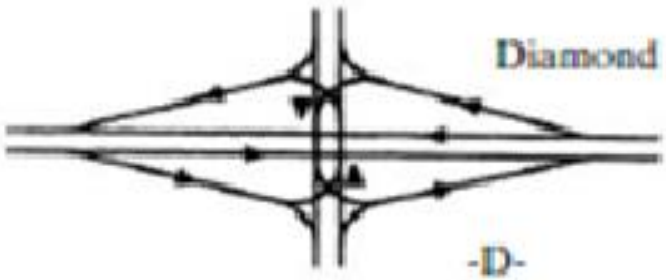
The potential for crashes is reduced because many potential conflicts are eliminated

Grade-separated intersections



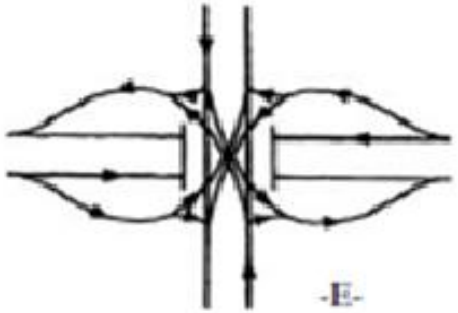




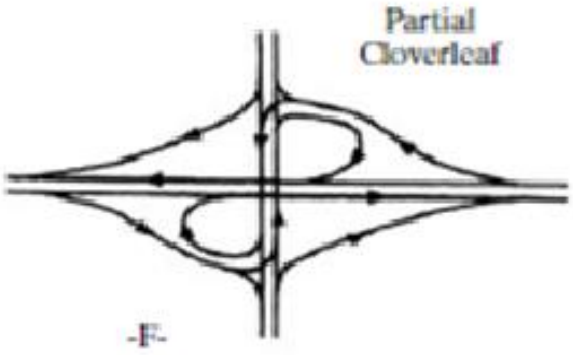


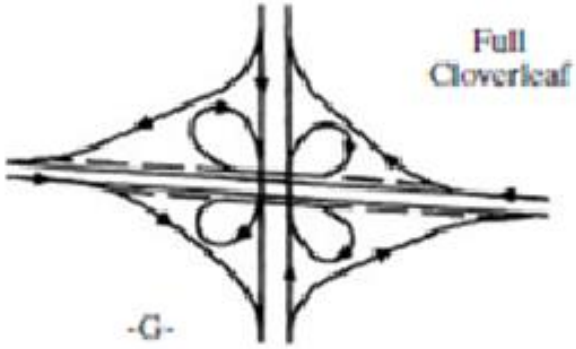
Grade-separated intersections

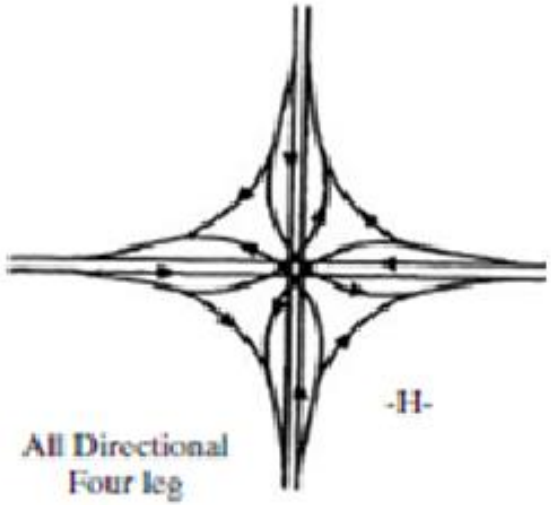
Grade-separated intersections



Single-Point
Urban Interchange





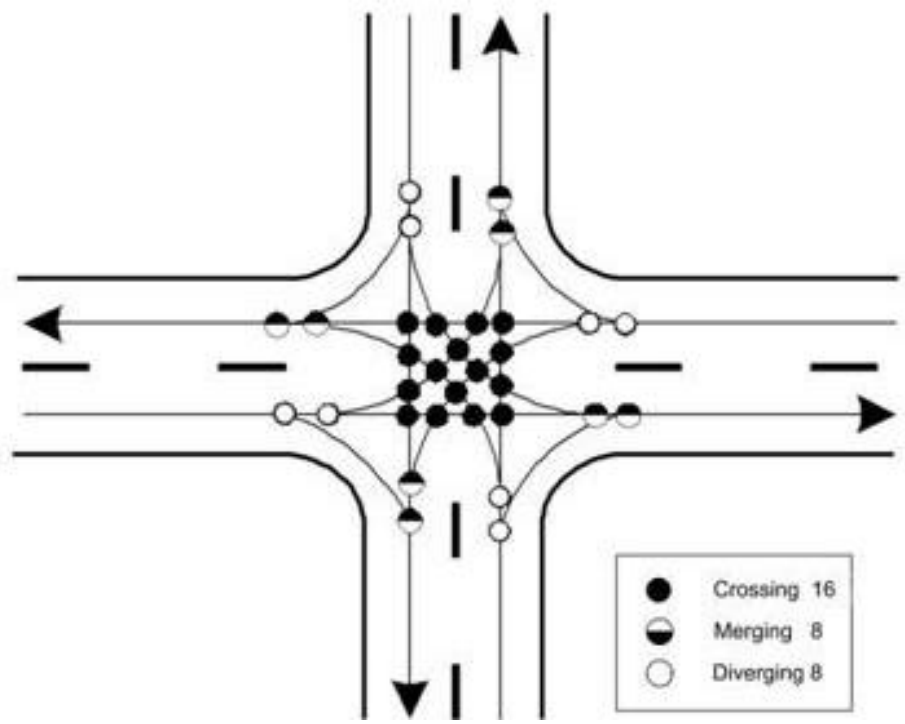


Grade-separated intersections

Intersection Design

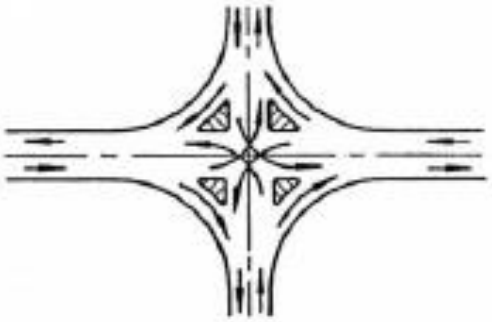
- **Intersections are classified into:**

3. **At-grade intersections:** do not provide for the flow of traffic at different levels and therefore there exist conflicts between intersecting streams of traffic.



Intersection Design

At-grade intersections



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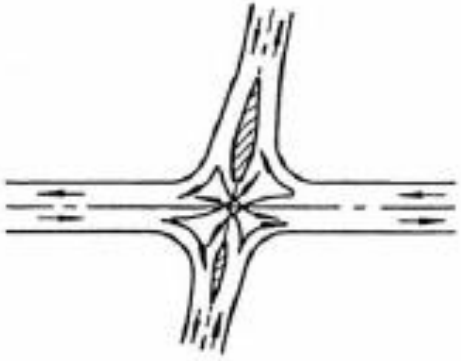

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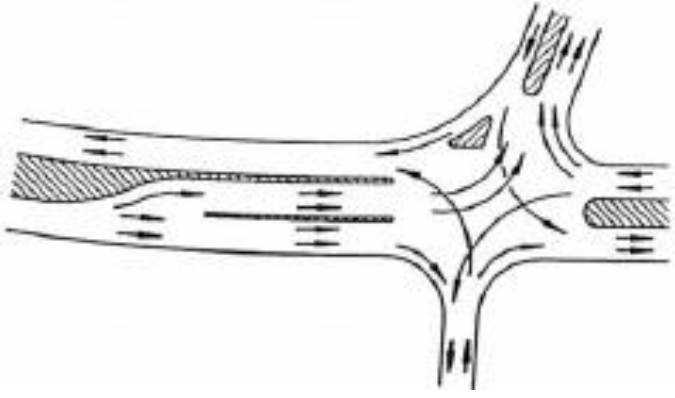

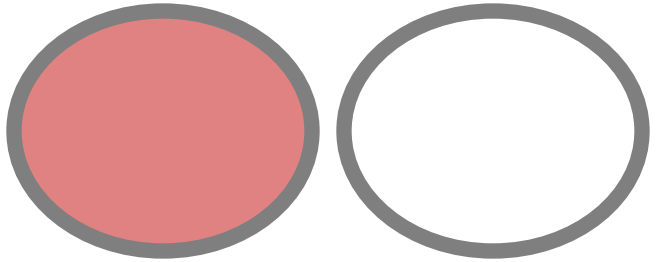

4.1 Types and Design of At Grade Intersections

Types of At-Grade Intersections

① **T or three-leg** intersections which consist of three approaches.

① **Four-leg** or cross intersections, which consist of four approaches.

① **Multi-leg** intersections, which consist of five or more approaches.

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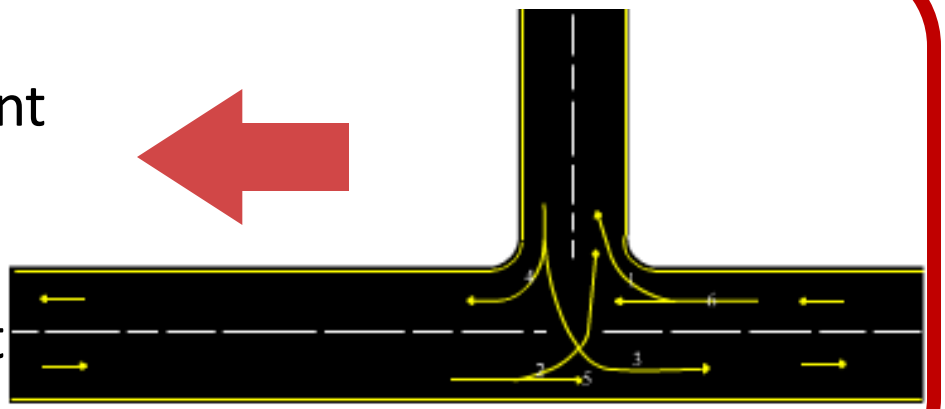
Types of At-Grade Intersections

① T or three-leg intersections:

- T intersections ranging from the simplest to a channelized one with divisional islands and turning roadways
- **Channelization** involves the provision of facilities such as pavement markings and traffic islands to regulate and direct conflicting traffic streams into specific travel paths

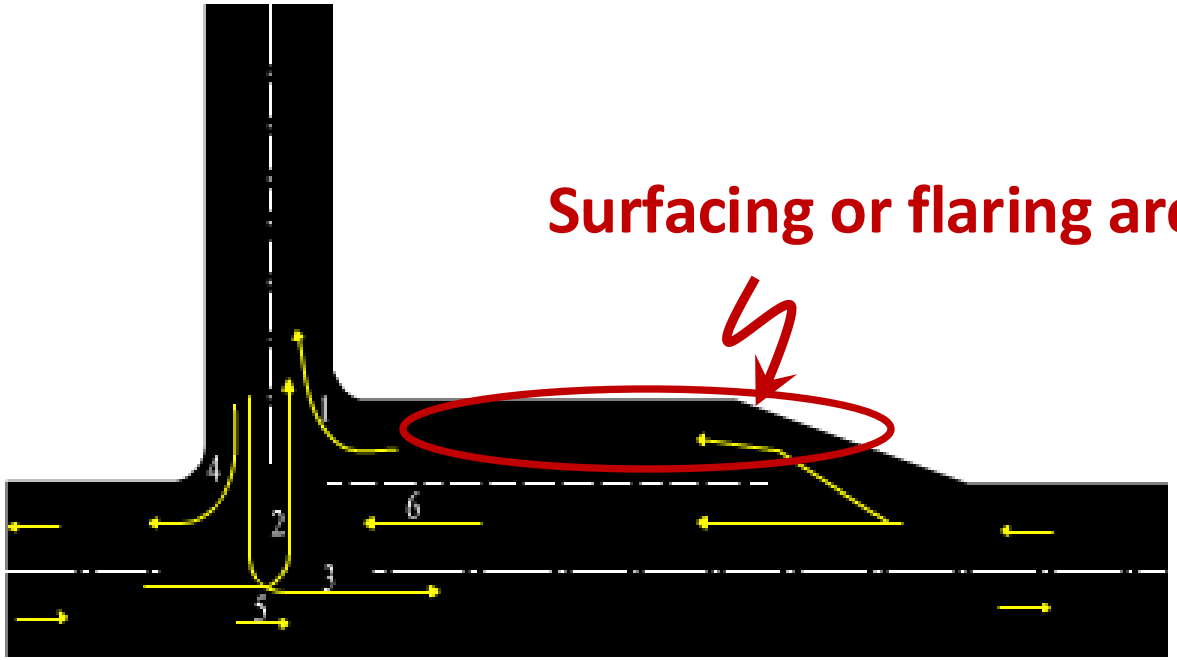
- Used when
  - Minor roads intersect important highways with an intersection angle less than 30 degrees.
  - In rural two-lane highways that carry light traffic.



Types of At-Grade Intersections

① T or three-leg intersections:

- At locations with higher speeds and turning volumes
  - increase the potential of rear-end collisions between through vehicles and turning vehicles, an additional area of surfacing or flaring is provided.

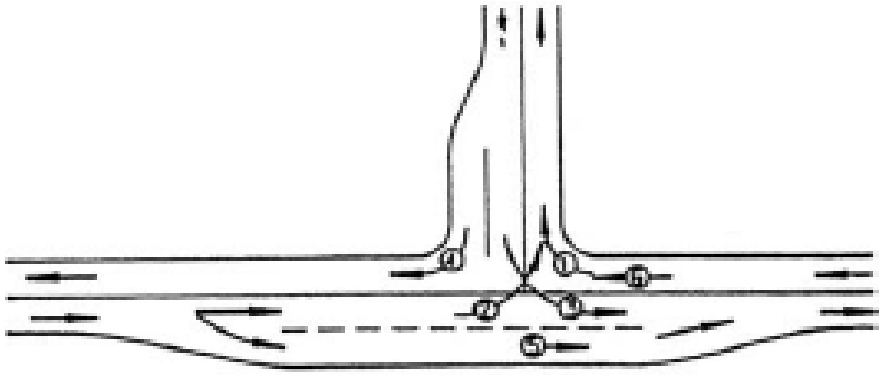


Types of At-Grade Intersections

① T or three-leg intersections:

- Where left-turn volume from a through road onto a minor road is sufficiently high, but does not require a separate left-turn lane.

- An auxiliary lane is provided to allow through vehicles to maneuver around left-turning vehicles.

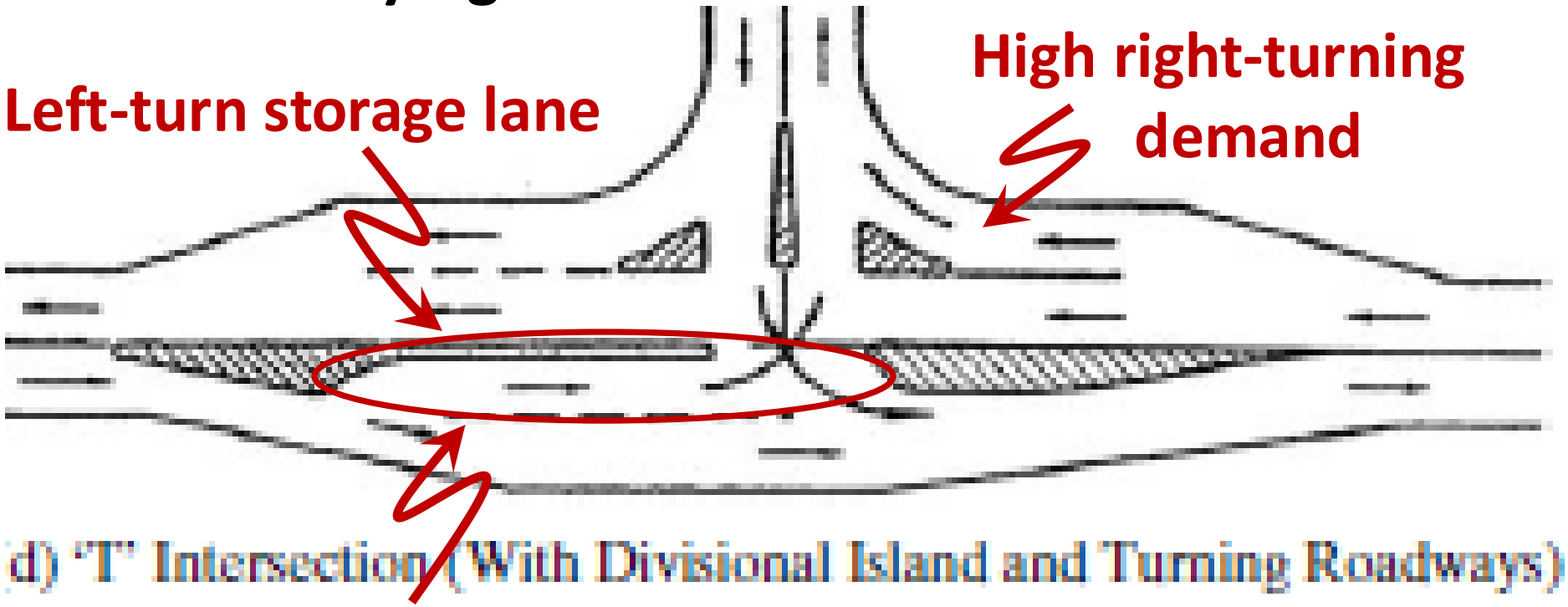


(c) 'T' Intersection (With Right-Hand Passing Lane)

Types of At-Grade Intersections

① T or three-leg intersections:

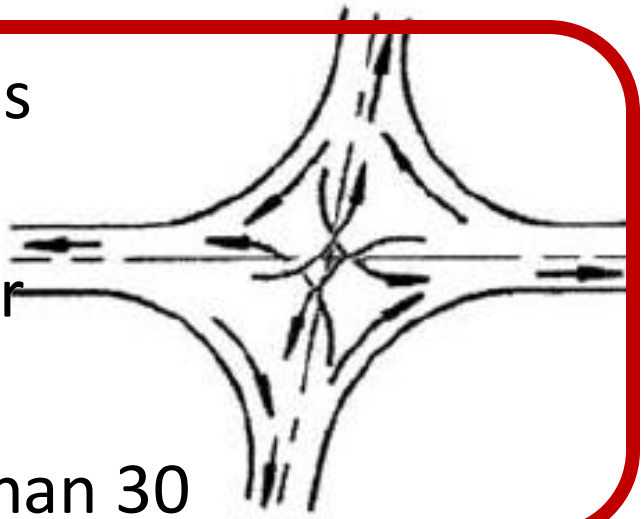
- Two-lane through road has been converted into a divided highway
- **Usually signalized**



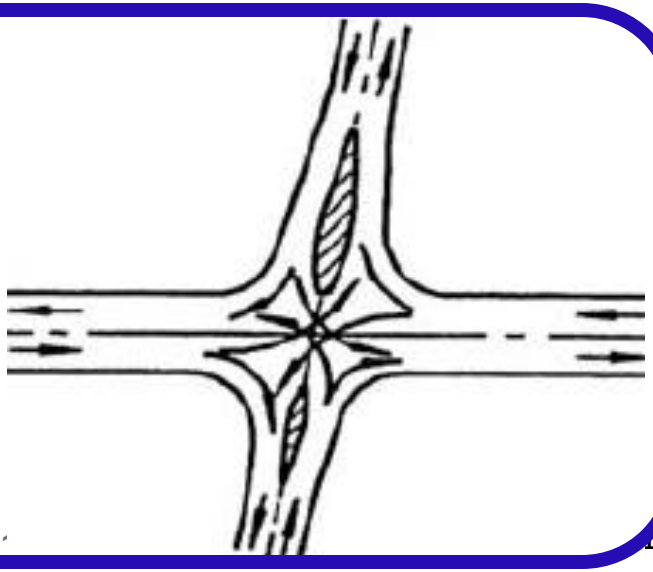
Types of At-Grade Intersections

② **Four-leg** intersections:

- Unchannelized, mainly at locations where minor or local roads cross,
- Where minor road crosses a major highway.
- Intersection angle is not greater than 30



- When right-turning movements are frequent
- Common in suburban areas where pedestrians are present



Types of At-Grade Intersections

② **Four-leg** intersections:

- At two-lane highways that are not minor crossroads
- Carries moderate volumes at high speeds or operates near capacity

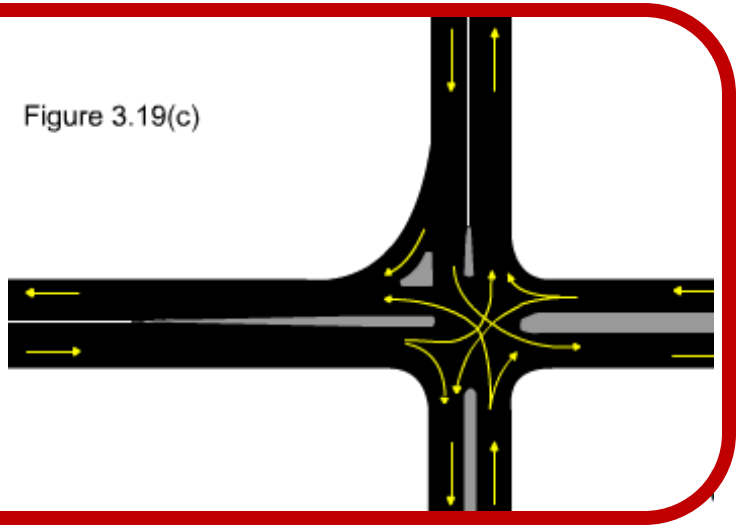
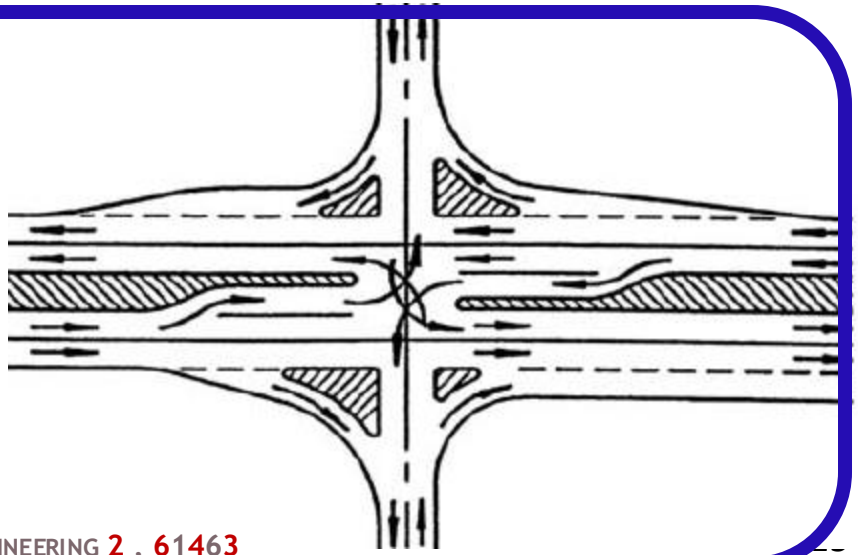


Figure 3.19(c)

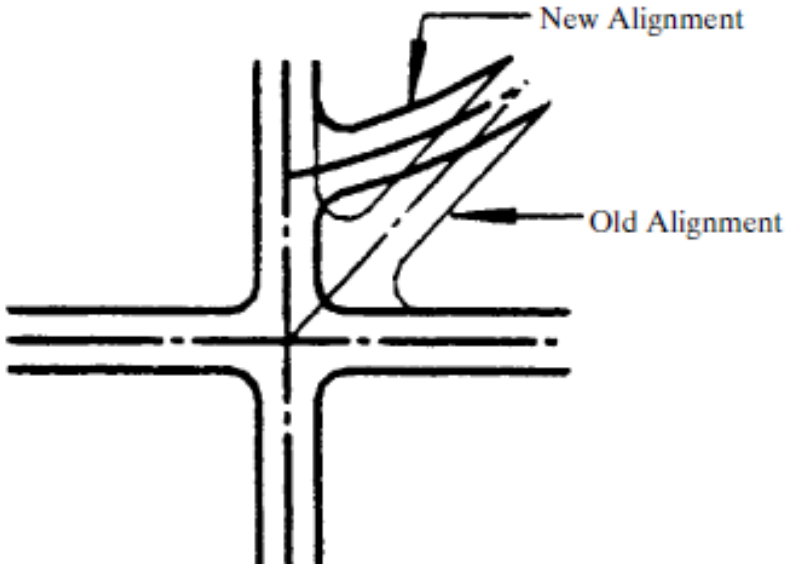
- At four-lane approaches carrying high through and turning volumes
- **Usually signalized**



Types of At-Grade Intersections

③ **Multi-leg** intersections:

- Whenever possible, this type of intersection should be avoided
- **One or more of the legs are realigned**, to remove some of the conflicting movements from the major intersection and thereby increase safety and operation.

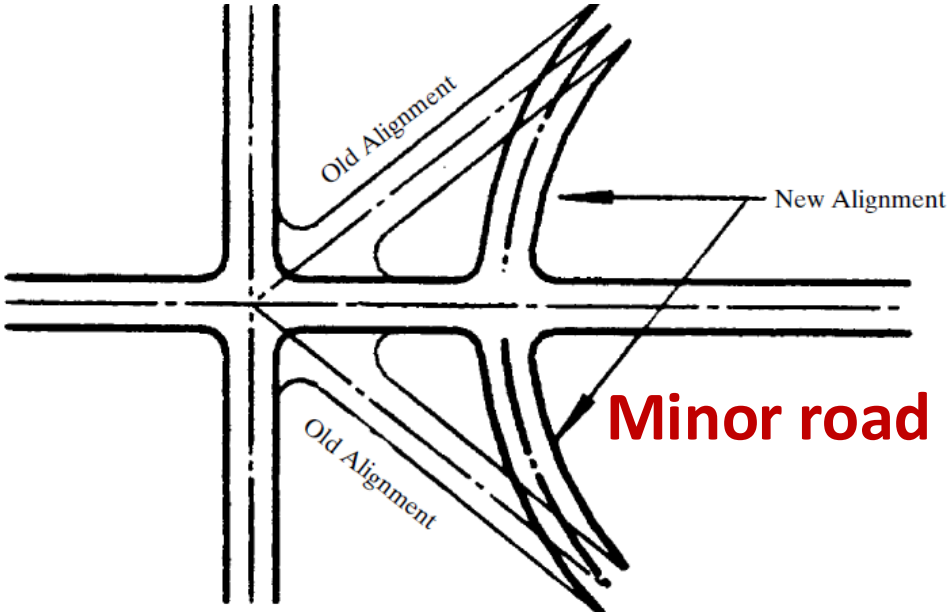


Types of At-Grade Intersections

③ **Multi-leg** intersections:

- **Intersection realignment**:
  1. Diagonal road are realigned to the minor road
  2. The distance between the intersections should be such that they can operate independently

❖ **If the right-to-left direction is the major road, each diagonal road is realigned to the road in the top-to-bottom direction, forming two additional T intersections**



Types of At-Grade Intersections

④ **Traffic Circles**: It is a circular intersection that provides a circular traffic pattern with significant reduction in the crossing conflict points

– Three Types of traffic circles:

a. Rotaries

b. Neighborhood traffic circles

c. Roundabouts

Types of At-Grade Intersections

a. Rotaries:

- Large diameters that are usually greater than 300ft.
- Allowing speeds exceeding 30 mi/h, with a minimum horizontal deflection of the path.

b. Neighborhood traffic circles:

– Their diameters are much smaller than rotaries and therefore allow much lower speeds.

- At intersection of local streets as a means of traffic calming and/or as an aesthetic device
- Using pavement markings, not raised islands
- Stop control or no control
- Parking might be allowed within circulatory roadway

Types of At-Grade Intersections

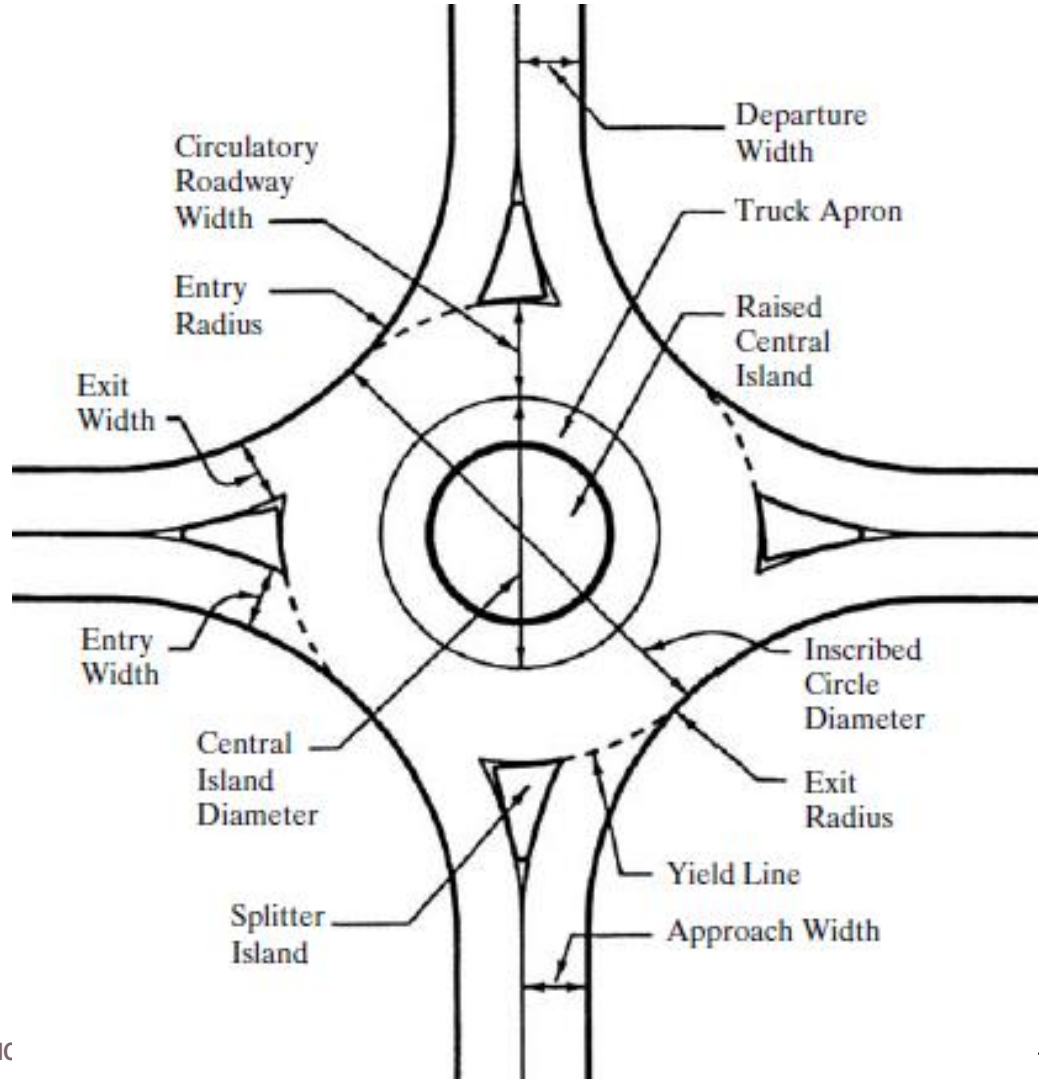
c. **Roundabouts:** have specific defining characteristics that separate them from other circular intersections

- These characteristics include:
  - Yield control at each approach.
  - Separation of conflicting traffic movements by pavement markings or raised islands.
  - Geometric characteristics of the central island that typically allow travel speeds of less than 30 mi/h.
  - Parking not usually allowed within the circulating roadway.

Types of At-Grade Intersections

c. Roundabouts:

Geometric elements of a single-lane modern roundabout



Types of At-Grade Intersections

c. **Roundabouts:** Roundabouts can be further categorized into six classes based on the size and environment in which they are located.
   - Mini roundabouts
   - Urban compact roundabouts
   - Urban single-lane roundabouts
   - Urban double-lane roundabouts
   - Rural single-lane roundabouts
   - Rural double-lane roundabouts

Types of At-Grade Intersections

c. Roundabouts:

Table 7.1 Characteristics of Roundabout Categories

Design Element	*Mini-Roundabout*	*Urban Compact*	*Urban Single-Lane*	*Urban Double-Lane*	*Rural Single-Lane*	*Rural Double-Lane*
Recommended maximum entry design speed	25 km/h (15 mi/h)	25 km/h (15 mi/h)	35 km/h (20 mi/h)	40 km/h (25 mi/h)	40 km/h (25 mi/h)	50 km/h (30 mi/h)
Maximum number of entering lanes per approach	1	1	1	2	1	2
Typical inscribed circle diameter[1]	13 to 25 m (45 ft to 80 ft)	25 to 30 m (80 to 100 ft)	30 to 40 m (100 to 130 ft)	45 to 55 m (150 to 180 ft)	35 to 40 m (115 to 130 ft)	55 to 60 m (180 to 200 ft)
Splitter island treatment	Raised if possible, crosswalk cut if raised	Raised, with crosswalk cut	Raised, with crosswalk cut	Raised, with crosswalk cut	Raised and extended, with crosswalk cut	Raised and extended, with crosswalk cut
Typical daily service volumes on four-leg roundabout (veh/day)	10,000	15,000	20,000	Refer to the source	20,000	Refer to the source

[1]Assumes 90° entries and no more than four legs.