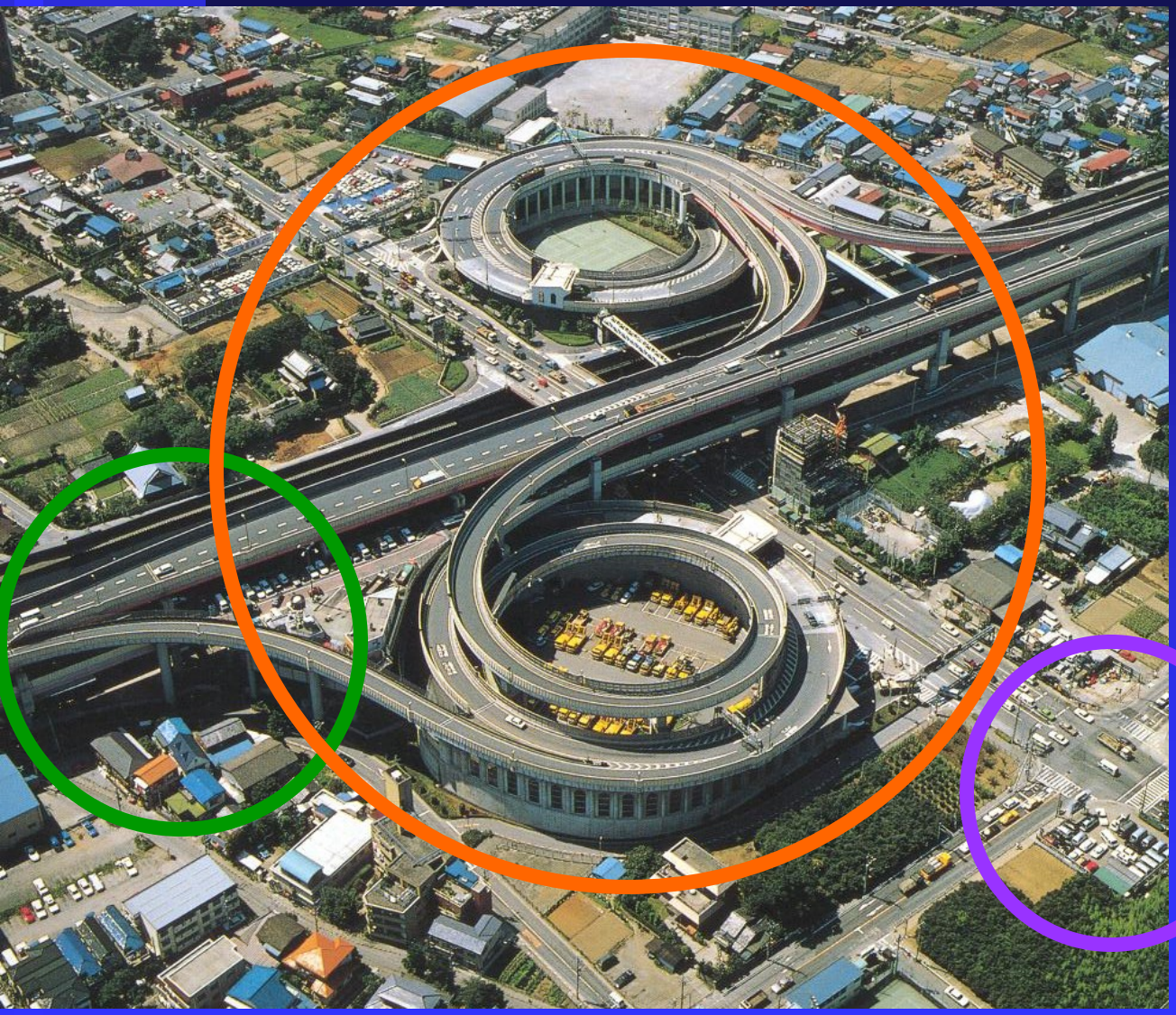
- Become familiar with the typical intersection types (See figures 7-1 thorugh 7-5) and their characteristics
- Become familiar with general design principles for at-grade intersections (CE561 will dig into the details of at-grade intersection design.)
- Know how to find minimum radii for the curves at at-grade intersections
- Know what the channelization is, objectives for using channelization, and factors affecting its application

What we cover in class today…

- Types of intersections
- Objectives in the design of at-grade intersections
- Alignment considerations
- Grade considerations
- Curve types and minimum radii
- Channelization: what it is, why we need it, how we provide it

Intersection types



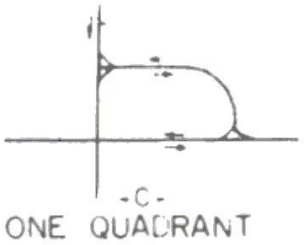
At-grade

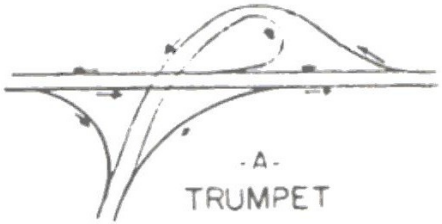
Grade separated

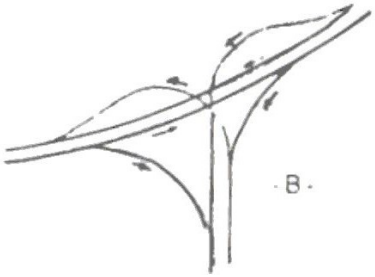
With ramps (Interchanges)

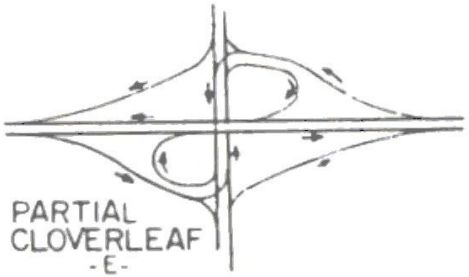
Without ramps (meaning no connection between the intersection roads!)

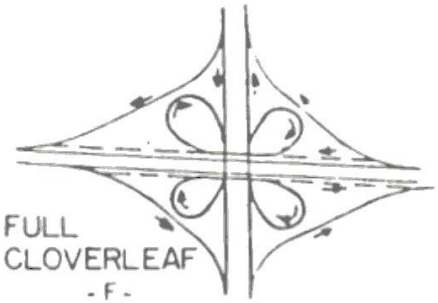
Examples of grade separated interchanges



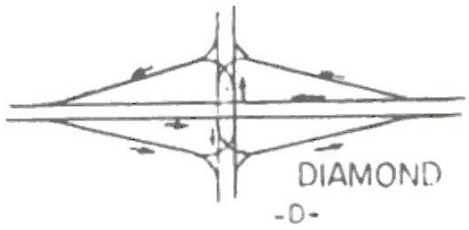


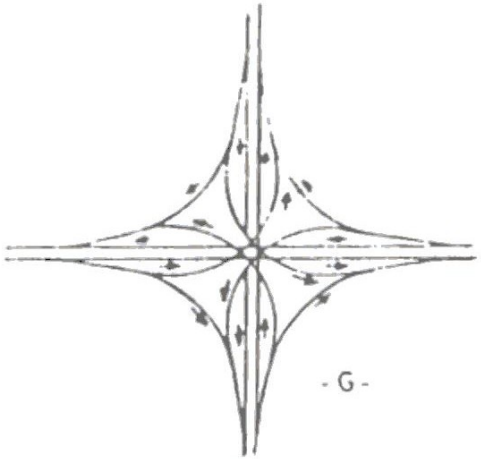






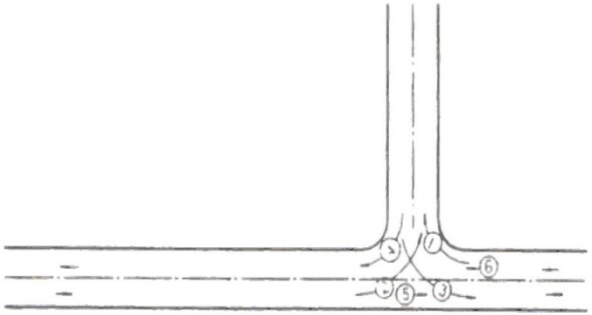
Examples of grade separated interchanges (cont)





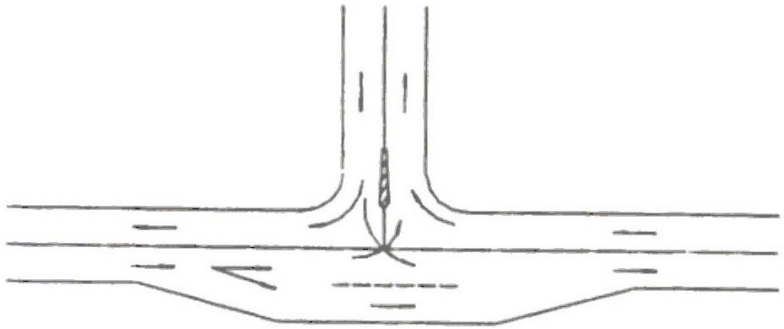
More examples of directional interchanges

At-grade intersections (pay attention to channelization techniques): T or 3-leg



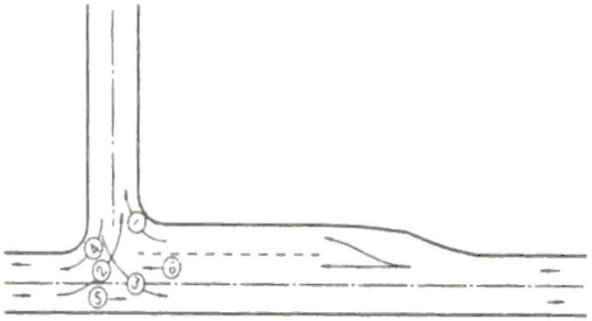
PLAIN 'T' INTERSECTION

(a)



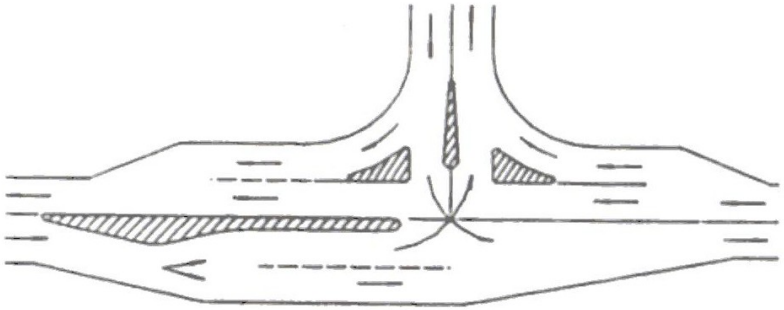
WITH DIVISIONAL ISLAND AND RIGHT PASSING LANE

(c)



'T' INTERSECTION

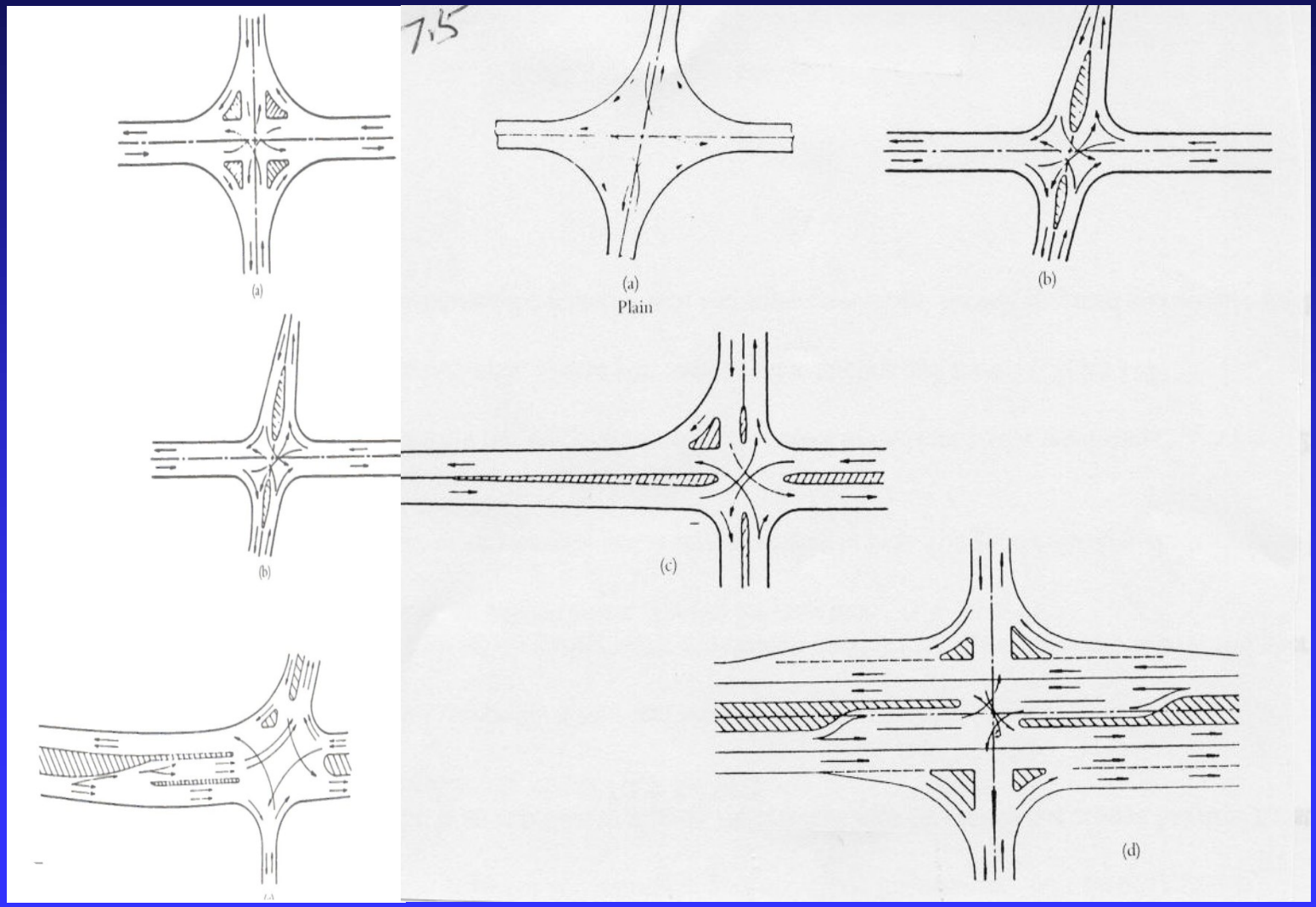
(With Right Turn Lane)



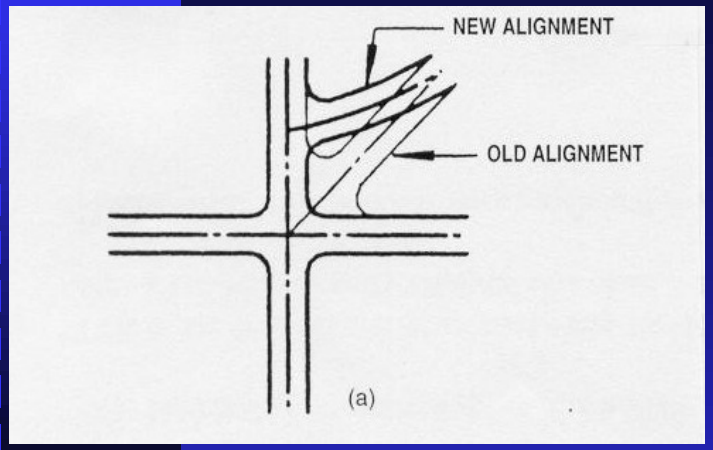
WITH DIVISIONAL ISLANDS AND TURNING ROADWAYS

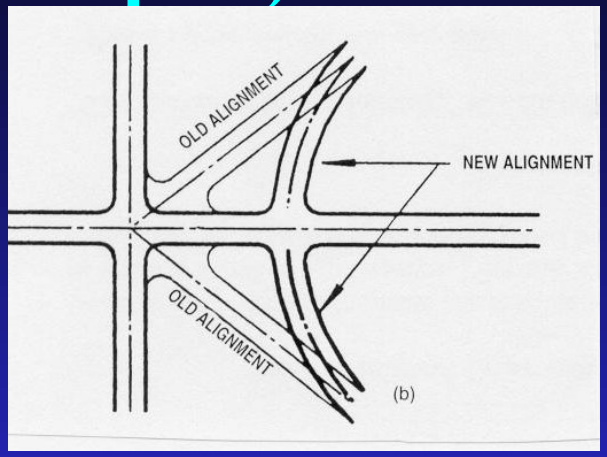
(d)

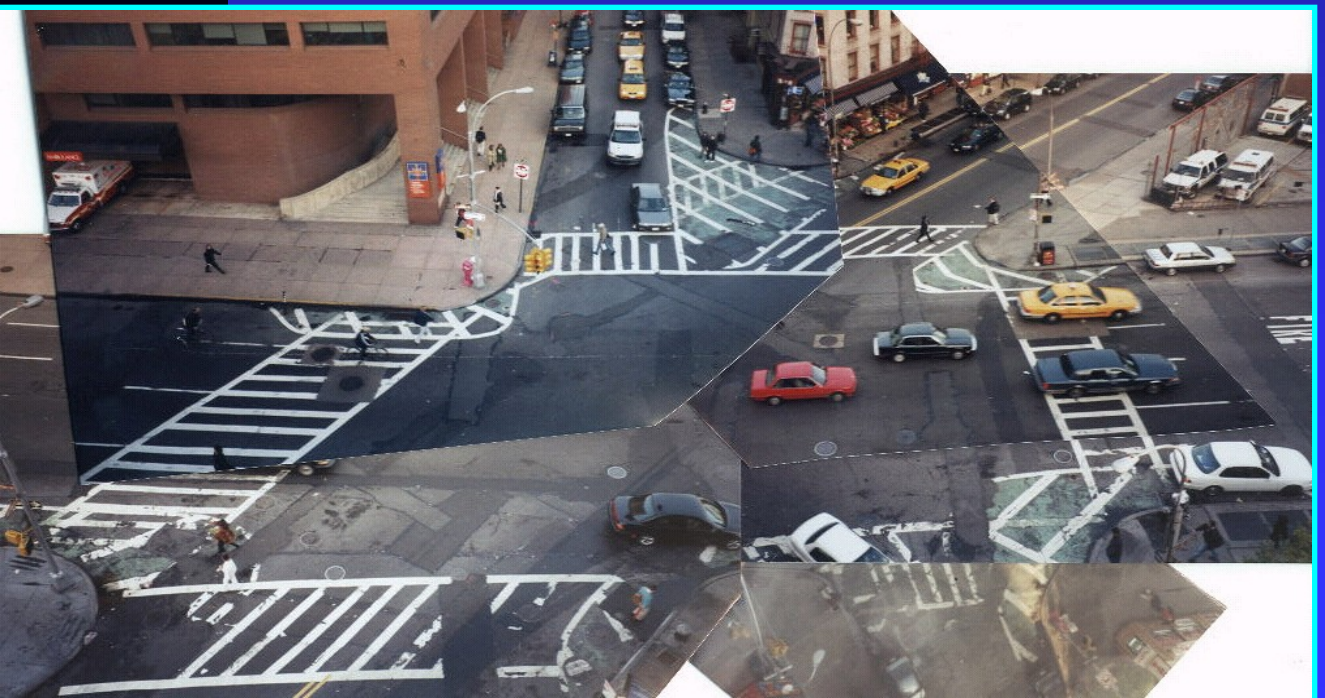
At-grade intersections (pay attention to channelization techniques): 4-leg



At-grade intersections (pay attention to channelization techniques): Multi-leg



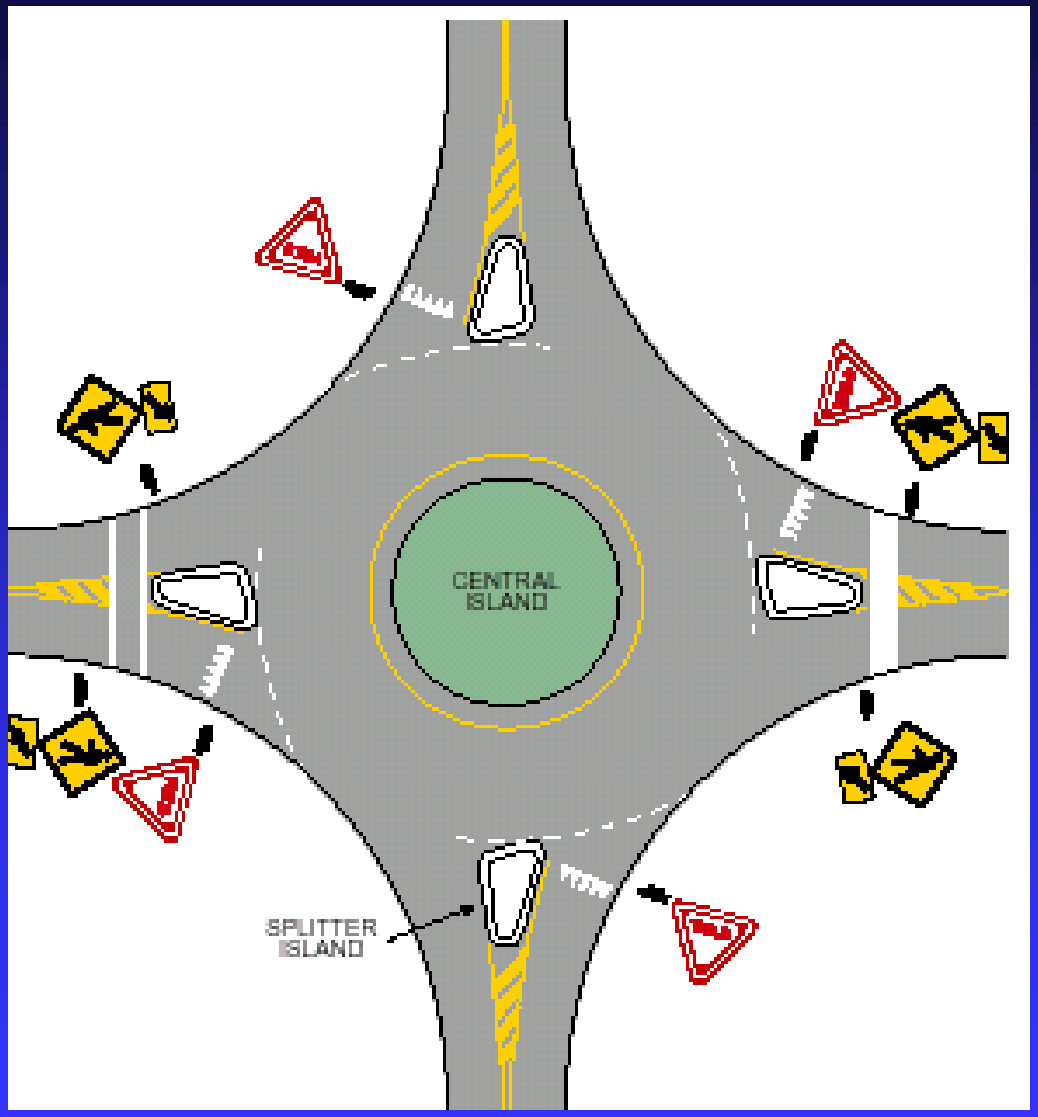




Mulry Square in Greenwich Village, Manhattan, New York City

Roundabouts – different from circles

- Circles may have a signal, STOP signs, no-control at entry – Roundabouts are always controlled by Yield signs.
- Splitter islands
- Peds are not allowed to use the central island
- No parking in the circle
- Circulating vehicles always have the ROW.



Typical markings for roundabouts with one lane

Roundabouts – different from circles

In Australia

In Maryland

Advantages:

- Provides non-stop movements
- Reduce crash occurrences
- Reduce crash severity
- Esthetically appealing
- Function as a traffic calming measure

Good for low to medium traffic. Definitely NOT for high volume intersections ➔ Too many weavings

In Norway

At-grade intersection design objectives and considerations

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

Operating characteristics of both the vehicles and pedestrians

Adequate pavement width and approach sight distances must be provided.

At-grade intersection design considerations

- Alignment and profile design
- Angle of intersecting roads
- Suitable channelization system for the traffic pattern
- Minimum required widths of turning roadways
- Adequate sight distance for the type of traffic control used (no control, Yield, Stop, Signal)

Alignment

Longer walking distance

Angle of turn

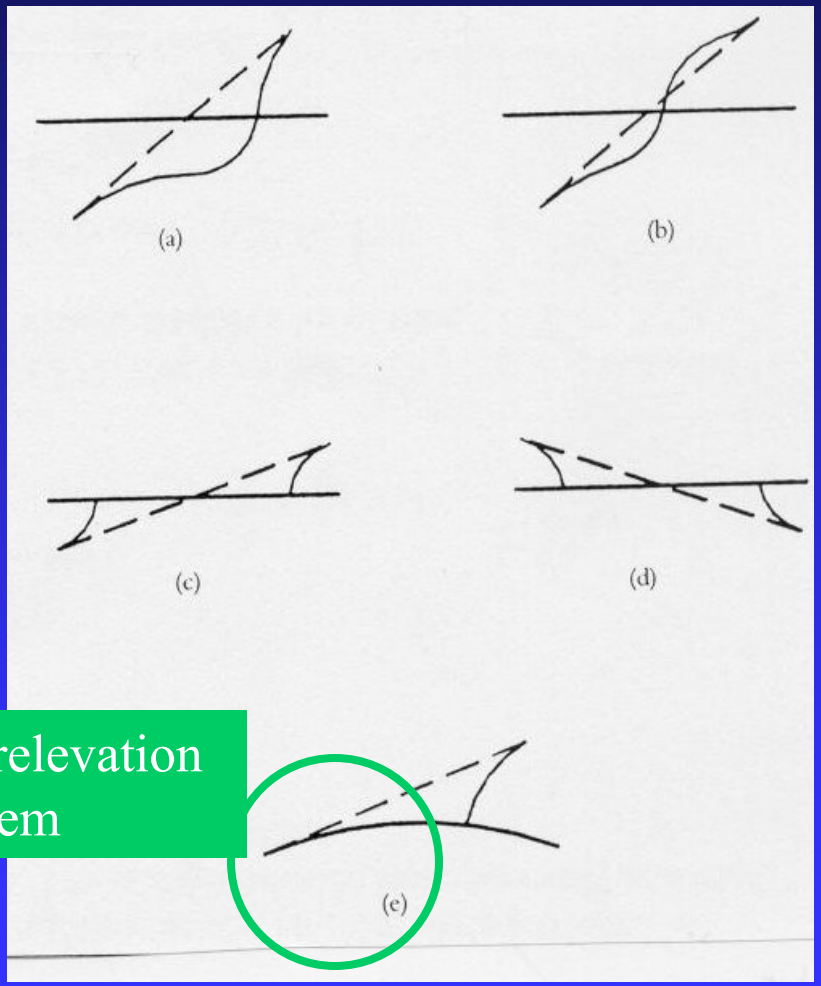
Obtuse angle

The angle of turns should be 60 to 120 degrees.

Acute angle

Wider pavement needed for turning vehicles

Suggested improvements to intersections with acute "angle" problems



Superelevation problem

Profile

- Make it as flat as possible
- Avoid approach grades in excess of 3%
- Avoid grade changes at intersections (Crest → sight distance problems, Sag → drainage problems)
- The grade line of the major highway should be carried through the intersection. Adjust the grade for the normal crown of the crossroad to an inclined cross section at its junction with the major road. → A good example at Columbia Lane and Grandview Road (the signalized intersection on Columbia Lane just north of DI).

Curves at at-grade intersections

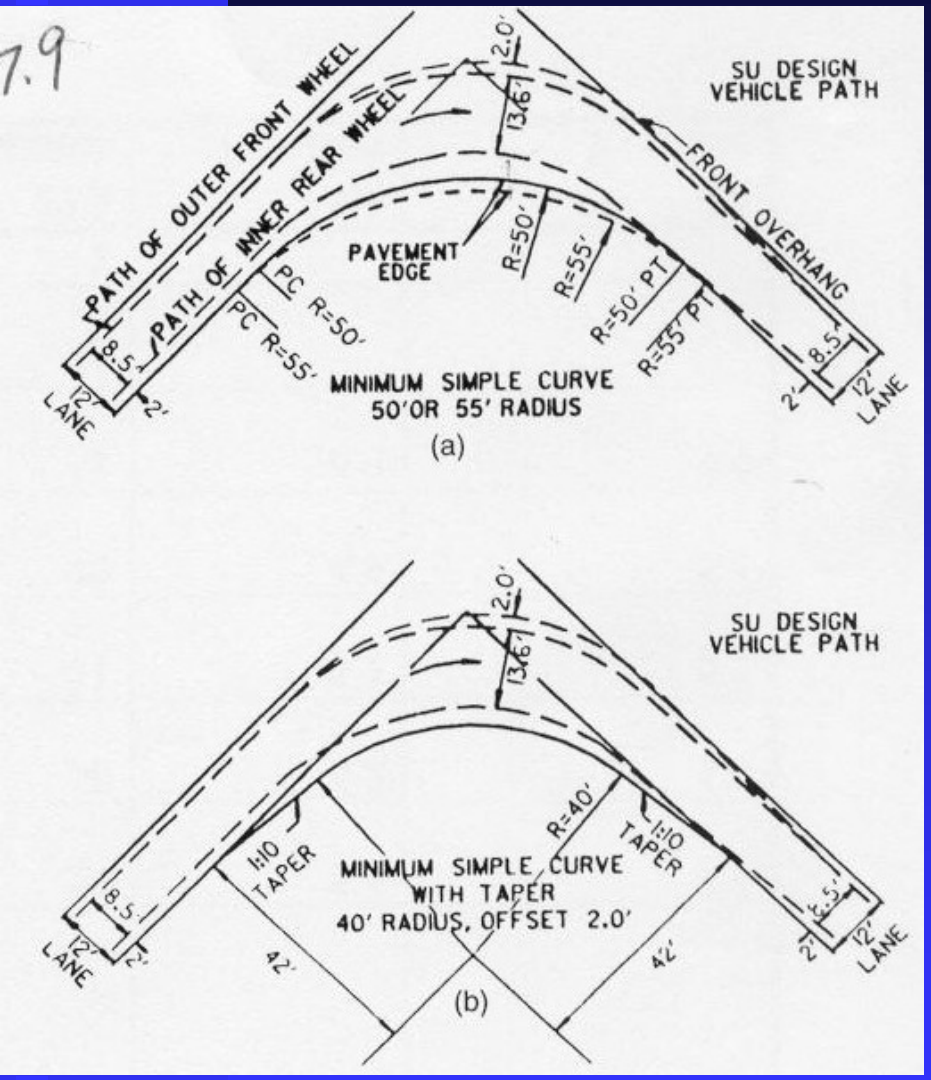
Rule 1: When the turning speed at an intersection is assumed to be 15 mph or less, the curves for the pavement edges are designed to conform to at least the minimum turning path of the design vehicle. If the speed is greater than this, the design speed is also considered to determine the radius (Remember? $R = u^2/(g[e + f_s])$. ➔ This means that you are not supposed to use the values in Table 7-2 and 7-3 in the textbook.

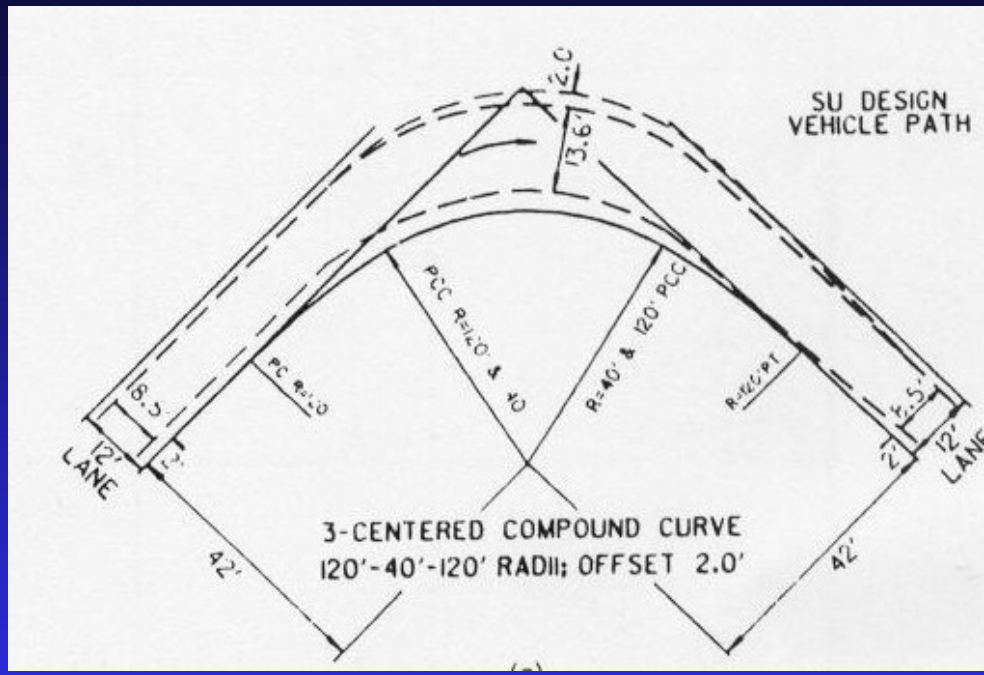
Rule 2: The angle of intersection affects the curve design.

Typical types:

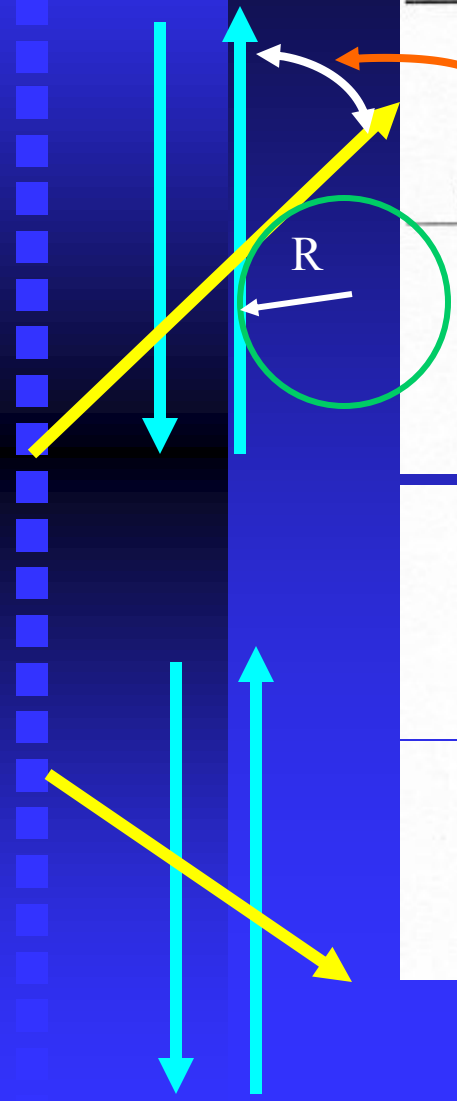
- Simple curve
- Simple curve with taper
- 3-centered compound curve

Three typical curve design methods





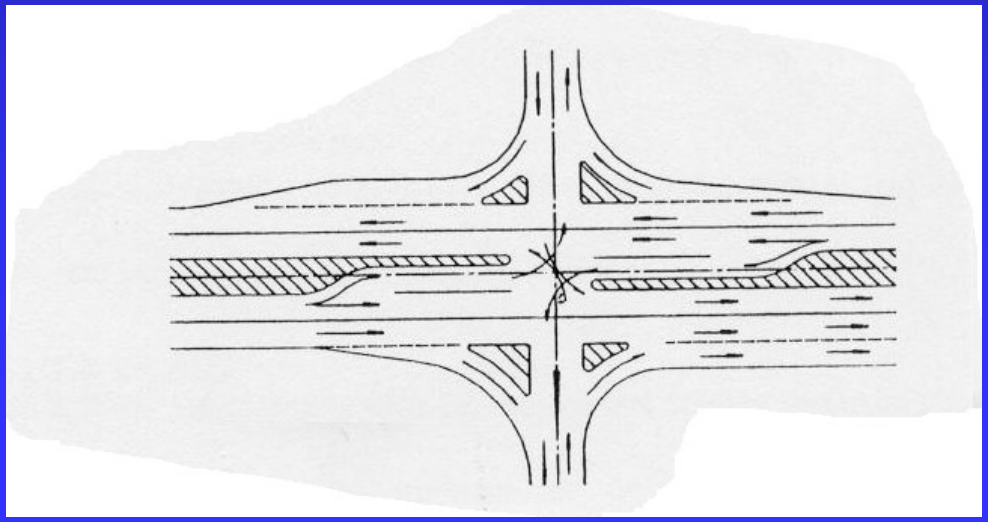
Minimum edge of pavement designs: Simple curve and simple curve with taper (Table 7.2)



Angle of Turn (degrees)	Design Vehicle	Simple Curve Radius	Simple Curve Radius with Taper		
			Radius (ft)	Offset (ft)	Taper (ft:ft)
30	P	60	—	—	—
	SU	100	—	—	—
	WB-40	150	—	—	—
	WB-50	200	—	—	—
	WB-62	360	220	3.0	15:1
90	P	30	20	2.5	10:1
	SU	50	40	2.0	10:1
	WB-40	—	45	4.0	10:1
	WB-50	—	60	4.0	15:1
	WB-62	—	120	4.0	30:1
120	P	—	20	2.0	10:1
	SU	—	30	3.0	10:1
	WB-40	—	35	5.0	8:1
	WB-50	—	45	4.0	15:1
	WB-62	—	100	5.0	25:1

Channelization: objectives

- Direct the paths of vehicles
- Control the merging, diverging, and crossing angle of vehicles
- Reduce the amount of paved area
- Provide a clear indication of the proper path for different movements
- Give priority to the predominant movements
- Provide pedestrian refuge
- Provide separate storage lanes for turning vehicles
- Provide space for traffic control devices for visibility
- Control prohibited turns
- Separate different traffic movements at signalized intersections with multiple-phase signals
- Restrict the speeds of vehicles



Channelization: considerations

- Motorists should not be required to make more than one decision at a time.
- Sharp reverse curves and turning paths greater than 90 degrees should be avoided.
- Merging and weaving areas should be as long as possible, but other areas of conflict between vehicles should be reduced to a minimum
- Crossing traffic streams that do not weave or merge should intersect at 90 degrees, although a range of 60-120 degrees is acceptable
- The intersecting angle of merging streams should be such that adequate sight distance is provided.
- Refuge areas for turning vehicles should not interfere with the movement of through vehicles
- Prohibited turns should be blocked wherever possible
- Decisions on the location of essential traffic control devices should be a component of the design process.