Grade separation

- **Grade separation** is the process of aligning a junction of two or more transport axes at different heights (grades) such that they do not disrupt the flow of traffic on one another when they cross.

- This is achieved by building bridges over or tunnels under the crossing site, allowing roads, railways and canals to pass another without interrupting the flow of traffic.

Advantages

- Roads with grade separation generally allow traffic to move freely, with less interruptions, and at higher overall speeds; hence why speed limits are typically higher for grade-separated roads.
- In addition, less conflict between traffic movements reduces the chances for accidents.

Disadvantages

- Grade-separated junctions are however large, and costly

- Their height can be obtrusive, and combined with the large traffic volumes that grade-separated roads attract, tend to make them unpopular to nearby landowners and residents.

- Grade-separation is expensive, time-consuming and requires significant engineering effort compared to provision of an at-grade intersection

- A junction which is grade-separated is an *interchange*, as opposed to an *intersection* which is not grade-separated

- a lack of grade separation is described as "at-grade".

- An **interchange** is a road junction that typically utilizes grade separation, and one or more ramps, to permit traffic on at least one road to pass through the junction without crossing any other traffic stream.
- It differs from an intersection, at which roads cross at grade.
- Interchanges are almost always used when at least one of the roads is a freeway, though they may occasionally be used at junctions

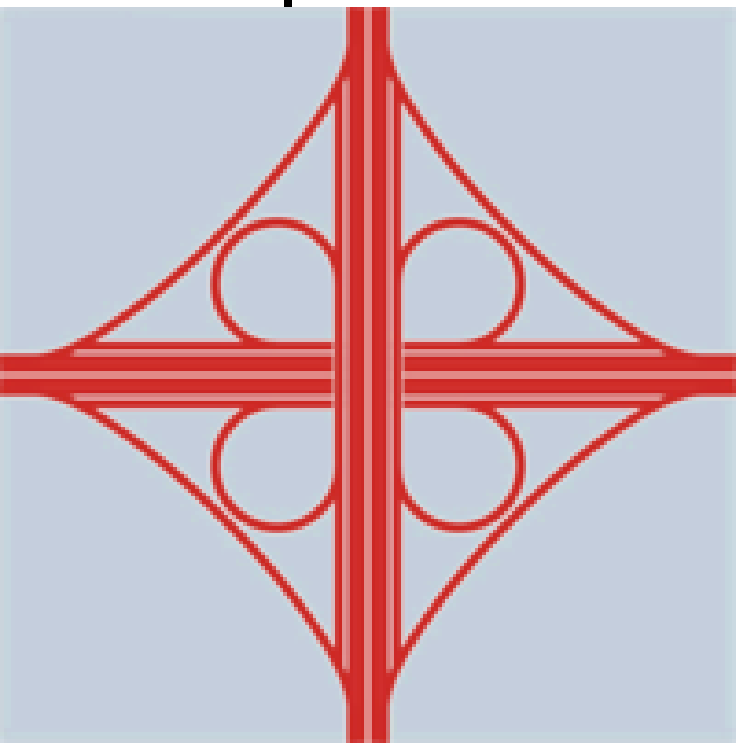
Stack interchange

- A **stack** interchange is a free-flowing junction between two or more roads that allows turning in all directions.

- This is the best type of four-way interchange for the driver and in terms of capacity, but is also the most expensive, both in terms of land and in terms of construction.

Cloverleaf interchange

- A **cloverleaf interchange** is a two-level interchange in which right turns are handled by loop ramps.
- To go right, vehicles first pass either over or under the other road, then turn right onto a one-way three-fourths loop ramp (270°) and merge onto the intersecting road.



- The major advantage of clover leafs is that they require only one bridge, which makes such junctions cheap if land is plentiful.

PROBLEMS

- A point of conflict is the merging of exiting and entering traffic in the same lane, known as weaving.
- Most road authorities have since been implementing new interchange designs with more straight exit ramps that do not result in weaving.
- Clover leafs also have a considerable land consumption

TRUMPET

- A *trumpet* is an interchange traditionally used where one freeway terminates at another freeway; it involves at least one loop ramp (for traffic leaving the terminating freeway) whose overpass is shared by traffic connecting to the terminating freeway.

- These junctions are also useful for toll roads as they concentrate all entering and leaving traffic in a single stretch of road, where toll booths can be installed.

TRUMPET

Directional T

- A *Directional T* provides for high-speed ramps in all directions at a three-way interchange.

- A *semi-directional T* does the same, but some of the splits and merges are switched to avoid ramps to and from the passing

Diamond interchange

- Diamond interchanges are used where a highway crosses a minor road. The highway itself will be grade-separated from the minor road, a bridge being provided for one or the other.

- Approaching the interchange from either direction, an off-ramp diverges only slightly from the freeway and runs directly across the minor road, becoming an on-ramp which returns to the freeway in similar fashion.

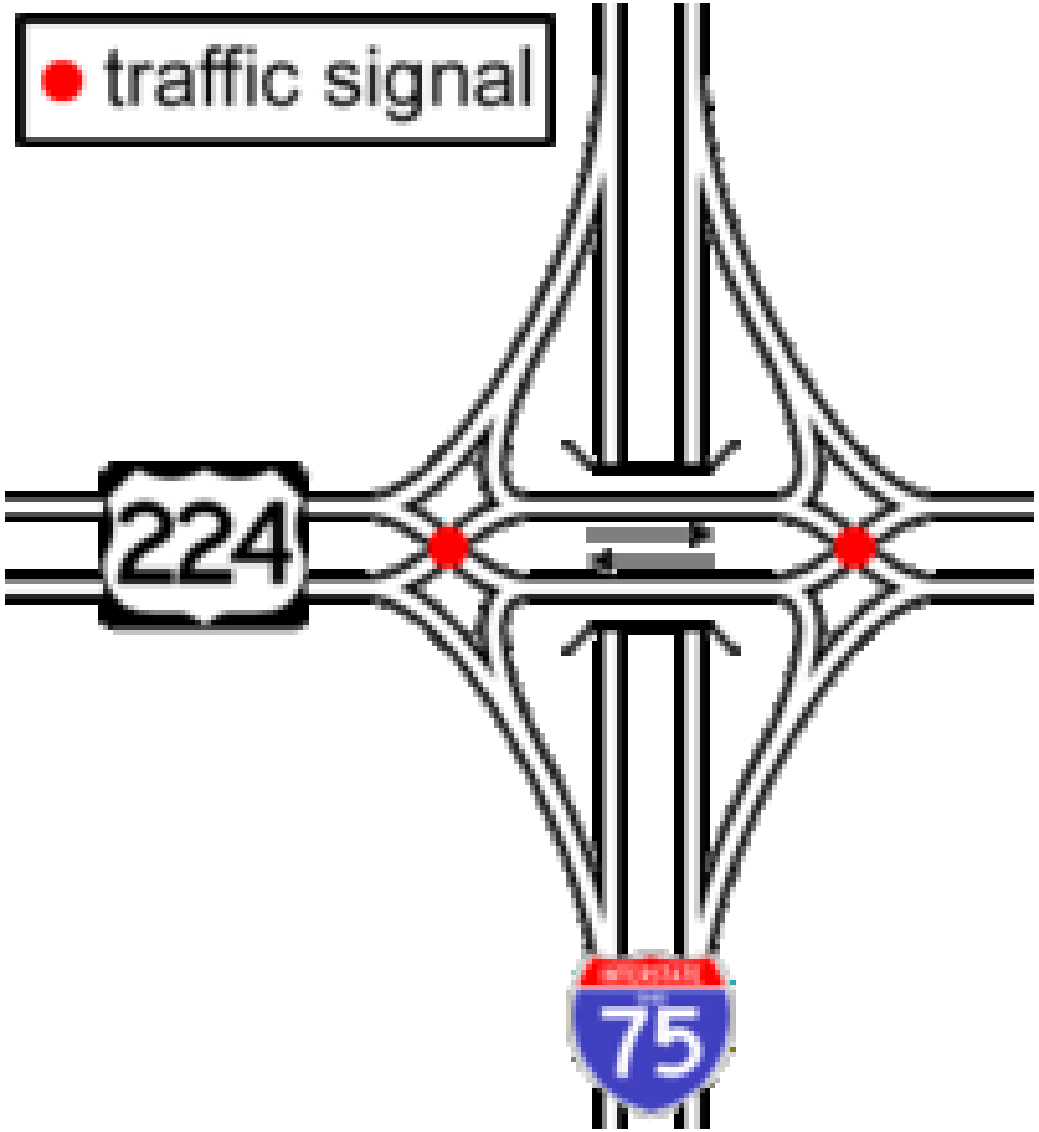
- The diamond interchange makes more efficient use of space than most types of highway interchange, and avoids the interweaving traffic flows that occur in interchanges such as the cloverleaf.

- Thus, it is most effective in areas where traffic is light and a more expensive interchange type is not needed.

- But where there is significant traffic, the two intersections within the interchange may cause congestion and accidents, requiring additional features such as traffic lights and extra lanes dedicated to turning traffic, or a pair of roundabouts to create a type of junction called a *dumbbell interchange*.

Diverging diamond interchange

- A **diverging diamond interchange** is a rare form of diamond interchange in which the two directions of traffic on the non-highway road cross to the opposite side on both sides of the bridge at the freeway.
- It is unusual in that it requires traffic on the highway overpass (or underpass) to briefly drive on the *opposite* side of the road from that which they are accustomed.

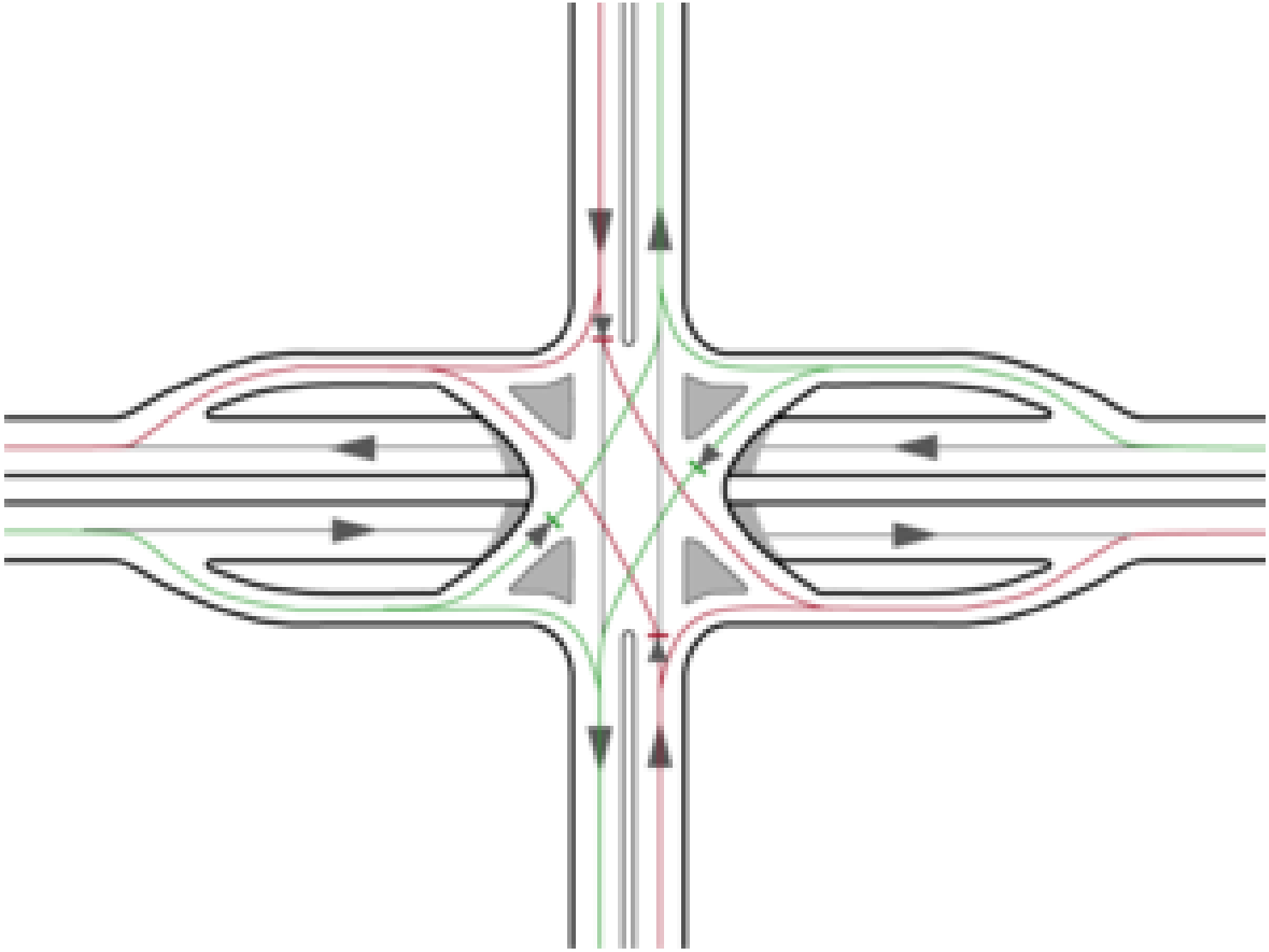

traffic signal
224
75

- The diverging diamond interchange allows for two-phase operation at all signalized intersections within the interchange.

- This is a significant improvement in safety, since no right turns must clear opposing traffic and all movements are discrete, with most controlled by traffic signals.

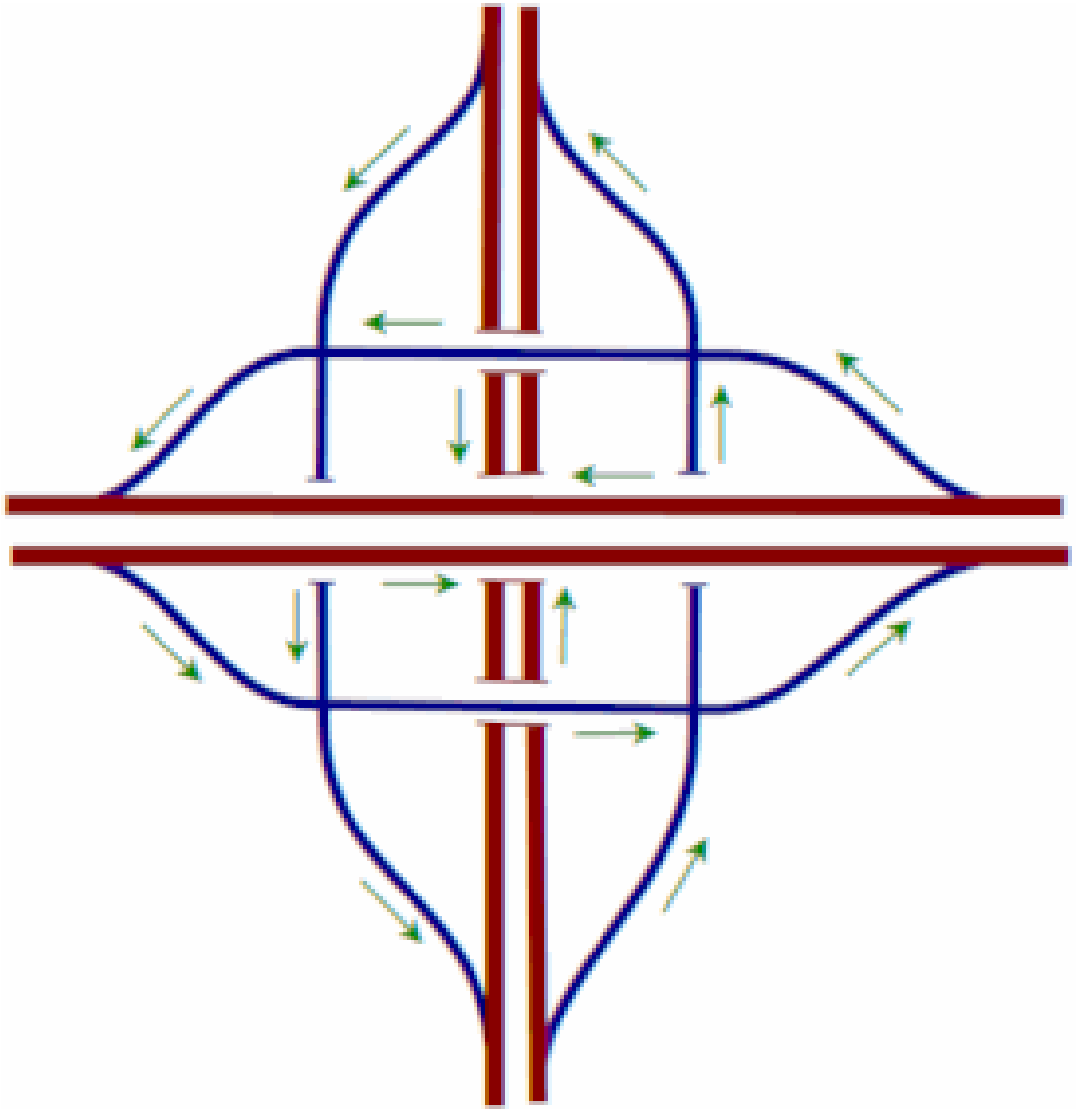
Single-point urban interchange

- . It is similar in form to a diamond interchange but has the advantage of allowing opposing left turns to proceed simultaneously, by compressing the two intersections of a diamond into one single intersection over or under the free-flowing road.



Volleyball interchange

- A **volleyball interchange** is a three-level interchange where through traffic on both main roads is grade-separated from intersections which handle transferring traffic.
- It is similar in design to a three-level stacked roundabout except for its use of (usually signalized) conventional intersections, and can be thought of as two diamond interchanges fused together.



- In a volleyball interchange, the two main roads are on separate levels, and on a third level, usually in the middle, there is a square of one-way roads.
- The square circulates counter-clockwise except in countries where traffic drives on the left. At each corner of the square is the terminal of an exit ramp from one main road and an entrance ramp to the other main road.

- Traffic transferring from one road to the other to make an overall right turn only passes through one corner of the square, at which point a right turn is made.
- Transfer traffic making an overall left turn must proceed straight through the first intersection it encounters, turn left at the next, and then proceed straight through a third intersection to enter the other main roadway.

Parclo interchange

- The P**arclo interchange** (short for **partial cloverleaf interchange**) is a successor to the cloverleaf interchange.
- The parclo interchange was developed by the Ontario Ministry of Transportation as a replacement for the cloverleaf
- Removing the dangerous weaving patterns and allowing for more acceleration and deceleration space on the freeway.