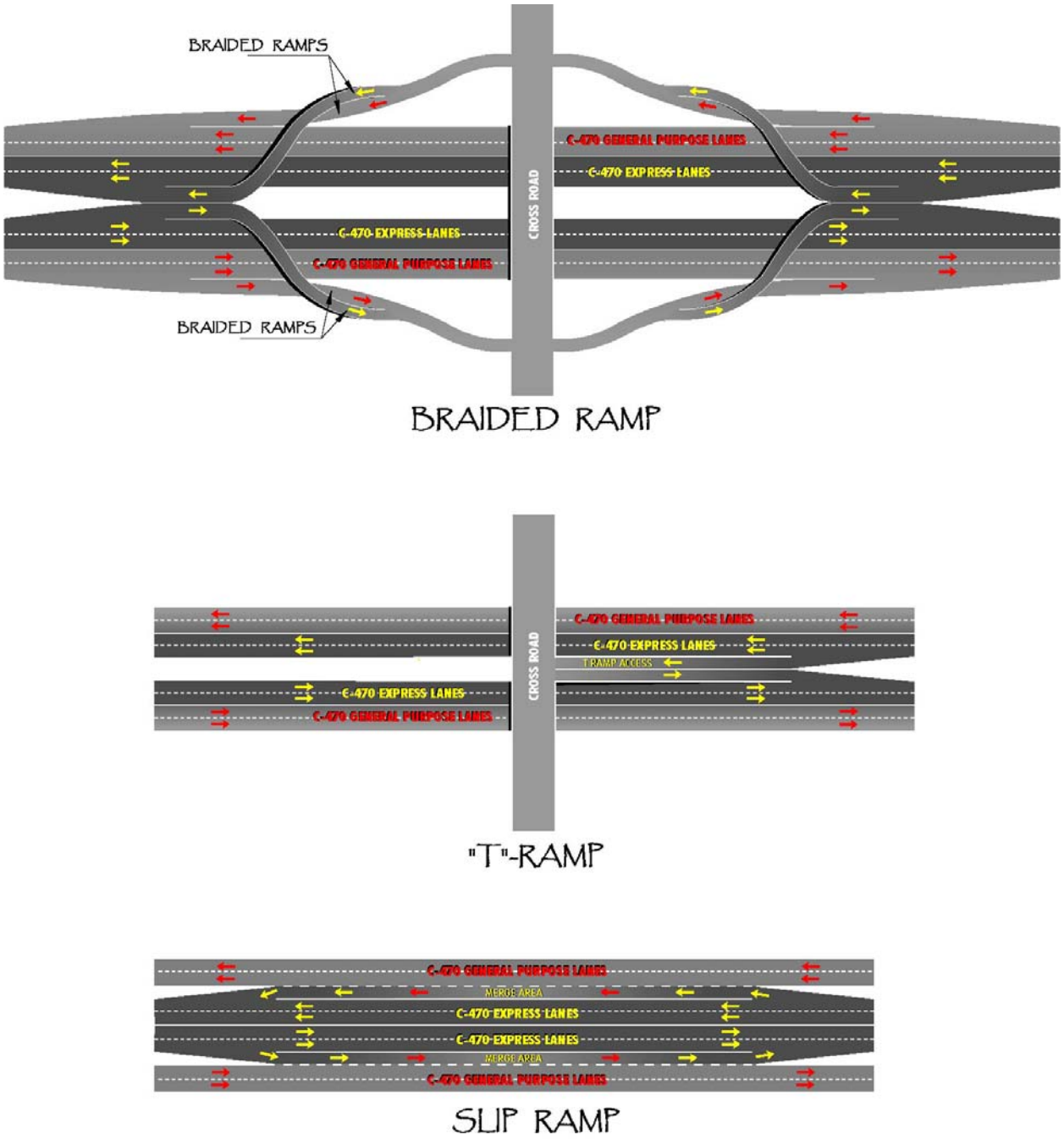
### 7.1.9 Access Types

Three types of express lane access ramps were considered in the design: slip ramps, braided ramps, and T-ramps. Figure 7.3 shows their typical configurations, and a description of each type follows.

**Figure 7.3**
**Access Types**



The braided ramp configuration utilizes a direct ramp for express lane traffic to access the express lanes, thus avoiding the need to mix with general purpose lane traffic. The braided ramp begins on the outside of the general purpose lane on ramp prior to the ramp metering and connects directly to the inside of the express lanes. This configuration is the most costly due to the bridge structure required to span over the express and general purpose lanes. However, it provides the lowest impact to the adjacent through lanes and offers the best overall traffic operations.

The T-ramp configuration is a form of direct access in which the express lane ramps connect directly to a cross street so that no mixing of express and general purpose lane traffic occurs. On the C-470 corridor, T-ramps were considered only where no general purpose lane ramps were present. By limiting the number of intersections on the cross street to one, the cross street traffic operations are not impaired. The T-ramps will be developed on the inside portion of the express lanes, allowing for the use of a common retaining wall in developing the ramp. This will reduce the structure cost and minimize roadway width in the ramp area.

Slip ramps utilize a break in the barrier to provide an access point between the two facilities. To facilitate weave maneuvers between both facilities, an auxiliary lane is developed on the inside of the general purpose lanes between entry and exit points to the express lanes. This access type is the most cost-effective option as it requires no additional road width, but simply the removal of barrier. However, the least desirable characteristic of this configuration is that it requires express lane and general purpose lane traffic to mix. This mixing of heavy traffic and the need for express lane traffic to change multiple lanes to access a destination interchange can cause additional congestion in the free lanes and reduce the effective time savings for express lanes users. One of the key design considerations of this configuration is to carefully select the location and design features so as to minimize these effects.

### 7.1.10 Toll Collection Scheme

The C-470 express lanes will use electronic toll collection only. This will eliminate the need for traditional toll booths, allowing drivers to maintain their speed while traveling through toll collection zones. All C-470 express lanes facility users will be required to obtain a vehicle-mounted transponder. State statute requires that all toll facilities in Colorado be interoperable. Interoperability refers to the ability of a toll collection system to use the parts, equipment, and user support services of other systems. To meet this requirement, the EXpressToll transponder system which is currently used on both E-470 and the Northwest Parkway toll facilities will be used.

The electronic toll collection system will use antennas mounted on overhead structures caused gantries to record transactions when vehicles pass under the gantry. A driver's account information is stored in the transponder. As the vehicle passes under the gantry, the radio-frequency field emitted from the antenna activates the transponder,

which then broadcasts a signal back to the lane antenna with basic account information. That information is transferred from the lane antenna to the central database. The toll is then automatically deducted from the driver's pre-paid EXpressToll account. Figure 7.4 shows a cross section and plan view of the toll collection zones.

Two types of toll systems were considered in the ELFS: barrier systems and closed systems. Barrier toll systems use a toll collection point on the mainline midway between access locations to detect vehicles that cross this imaginary barrier. It is simplistic and effective, especially for express lanes with limited access points. A vehicle that passes a barrier is charged the toll for that section of the express lanes. Closed toll systems use a toll collection gantry at every entry and exit point to track a vehicle's precise entry and exit location. That information is then used to calculate trip length and apply the appropriate rate per mile to compute the toll. Additional gantries required at each access point increase the capital cost of this scheme and make this alternative less attractive. The closed toll system, however, provides the most toll equity by tracking a vehicle through the entry and exit points.

For an express lanes facility, the higher level of vehicle tracking associated with the closed system is not necessary, and the additional capital cost does not provide an added benefit. Because the barrier system will provide the same functionality at a lower cost, the barrier system was selected as the preferred toll collection system for the C-470 express lanes. Figure 7.5 shows the proposed toll collection scheme and illustrates the locations of gantries on the corridor.

**Figure 7.4**
**Typical Toll Collection Zone**