10.3.1 Design Process

In the System Detector Station (SDS) design process, the designer must follow several steps to ensure successful implementation and proper operational capabilities. Many of these steps, such as power and communication requirements, must be addressed early in the design process.

1. Collect initial data required for the proposed system detector station location
2. Determine the detector station type required for the design location
3. Determine the location of the controller cabinet and meter service pedestal
4. Prepare the underground infrastructure, including detectors, conduit, and pullboxes
5. Perform cable routing to provide hardwire interconnection between the controller cabinet and detector station devices such as detectors, electrical service, etc.
6. Determine the communications medium used for the proposed location (See Chapter 8, Communication Systems.)
7. Revisit steps 3 through 6 until final design is complete
8. Begin the process to establish electrical service for the proposed location with the local power company. This should be done early in the design process to establish an acceptable electrical service location.
9. Determine the construction details needed for the proposed design, details which need to be modified, and new details which need to be created to provide a complete construction plan.
10. Determine the special provisions needed for the proposed design, special provisions which need to be modified, and new special provisions which need to be created to provide a complete construction plan.
11. Determine the standard specification bid items and procurement items that will need to be included in the estimate and miscellaneous quantities to provide a complete construction plan.

10.3.2 Cabinet and Equipment Placement

10.3.2.1 Cabinet Placement

The placement of the controller cabinet involves:

- Visibility of the mainline detectors from the controller cabinet
- Distance between the controller cabinet and the loop detectors
- Off-freeway accessibility for maintenance vehicles, whenever possible
- Safety of the cabinet location (do not place the cabinet on the outside of a curve)
- Grades
- Drainage
- Maintenance Accessibility (parking availability for maintenance vehicles)

For maintenance considerations, it is very important that the mainline detectors be visible from the controller cabinet. Due to the necessary loop to lead-in inductance ratio, the distance between the cabinet and loop detectors is also an important factor. Appendix C provides an overview of loop inductance calculation and maximum lead-in cable distance. The slope of the terrain for cabinet placement must be no steeper than 4:1. Placement of the cabinet on 3:1 slopes or steeper requires grading provisions to provide a level area around the cabinet.

10.3.2.2 Detector Placement

Detector placement (either loops or microwaves) should follow the following guidelines.

- Detection should be placed outside of any “weaving” areas.
- For interchange detection, the detectors must be placed within the exit and entrance ramp gores.
- For non-interchange areas, detectors must be placed away from lane-drops, acceleration/deceleration lane introductions, and other similar features.
- Placement of side-fire microwave detectors (on poles) must be outside of the clear zone if breakaway

pedestal bases are not used, and is good practice even with breakaway bases.

- Placement of side-fire microwave detectors (on poles) should be accessible for maintenance vehicles (e.g., bucket trucks).

10.3.3 Underground Infrastructure

When the controller cabinet, electrical service and detectors have been placed, the underground conduit infrastructure can be designed. Issues to keep in mind when designing the conduit infrastructure include:

- Conduit Size - 3-Inch conduit is typically used for detector station raceways, since a) cost savings between 3-inch and smaller diameter conduits is minimal, and b) 3-inch conduit may provide for greater future expansion depending on the number of cables and % fill of the conduit. Conduit entering electrical service pedestals must be sized per pedestal requirements.
- Conduit Fill - The size and number of conduits along a run is dependent on percentage of fill as established by the National Electric Code (NEC). Although it may not violate the NEC fill code, no more than 13 loop detector lead-in cables should be designed for installation in a single 3-inch conduit. Installation of more than 13 lead-in cables becomes difficult due to the quantity and weight of the cables.
- Pull Box Spacing - Pull boxes should be spaced no greater than 200 feet. If a conduit run contains only one or two lightweight cables (e.g., loop lead-ins), this distance can be stretched to approximately 300 feet.
- Terrain - Conduit infrastructure should be designed on relatively flat (4:1 slope or flatter) terrain. For steeper sloped terrain (3:1 or greater) , conduit may be run perpendicular to (i.e., up or down) the slope to locations where the terrain is more suitable for conduit installation.

10.3.4 Cable Routing

10.3.4.1 General

Cable routing for system detector stations typically involves the connection of all equipment to the controller cabinet, including loop detectors, microwave detectors, and the electrical service electrical service. Other devices, such as cameras (see Chapter 15), may be added to a system detector station site, and require cable routing as described in their respective chapters. The power distribution cable running between the controller cabinet and the electrical service should be in a separate conduit. Power and communication cables should not be mixed together.

10.3.4.2 Loop Detectors

Each loop detector reporting to the ramp meter controller cabinet requires a lead-in cable between the loop and the cabinet. A maximum of 64 loops can be housed in a 2070 controller cabinet. Appendix C provides guidance on loop inductance and maximum lead-in cable length calculations.

10.3.4.3 Microwave Detectors

Microwave detectors utilize 12-pair cable, or “Microwave Detector Cable” as called under the Appendix B, Special Provisions. One microwave detector cable is required for each unit. A 2070 controller cabinet can accept 32 detector inputs, or the number of detection “zones” a microwave detector captures. In a side-fire configuration collecting data for 3 freeway lanes.