### 15.3.1 Design Process

In the CCTV camera 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 CCTV camera location.
2. Determine the CCTV camera type required for the design location.
3. Assign name to CCTV camera device for proper recording.
4. Determine the location of the controller cabinet and meter service pedestal.
5. Prepare the underground infrastructure, including camera pole, conduit, and pullboxes or vaults.
6. Perform cable routing to provide hardwire interconnection between the controller cabinet and CCTV camera station devices.
7. Determine the communications medium used for the proposed location.
8. Revisit steps 3 through 6 until final design is complete.
9. 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.
10. Determine the construction details needed for the proposed design, details that need to be modified, and new details that need to be created to provide a complete construction plan.
11. Determine the special provisions needed for the proposed design, special provisions that need to be modified, and new special provisions that need to be created to provide a complete construction plan.
12. 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.

### 15.3.2 Camera Placement

Camera placement is based largely on the spacing requirements as documented under the *Initial Data Collection* section of this chapter. Placing cameras involves field verification of camera sites using a video recorder and bucket truck. When performing this video review, the following issues must be kept in mind when placing a camera:

- **Foliage** - Whenever possible, the video review should be done while trees are in full foliage. If this is not done, the view from installed CCTV camera sites may be minimized since foliage has a detrimental effect on sight distance.
- **Right-of-way**- If the camera is being placed on a local arterial, right-of-way restraints are critical. Arterial right-of-way is much narrower than typically found on the freeway. If the camera is placed outside of WisDOT right-of-way, permits and easements will be required to construct the site.
- **Maintenance** - The camera must be able to be maintained via a bucket truck. If the designer is unable to access the proposed location with a bucket truck during design, future maintenance (and installation) of the site may be cumbersome.
- **Site distance to other ITS equipment** - It is desirable for CCTV cameras to be capable of viewing nearby ramp meters or variable message signs.
- **Cross-street viewing** - Whether the proposed camera is being placed along the freeway or along an arterial, coverage of major cross streets is desirable. Cross street video surveillance is very important if an entrance ramp is being metered, or if the street is typically used as an alternate route.
- **Viewing of other features** - It is desirable for CCTV cameras to be capable of viewing features surrounding the freeway, such as park-and-ride lots and crash investigation sites.
- **Future Construction** – Find out if there is any planned construction (1-10 years) in the area where the camera will be placed. You may need to coordinate with the plan designer or construction manager of

the projects to ensure that the camera, or any of its components, will not need to be relocated or replaced during the construction process.

- **Blind Spots** - When a camera-lowering device is used there will be a blind spot at the pole. It is very important that the pole be orientated so the blind spot is located in the least desirable viewing sector. A pole orientation detail should be included in the plan set, so the contractor places the anchor bolts correctly in the concrete base.
- **Permanent Structures** – It is acceptable to install cameras on existing structures (poles, sign bridges, buildings, etc.) when power is available and stand alone options are not available.

### *15.3.3 Cabinet and Equipment Placement*

Placement of equipment for camera sites involves the controller cabinet, camera pole, and electrical service.

#### 15.3.3.1 Cabinet Placement

The placement of the controller cabinet includes the following:

- Visibility of the camera from the controller cabinet.
- Distance between the controller cabinet and the camera.
- Off-freeway accessibility for maintenance vehicles whenever possible.
- Safety of the cabinet location.
- Grades.

For maintenance considerations, it is very important that the **camera be visible from the controller cabinet**. 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 require grading provisions to provide a level area around the cabinet.

Pole Mount Cabinets may be used if a controller cabinet size or capability is not needed. These cabinets are mounted directly to the pole. The pole mount cabinet has enough space to house electric service, a video encoder, and other communication equipment. Conduit is run from the bottom of the pole mount cabinet to the nearest pullbox or vault.

#### 15.3.3.2 Camera Pole Placement

The camera pole should be placed within 350-ft of the controller cabinet. Extending beyond this distance requires re-design of the camera power cable size (gauge) and size of the coaxial cable, which transmits the video images.

Placement of the camera pole must be outside of the clear zone (as determined by *AASHTO: A Policy On Geometric Design of Highways and Streets* or the *AASHTO Roadside Design Guide*, latest editions). The poles also must be accessible for maintenance vehicles, including large bucket trucks, unless using a lowering system, in which case maintenance may be performed with smaller vehicles.

### *15.3.4 Underground Infrastructure*

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

- Pull Box Spacing - Pull boxes should be spaced within 200 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.
- Conduit Size - 4-Inch conduit is typically used for camera cable raceways. 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). For new conduit installation, the percent fill must not exceed 31%. For installation of cable in existing conduit, 40% of the available area may be used.
- Conduit in Camera Base - Two 4-inch conduits, and one 2-inch conduit or three 2-inch conduits should be placed in the camera's concrete base. This will allow one conduit for electrical wire, one conduit for communication wire, and one conduit for coaxial cable (which is sensitive to electric-magnetic fields).

### *15.3.5 Cable Routing*

#### 15.3.5.1 General

Cable routing for camera sites typically involves the connection of all equipment, including the camera pole and the electrical service, to the controller cabinet or pole mount cabinet. Other devices such as ramp meters or system detector stations (Chapters 2 and 3) may be added to a camera site, and require cable routing as described in their respective chapters. The power distribution cable running between the controller cabinet or pole mount cabinet and the electrical service should be in a separate conduit. Power and communication cables should not be mixed together.

#### 15.3.5.2 Camera Cables

Camera cables consist of two different types: *conductor cables* for power and control, and *coaxial cable* for transmission of the video image between the camera and the video encoder. The maximum distance between the camera and controller for these cables must be kept within 350 feet. If this 350-ft maximum distance requirement is unobtainable, the size of the camera cables (for power, control, and video) must be redesigned and incorporated appropriately.

#### 15.3.5.3 Electrical service

The power distribution wires running between the electrical service and the controller cabinet consists of stranded copper single conductors, cross-linked polyethylene (XLP), USE rated. Section 655 of the standard specifications provides guidance on additional requirements. The bid items for “Electrical Wire Lighting (gauge #) AWG will meet the requirements. The gauge of conductors must be calculated per the requirements of the National Electric Code.

#### 15.3.5.4 Electrical Wire Routing

The conduit system for camera sites needs to be bonded together, due to the fact that power cables are running within the system. Bonding all metallic components of the system together assures that there will be no difference in voltage potential across two points in that system. In addition, grounded conductor needs to be run with current-carrying cables (such as traffic signal conductors, power distribution wires, etc.), which returns the circuit’s current at zero voltage. The bonding/grounding wires in system typically use Electrical Wire Traffic Signals 10 AWG (Item 655.0515) in the State’s Standard Specifications. The gauge of grounded conductor must be calculated per the requirements of the National Electric Code. There is a distinct method required for the bonding system. Examples of this method can be found in Chapters 2 and 3.

The pull boxes do not require grounding if the total voltage encountered in the pull box is 50 volts or less. In some Districts, a policy has been made to bond and ground all conduit systems, since equipment is frequently added to various locations in the future. For assistance in bonding and grounding of underground systems, consult the State Electrical Engineer.