

## STAKING

### SIGNAL SYSTEMS

Locating the components of a traffic signal is not an exact science; many factors influence the location of the components. These factors include: lane widths, radii, crosswalks, cracks and joints in the pavement on existing roads and utilities below ground and overhead. It takes an experienced person approximately two to three hours to stake a signal.



Using an experienced person to stake a traffic signal will ensure efficient installation, easy maintenance and good operation. On most projects, the Mn/DOT Traffic Office personnel will determine, in the field, the exact locations of handholes, poles, loop detectors, and the equipment pad.

The primary considerations in staking a traffic signal are:

1. **Lane widths and radii.** All thru lanes and turn lanes have to be measured prior to staking. On new construction, the lanes and the radii must be determined and laid out.
2. **Location of crosswalks** and pedestrian ramps. Look at the plan and determine where the crosswalks and/or stop bars are located. Lay them out on the roadway. Many of the signal components are located relative to the crosswalks and stop bars. Keep in mind, median nose locations and existing sidewalks. The crosswalks and stop bars should be laid out parallel to the adjacent road and kept in a straight line from pedestrian ramp to pedestrian ramp. It is essential that they be established and tied in so that they can be relocated during all phases of construction.
3. **Signal Poles**, are generally located on the back edge of the crosswalk or stop bar when possible. Check for utilities above and below ground.
4. **Loop detectors**, are located by measuring from the back edge of the cross walk or stop bar.
5. **Non-Intrusive Detection**, located on luminaire extensions, span wire, and/or mast arms as determined by the Engineer.
6. **Handholes**, are located opposite the loop detectors. Intermediate handholes are located equal distance between the loop detector handholes or conduit crossing handholes.

7. **Conduit crossings**, are located at specific handholes.
8. **Signal cabinet** is located as shown on the plan and within the right-of-way.
9. **Source of Power**, which supplies electricity to service equipment for the signal.

### STAKING CROSSWALKS, STOP BARS & PEDESTRIAN RAMPS

Refer to the plan to layout the crosswalks and pedestrian curb ramps where they intersect the curb. These are preliminary locations that may need to be changed. The primary things to look for are: drainage structures in the pedestrian curb ramps (not desirable) and the ends of median noses on a divided roadway (used to align pedestrian curb ramps). Keep pedestrian crossings straight to the adjacent streets (when possible). Locating the pedestrian curb ramps shall be as indicated in the contract documents *or as directed by the Engineer*



### STAKING SIGNAL POLES

Key points to keep in mind:

1. Length of the mast arm +2 feet (for staking measurement).
2. Type of pole foundation (A or B).
3. Actual lane widths.
4. Locations of overhead signal indications relative to lane markings and curbs.
5. The size of the concrete base and the height of poles.
6. The minimum required overhead clearance 17 to 19 feet (5.2 to 5.8 meters) and the horizontal distance of shaft mounted signal heads from the face of the curb or the edge of the road or shoulder.
7. Locations of pedestrian push buttons (on the roadway side of the pole). Verify exact locations with the Engineer/Inspector.
8. Locations of crosswalks or stop bars.
9. Locations of new and existing utilities (overhead and below ground).

## 6 PA100 POLE FOUNDATION

TYPE PA100-A-50-D40-9 (DAVIT AT 350')

The length of each mast arm is listed in the pole notes on the intersection layout sheet of the Plan. For example: PA100-A-50-D40-9. This means a 50 foot (15.2 meter) long Type A arm (90 degrees to the road).

2-ONE WAY SIGNALS OVERHEAD  
 (0' AND 11' FROM END OF MAST ARM)  
 2-TYPE 10B (0° AND 270°)  
 LUMINAIRE-200W HPS WITH PEC AND CHECK SWITCH  
 1-PEDESTRIAN PUSH BUTTON SIGN (R10-4c)  
 ONE WAY EVP DETECTOR AND CONFIRMATORY LIGHT  
 3" RSC TO HH 15  
 2-12/C#12  
 3-3/C#12  
 1-3/C#20

### To stake the signal pole:

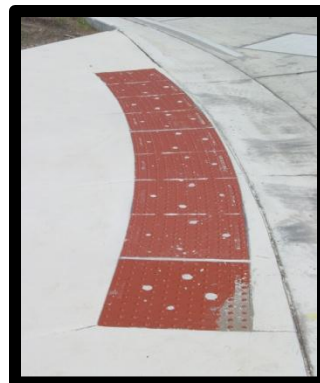


Check the plan to determine where the signal heads are to be located relative to lane lines. Place a paint mark on the pavement where the signal heads will be located. The mast arm with a signal indication installed on the end of the arm, adds approximately 15 inches to the length of the mast arm. From the pole end of the mast arm to the

center of the pole shaft is approximately 6 – 8 inches. The combination of these two measurements requires an additional 2 feet (0.6 meters) of added length to the mast arm. This gives an approximate length of 52 feet (15.8 meters) from center of the foundation to the center of the signal head at the end of the mast arm. Using the pole notes, determine the type of pole used (A or B). Type "A" is designated to be installed at 90 degrees to the road, Type "B" is designated to be installed at 45 degrees to the road. The two pole types are not interchangeable. From the paint on the pavement that represents the signal head at the end of the mast arm, construct a 52 foot (15.8 meter) offset line, parallel to the road, that is near the location of the pole foundation.



Depending on the type of bracketing, shaft mounted signal heads with visors can extend approximately 3-1/2 feet (1 meter) from the face of the pole. Add 6 inches (152 millimeters) for half the diameter of the pole makes the distance from the center of the pole to the end of the visors approximately 4 feet (1.2 meters). The use of more than one head on one set of brackets (20 series) is not recommended. The minimum allowed (MMUTCD) distance from the face of the curb or edge of shoulder to the visors is 2 feet (0.6 meters). This places the center of the base at least 6 feet (1.8 meters) from the face of the curb or edge of the road. Stake the pole at the point of intersection of the 6 foot (1.8 meters) line and the 52 foot (15.8 meters) line. If the signal heads are side mounted, the pole can be moved closer to the edge of curb if necessary, but is not recommended.



Keep in mind the locations of new or existing sidewalks. The staking of pedestrian curb ramps and the placement and orientation of the pedestrian push buttons are critical. There are specific requirements in the Contract documents for the installation of Accessible Pedestrian Signals (APS).

Move the pole location so that it lines up with the back of the crosswalk (or be as close to it as possible). Keep the 6 foot (1.8 meter) clearance and the 52 foot (15.8 meter) mast arm length in mind. According to the Americans Disability Act (ADA), pedestrian curb ramps must have a square flat area at least 4 feet by 4 feet (1.2 meters by 1.2 meters) at the end of the pedestrian curb ramp. The Standard Plate no. 7036 does not show the landing area.



Check for utilities, above and below the ground. If a luminaire extension is to be installed on the pole, it will stand 40 feet (12 meters) above the top of the foundation. A minimum clearance from overhead wires must be maintained. The amount of clearance depends on the type of service; check with the power company. Keep in mind the underground utilities. Sewer lines can be very large and the pole foundation can be 12 feet (3.66 meters) below ground. Adjust the location of the pole accordingly.

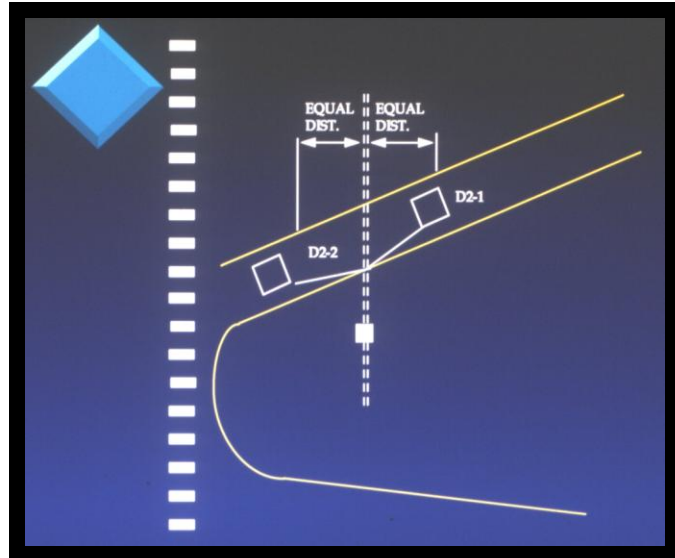
**STAKING THE FRONT LOOPS AND CONDUIT CROSSINGS**

After the crosswalks, stop-bars and poles have been located, look at the loop detector chart on the plan to get the location of the loops. The measurements given in the chart are the distances from the crosswalk (or stop bar to the front edge of the loop).

LOOP DETECTOR CHART		
NUMBER	SIZE (FT)	LOCATION
D1-1, D5-1	6 X 6	40
D1-2, D5-2	6 X 6	10
D2-1, D2-2	6 X 6	475
D3-1, D7-1	2 - 6 X 6	20 & 50
D3-2, D7-2	2 - 6 X 6	5 & 35
D4-1, D8-1	6 X 6	180
D4-2, D8-2	6 X 6	180
D4-3, D8-3	6 X 6	5
D4-4, D8-1	2 - 6 X 6	5 & 20
D6-1, D6-2	6 X 6	475
ALL LOOP DETECTORS SHALL BE PVC UNLESS NOTED OTHERWISE LOCATION: DISTANCE FROM CROSSWALK/STOP BAR IN FEET		

## LOCATING LOOP HANDHOLES

Place the handhole and conduit crossing at equal distance between the loops to balance the milling or saw-cuts to the loop lead-in conduit. This will prevent the placement of the conduit crossing under the loop detectors which could become damaged if the pavement cracks above the conduit crossing. In addition, it will allow room for re-cutting should that become necessary in the future.



## STAKING THE BACK LOOPS AND HANDHOLES

Referring to the loop detector chart, determine the locations of the back loops. Measure the distance from the back edge of the stop bar or cross walk to the front edge of the loop detectors. Check the pavement condition and adjust the locations of the loops to avoid placing on paving joints or in cracks. The location of the back loops is not as critical as those near the crosswalk and they can be moved back and forth 5 to 10 feet (1.52 to 3.05 meters) without creating problems. Check with the Traffic office and note any changes on the plan.

## STAKING THE INTERMEDIATE HANDHOLES

The intermediate handholes are located by spacing them evenly between the handhole of the back detectors and the handhole of the front detectors. The maximum distance between handholes must be less than 300 feet (90 meters).



## STAKING THE SIGNAL CABINET

When locating the signal cabinet, look for an area, within the right of way, where the cabinet will not be flooded, hit by a car going off the road or be plowed in during snow removal. Whenever possible, orient the door of the cabinet to allow workers to face traffic while working on the cabinet.

## STAKING THE SERVICE POLE

Next, stake the service pole that provides the electric power to the traffic signal. If the contractor is required to set a new pole, it should be located in an area that will not be flooded or be hit by traffic. It should be placed so that the conduit and handholes can be easily installed from the pole to the traffic signal cabinet.

## STAKING A SIGNAL SYSTEM ON A NEW ROADWAY

The preceding dealt with staking a signal system on an existing roadway. There are additional problems involved in staking a traffic signal on a roadway that is under construction:

The characteristics of the new road are not fully developed and you have to layout the curbs before you can begin to stake the signal components. It is essential to have the survey crew provide you with enough stakes so that you can do this correctly.

Conduit crossings have to be located and installed before the curb or pavement is placed (usually just before the gravel is placed).

To properly locate the conduit crossings, you must locate the crosswalks and loops.

In new construction areas, the curb and gutter should be installed before installing the new signal system components.

Nearly all the components of the traffic signal need to be located and tied before the pavement is installed.

Caution must be taken to avoid all structures and utilities above and below ground in the new roadway.



**FINAL CHECK**

Make sure that the final locations of all the signal components are clear of all the new and existing utilities above and below ground and located within the right of way. Next, establish reference ties to the signal poles, pedestrian ramps, crosswalks and stop bars. This will ensure that they are built as staked. Detector locations, conduit crossings, and poles depend on the location of the crosswalks. They must be tied in, and/or marked, so that they can be re-established accurately.

The best way to ensure that the pedestrian ramps/crosswalks get located correctly, is to have them staked in the presence of the inspector for the curb and gutter construction.



## LIGHTING SYSTEMS

There are typically three types of light standards that need to be properly staked.

- (a) Breakaway and non breakaway davit Poles with 250 watt HPS Cobra Heads
- (b) Breakaway and non breakaway davit Poles with 400 Watt HPS Cobra heads
- (c) High Mast (Tower) lighting

Each plan will show stationing and offset for each pole location.

250 watt HPS cobrahead lighting units may be spaced 250 feet apart and will have a 23 foot set back from the right lane fog line (right edge of driving lane).

- Center median lighting should be spaced the same but will not have the 23 foot setback.

400 watt HPS cobrahead lighting units may be spaced 275 feet apart and will have a 26 foot set back from the right lane fog line (right edge of driving lane).

- Center median lighting should be spaced the same but will not have the 26 foot setback.

High mast lighting plans will have stationing and offset shown on the plans. High mast lighting unit locations should be staked by the survey crew and placed as shown on the plan.

If the plan calls for a roadway light pole to be placed in the bottom of a ditch do not place the pole in that exact location. Move the pole closer to the driving lane or further away from the driving surface so the pole foundation is not at the bottom of the ditch (as pictured).

Large amounts of water that can collect in the bottom of ditches and can create situations where the lighting cable shorts out due to water and would force the circuit breaker to trip making all the luminaires on that specific cable run to go dark.



Poles can be moved 3 feet closer or further away from the roadway if the exact plan placement would put the pole in the bottom of the ditch.

Poles can be moved 10 feet in either direction forward or backward along the roadway if there is an obstruction on the side of the road. An example of an obstruction would be some sort of drainage structure.

The exact locations of lighting units may be adjusted to avoid obstructions encountered in the field. Such items as solid rock, power lines, slopes, existing guardrail, etc., may make it necessary or desirable to locate the pole differently than is indicated in the Plan. If farther changes are required, the project engineer should consult with the lighting system designer to determine if such a change requires changing the placement of other light poles in the system. The plan contains details showing the placement of lighting units from the edge of the traveled roadway. If a guardrail or noise wall exists at the location and is not indicated in the plans, light poles should be placed behind it if possible. Clearance between the back of the guardrail and the front of the light poles should be at least 2 feet to allow the guardrail to properly deflect on impact. Poles should not be closer than 20 feet in any direction from power lines. If 20 feet cannot be maintained, contact the power company or the lighting section.

The exact location of each light pole should be approved by the Mn/DOT District Traffic Office prior to any foundation excavation being started.