

generally exist, warning signs in the immediate vicinity of the work area may be placed at closer intervals to meet the needs of individual survey crews.

Channelizing Devices

There are five types of channelization devices available: cones, vertical panels, plastic drums, and Type I and Type II barricades.

Vertical panels and cones are to be used only when a portable device is needed for lane closure operation that will last only one day or when the more durable Type I or Type II barricades are not available.

Type I & II barricades should be used whenever appropriate. They are, however, difficult to carry and stack.

Cones are orange in color and shall meet Department requirements. For the most part, cones are used to channel traffic through and around a work area. Occasionally, the need arises for the surveyor to close off or separate traffic. Cones are used to accomplish this.

Plastic drums should be used only when other types of devices are not available. Drums are not practical on a daily basis because of their size. Generally, they should be used only during heavy construction and maintenance operations.

If it is necessary to place an instrument or other tripod within the traveled way or within 15 feet of the traveled way, the tripod will be protected by cones according to field conditions. For horizontal control surveys between active traffic lanes or within shared left turn lanes, cones shall be used to protect tripods at 50 foot intervals for at least 200 feet towards the flow of traffic.

For Elevation Surveys between active traffic lanes or within shared left turn lanes, cones may be used at the discretion of the party chief to protect prism holder and flagger(s) at up to 50 foot intervals along the break line throughout the work zone.

These cone placements for surveying between active traffic lanes or shared left turn lanes apply to main roadway traffic control work zones. When the survey work zone includes intersections, cones shall be adjusted by the party chief to fit roadway and traffic conditions.

Advance Warning Arrow Panel

Advance Warning Arrow Panels are intended to supplement other traffic control devices when closing a lane on a multilane, divided or undivided, highway. For stationary lane closures, the arrow panel should be placed on the shoulder at the beginning of the taper or where there are narrow shoulders in the closed lane. The panel shall be located behind any channelizing devices used to transition traffic from the closed lane. Advance Warning Arrow Panel placement and specifications shall conform to the Roadway and Traffic Design Standards, Series 600.

Variable Message Signs (VMS)

Variable Message Signs may be used by surveyors to advise the traveling public of survey work being done on the highway. The information on these signs should make the driver more aware of surveyors on the highway and increase the surveyors' safety. They are used to supplement the standard signing in the survey work zone.

Flagging Operations

When operations are such that signs, signals, and barricades do not provide adequate protection on or adjacent to a highway or street, flaggers or other appropriate traffic control shall be provided.

Flaggers shall be located far enough ahead of the work space so that approaching traffic has sufficient distance to stop before entering the work space.

Stop/Slow Paddles are the primary hand-signaling device. Flag use is limited to Immediate Emergencies, Intersections, and when working on centerline or shared left turn lanes where two (2) flagmen are required and there is opposing traffic in the adjacent traffic lanes.

Where flagmen are used, a FLAGMAN symbol or Legend sign shall replace the WORKERS symbol or Legend sign.

The party chief may at his discretion use a staffed state police car. A staffed state police car with flashing lights at the beginning of the work zone is the most effective way to reduce speed in the work zone and get the attention of drivers.

Here are nine common surveying procedures and the recommended safety precautions that should be utilized for each. These are minimums and shall be expanded if traffic volume and/or work zone conditions require.

1. Finding old baselines on pavement and then offsetting them: This involves the process of digging up pavement to find an old baseline and offsetting that line from the pavement to the side of the road. This safety procedure is designed to get surveyors off the roads and away from traffic.
We know from prior experience that the first action we need to perform is the positioning of warning signs. For this procedure, you are required to use three types of signs, SURVEYORS AHEAD, STAY IN YOUR LANE, and FLAGGERS AHEAD signs.

The SURVEYORS AHEAD sign should be positioned approximately 1500 feet from the work area and the FLAGGERS AHEAD sign should be placed approximately 500 feet from the work area on both sides of the road, depending upon the posted speed limit and the location of the survey baseline. When survey crew members are working between active traffic lanes, a STAY IN YOUR LANE sign shall be added as the second most immediate sign from the work area. (See also Roadway and Traffic Design Standards

(current edition) Index 600, where appropriate.) Once these signs are in place you can put cones around one of the old P.O.T.s.

The next step involves the actual digging up of pavement to find the old P.O.T. The person doing the digging shall be protected from traffic by flaggers as he will not be able to watch the traffic as he is digging. He shall wear eye protection to guard against flying debris from the pavement as he is digging.

After all control points are found, they are then tied to the Project Network Control points. The total station is set up on one of the PNC points and a backsight is taken to another PNC point. The safety procedure to tie in the old baseline control point between active traffic lanes with traffic flow in opposite directions (including within shared turn lanes) requires the use of cones to protect the backsight tripod and additional cones placed at up to 50 foot intervals for at least 200 feet towards the flow of traffic in both directions. (Please see Horizontal Control Diagrams 1 & 2)

On multilane divided or undivided highways where the old baseline control point falls between active traffic lanes with traffic flow in the same direction, the use of cones placed at up to 50 foot intervals along the lane line for at least 200 feet towards the flow of traffic is required. (Please see horizontal control diagram 3)

Flaggers are required when the tripod is being set up. The old baseline control point is then tied into the horizontal control point.

Once all of the old baseline control points have been tied into the Project Network Control and all of the existing Right of Way information has been found and tied in, the position of the old historical baseline is then calculated back in the office. Then the new reference baseline control points are set preferably greater than 15 feet off the traveled way, opposite the old control points. The reference baseline is then run, which keeps the crew out of traffic as much as possible.

Cone placement shall follow the Roadway and Traffic Design Standards, 600 Series. If any control point is placed within 15 feet of the edge of the traveled way, then the instrument and/or backsight requires cones for protection.

2. Tying in a section corner on a two-lane, two-way highway, between active traffic lanes with GPS receiver on a tripod, requires the use of cones to protect the GPS equipment and workers. The cones are placed at the GPS equipment and additional cones placed at up to 50 foot intervals along the lane line for at least 200 feet towards the flow of traffic in both directions.
3. Bench Runs: This procedure involves the protection of surveyors from traffic while they are doing bench runs. For maximum safety, bench runs should be run off the road whenever possible. This will move the surveyor away from traffic.

4. Finding utilities on a design survey: It is sometimes difficult to locate utilities on a particular project. It is necessary to contact a person from the utility company to come and help you find the utility line crossings. The person from the utility company and the crew chief will walk the job and spray paint on the road where the utility lines are crossing under the pavement.

The safety precautions that shall be taken are to have a flagger keeping pace between them and oncoming traffic to warn motorists of their presence on the road. All personnel will wear proper safety gear. Cone placement is optional and left to the discretion of the party chief.

After the utility lines are marked, the crew will then set up on the horizontal PNC points and tie in the marks to obtain the xyz coordinates. If the utility company has to dig to find the lines, then barricades or cones shall be used to channel traffic around the work area. (See Roadway and Traffic Design Standards Series Index 600)

5. Obtaining elevations for a DTM between active traffic lanes on a two-lane, two-way highway and also in a shared turn lane requires that the prism holder shall be protected by two flaggers where traffic flow is in opposite directions. On multilane, divided or undivided, one flagger is required.

Cones may be used at the discretion of the party chief to protect prism holder and flagger(s) working between active traffic lanes or in a shared turn lane. Cones, if used, may be placed at up to 15 foot intervals along the break line throughout the work zone. (Please see Elevation Survey Diagrams 4 thru 7). These cones will help keep the traffic from crossing lanes when the workers are between active traffic lanes, when the traffic is heavy and moving fast. The workers working between multilane divided highways or undivided highways are especially vulnerable to cars crossing lanes, and the cones serve as an additional warning device.

When obtaining elevations between active traffic lanes on a multilane divided highway with three lanes in each direction and traffic is extremely heavy, the party chief may decide to close the center lane to traffic, which will allow him to obtain elevations on the break lines at the lane lines safely. He shall first check with the Administrator of Surveying & Mapping or Location Surveyor to see if this procedure is warranted. He shall coordinate this with all persons involved in the placement of MOT devices and he shall follow the correct Roadway and Traffic Design Standard Series 600 index. Multiple crews should be used when obtaining elevations on the break lines if the center lane is closed. This will allow the lane to be opened up sooner so the traffic can flow through the lane again.

Obtaining elevations for a DTM on edge of pavement and curb and gutter along the medians and sides of the highway, the surveyor holding the prism pole shall be protected by a flagger. This procedure will reduce the surveyors risk by allowing him to concentrate on his duties, making sure the level bubble is centered correctly while obtaining the survey

data. This procedure shall be used along the main project corridor and major side streets coming into the project. The use of this procedure on minor side streets will be left up to the discretion of the party chief.

6. Obtaining Elevations for a DTM on High Speed Highways:

The dangers to surveyors and consultants while working on high-speed highways are well documented. In Florida alone several fatalities involving consultant personnel have occurred which can be directly attributed to high-speed traffic. One particularly hazardous procedure is the process of obtaining elevations for a DTM on high-speed highways from the edge of the pavement to the right-of-way line. Although there is no sure way to make this procedure 100% safe, there are precautions that can reduce the dangers.

On high-speed highways we are specifically concerned with increasing our crew's visibility to motorists. We shall let the motorists know well in advance of our position on the highway. Warning signs should be used to gradually slow traffic through the work area. This will help prevent quick traffic slow downs which have the potential to create traffic jams and collisions.

The first placement of signs should be 1 mile from the beginning of the designated work area on both sides of the road and/or in the median. Subsequent signs leading to the work area should be placed at approximately half mile and 1500 foot distances from the beginning of the work area, depending upon the posted speed limit and the width of pavement. The remaining WORKERS AHEAD signs shall be positioned on both the median and the work side of the road 500 feet from the beginning of your work area. After positioning the signs, the next step consists of placing cones down the entire length of the work area as an additional precaution for safety and protection. Recommended cone interval is 50 feet. The cones should be placed approximately one foot inside the shoulder. High visibility safety vests shall be worn during the entire procedure.

Obtaining elevations from the medians is particularly hazardous to survey crews because it increases their exposure to high-speed traffic two-fold. You now have to plan for traffic coming at you from opposite directions. Basically, the safety precautions employed for this procedure are the same as the ones just described. Warning signs are placed at exactly the same distances, but this time you shall compensate for traffic coming from opposite directions on the highway. This is achieved by placing the same number of signs down on the opposite side of the highway. Cones are again placed along the work area, but this time on both sides of the median. Again the cones are used in this instance as an added safety precaution. They are not required.

For additional protection, a lookout should be stationed to warn the crew of changing traffic conditions or errant vehicles straying into the work area at high speeds or slow speeds. It is very important to check with the Project Manager to determine if median elevations are absolutely required.

7. Recovering P.O.T.s from an old baseline and then placing a new baseline in its old position: If the old baseline was not offset to the sides of the road (the preferred practice), it is necessary to put it down the center of the road. To protect the surveyors while they are putting the baseline down, cones shall be placed around the Instrument Operator, and for added protection, it is suggested that you put additional cones down at 50 foot intervals on both sides of the centerline. This provides protection to the Instrument Operator as well as the rest of the crew while they are working in the centerline area. For added protection, the chain person and the Instrument Operator should be flanked by flaggers who are responsible for directing traffic away from the surveyors in the centerline area and warning them of any vehicles intruding into the work area. They also alert motorists of the presence of surveyors in the area. This procedure also calls for tapering of cones at the end of the work area as well as the beginning.

8. AUXILIARY LANE and LANE CLOSURES shall conform to the Roadways and Traffic Design Standard 600 Series and shall be done when the auxiliary lane or traffic lane itself is occupied for the time periods indicated.

Occasionally during the course of a design survey the need arises to channel high speed traffic around a designated work area. Before your crew can begin the actual process of closing off the lane, the party chief shall obtain the correct index from the Roadway and Traffic Design Standards (Index Series 600). Next the crew shall determine the exact length of the cone taper prior to reaching the work area. To make this calculation he or she has to use an equation called the "Taper Length Formula".

For example, using the 1996 Roadway and Traffic Design Standards 600 Series for a road with 12 feet lanes and a 55 MPH speed limit. The formula is $55 \text{ (speed)} \times 12 \text{ (lane width)} = 660 \text{ (length of taper in feet)}$. For speeds of 40 MPH or less, the formula is $WS^2/60$. The warning signs are next placed and shall conform to the correct index, the Manual on Uniform Traffic Control Devices (MUTCD) and other Safety Standards which may be adopted by the Department. If deemed necessary, an Advance Warning Arrow Panel is next placed on the shoulder at the beginning of the taper.

The cones are next placed in their correct position. The distances between the cones in the taper should be 25 feet. Where they are needed to close off or separate traffic, the cones along side the work area should be 25 feet apart for the first 250 feet and then 50 feet apart for the remainder. After observing traffic for a while, if the traffic seems to be having trouble merging, the taper length should be increased. The taper length shall never be shortened, however. In cases like this it is advisable to contact the Maintenance Office in the area for support and assistance with the maintenance of traffic. This is especially true on heavy traffic facilities, i.e., Interstate and Primary, multilane facilities.

9. Working in Intersections: This procedure deals with the protection of you and your crew while working in main intersections.