4.20 LAND MONUMENTS AND ROAD CENTERLINE

4.21 RE-ESTABLISHING ROAD CENTERLINE CONTROL POINTS

Refer to "Inspector's Handbook for Construction Surveying" for instructions on setting control points.

Grading Projects

After completion of a grading project, iron pins 375 to 450 mm (15 to 18 inches) long are to be installed to represent a point of intersection (PI) or point on tangent (POT). Iron pins should be driven so that top of pin is 125 to 150 mm (5 to 6 inches) below ground surface. If the PI does not fall within the right-of-way, mark location of point of curve (PC) and point of tangent (PT) with an iron pin but do not mark the PI location. The location of each iron pin should be cross-referenced to concrete reference posts set in or near right-of-way line.

WARNINGS:

When setting reference monuments or land corners, utility companies must be notified by calling the "One Call" telephone number, **1-800-292-8989**.

USE HAND TOOLS WITH WOODEN HANDLES IN AREAS SUSPECTED OF HAVING BURIED POWER LINES.

Portland Cement Concrete Pavement

Above mentioned points should be represented by an "X" chiseled in the hardened pavement surface.

Hot Mix Asphalt Pavement

Above mentioned points should be represented by hinge nails driven in the finished surface.

Land Corners

The District Land Surveyor will reset land corner monuments or supervise the resetting of these monuments by construction survey crews.

4.22 REPLACEMENT OF FEDERAL MONUMENTS & PRESERVATION OF ENGINEERING DATA

Survey monuments of federal surveying and mapping organizations are occasionally damaged or destroyed as a result of highway construction or maintenance activities. When a federal agency marker is encountered and must be relocated, contact the Construction Office for assistance in determining how to appropriately relocate the marker.

Examples of typical federal markers are shown in *Appendices 4-2 and 4-3*.

4.23 CENTERLINE POINT REFERENCING

Survey points along the roadway centerline must be referenced to perpetuate the alignment. Reference points must be made of ferrous metal to ensure magnetic attraction. A #15 metric size (5/8 inch) diameter smooth iron pin at least 375 mm (15 inches) long is a suitable reference marker. Aluminum ROW caps are to be placed on

top of pin and center punched at exact point after being driven. Pins should be driven as nearly vertical as possible.

Reference markers and centerline control points, if off the paved area, are to be buried 200 to 250 mm (8 to 10 inches) deep.

Location of Reference Points

Placement of reference markers is critical since they are used to find the centerline control point at some future date and, more importantly, to restore a control point to its original position if disturbed. These markers should be kept at a minimum distance from the control point, preferably less than 30 m (100 feet), but not too close so it might be confused with the point itself.

Precautions must be taken to preserve control points during construction.

- Rural Areas
  The reference points shall be within right-of-way limits in areas protected from normal maintenance operations. Reference points on the tops of backslopes should be avoided because of their vulnerability to farming operations. Likewise, reference points on the backslope should be avoided because of the potential of a backslope slide. In most cases, area along the roadway approximately 1 m (3 feet) beyond shoulder line is an acceptable location for reference markers as this area is relatively safe from maintenance operations and in stable soil. Base of foreslopes and base of backslopes also appear to be relatively good spots for reference marker placement.
- Urban Areas
  Identifying a location for referencing centerline control points is challenging in urban areas. Figure 5 in *Appendix 4-6* is an example of referencing by using lead plugs placed in sidewalks which will not be disturbed during construction. These lead plugs should be set before construction begins and can serve as a check on alignment during construction as well as becoming the final reference.

Methods of Referencing Points Using a Transit

Methods using iron pins placed on a line 90° to the construction centerline or tangent line are shown in Figures 1, 2, and 3 of *Appendix 4-5*. Where it is not practical to reference at right angles to the construction survey line, such as at road intersections, it may be desirable to transit tie the point as shown in Figure 4, *Appendix 4-5*. Angles are to be measured from centerline to both lines of reference. In all cases, stationing of the point and its physical description are to be shown in reference box.

Method of Referencing Using an Electronic Total Station Survey Instrument

The use of advanced survey equipment allows referencing of centerline points with fewer reference points. While a “transit tied” method may require four to six reference points, the following method uses only three reference points.

The location for reference points, as previously recommended, also pertains to this method.

Two iron pins are placed in line with the control point to be referenced (one pin on each side of the control point) as shown in Figure 7, *Appendix 4-6*. A third iron pin is placed at approximately a 45 degree angle to the set pins. An aluminum cap should be placed on each of the pins with the center punched at the exact point after being driven.

The angles and distances between the three reference points are measured, as well as the distance from the reference points to the centerline point.

In order to reestablish the centerline point, the surveyor should set on either of the two "in-line" reference points and sight toward the reference point. The centerline point can be located by measuring the recorded distance from the reference point to the centerline point.

If either of the "in-line" reference points are destroyed, the third reference point, which was placed as approximately a 45 degree angle, can be used. In this case, the instrument is set on the existing "in-line" reference point and the third reference point is sighted upon. Using the recorded distance and angle, the centerline point can be reestablished.

Land Corners
A land corner should be referenced as shown in Figure 1, *Appendix 4-5*, if located near a centerline control point. If there is no centerline point in the same general vicinity, the land corner should be transit tied as shown in Figure 6, *Appendix 4-6*.

Concrete Monuments
While above methods are preferred, concrete monuments are also allowed as reference markers.

4.24 BENCH MARKS

During construction of a highway project, many bench marks may be destroyed and alternate ones must be selected for future use. A permanent bench mark should be established at approximately 0.8 km (½ mile) intervals along the highway route in rural areas. Bridge abutments are good locations for permanent bench marks. Headwalls of culverts have also been a favorite place for bench mark locations, but a certain amount of settlement may take place during the first year in a new culvert and may result in erroneous bench mark elevations. Best results can usually be obtained by establishing a bench mark circuit after initial settlement has been completed, normally one year after construction.

Utility poles, fence posts, ends of drainage pipes, and railroad rails should all be avoided since these objects tend to be disturbed by frost, wind, and farming operations. Casting of a permanent concrete monument within the right-of-way appears to be the best solution in the absence of some other stable, permanent object.

Establishment of permanent bench marks should be considered near the end of every major grading and paving project. Monument location should be at the direction of project engineer. Occasionally, the project engineer will have cast-in-place concrete monuments placed by contractor and paid by extra work order. Standard brass bench mark shall be provided by the project engineer to be set in plastic concrete.

Locations for permanent bench marks in urban areas include fire hydrants, concrete sign bases, and other permanent objects. Interval of bench marks should be established at about one per city block.

Permanent Bench Marks Along Rural Highways
Permanent cast-in-place concrete bench marks should be constructed using the following guidelines. These should be considered minimum dimensions:

- Excavate a 300 mm (12 inch) diameter hole 1.5 m (5 feet) deep
- Insert a #20 metric size (3/4 inch) diameter reinforcing bar in center of excavation
- Place concrete around reinforcing bar to a depth of approximately 50 mm (2 inches) below ground elevation
- Finish concrete so surface is slightly rounded
- Insert a brass cap in center of plastic concrete

Monument shall be tied to construction centerline by station and distance and recorded on "as built" plan.