



7-60.1 General

Staking Supplemental Control includes furnishing and setting construction stakes necessary to establish the vertical and horizontal control for the construction project, including the following:

- Vertical control and bench level circuits (benchmarks)
- Horizontal control (control points)
- Horizontal and vertical alignments
- Radius points
- Clearing and grubbing
- Marsh excavation limits

Most WisDOT projects have existing horizontal and vertical project control that was established during the preliminary phases of the project. The staking contractor will perform the work using these points as their field control.

It is the responsibility of the staking contractor to locate, verify, and document the accuracy of all existing control points before using them for construction staking control work. The staking contractor must notify the engineer in writing of any discrepancies before using those points.

The elevations, dimensions, and horizontal alignment of structures, earthwork, and roadways must be checked for plan errors, compatibility, and consistency with existing field conditions. If any discrepancy is discovered, the engineer must immediately be informed. New grades must be established from the approved plan with adjustments to match existing roadway features as approved by the engineer.

The staking contractor will always consult with the engineer before doing any staking or computations. Data availability, project staging, or plan changes are all considerations that should be discussed before starting initial layout.

All field adjustments must be approved by the engineer. The staking contractor should always check with the engineer for changes to the approved plans before doing any staking or grade computations.

7-60.2 Vertical Control and Bench Level Circuits (Benchmarks)

This activity consists of locating the existing benchmarks set during the preliminary phases of the project, verifying their accuracy, correcting errors if necessary, transferring benchmarks to new locations to prevent conflict with construction, and establishing new benchmarks as needed.

Additional benchmarks must be set so as not to conflict with the construction operations. They should be set with a spacing not to exceed 500 ft or other spacing required by the engineer and/or contractor. Additional benchmarks must be of suitable material to endure the duration of construction.

Additional benchmarks should be set in locations that will be convenient for future work. It is also beneficial to alternate on left and right sides of the roadway, particularly when work is to be done under traffic. Benchmark number and elevation should be written on the guard stake or directly on the benchmark. All additional benchmarks set must be recorded (number or name, description, location and elevation) in the field book that is to be kept in the field office when not in use.

Good guidelines for locating benchmarks are:

- At each end of large structures.
- At points of change from cut to fill.
- At high and low points.
- Locations that are handy for cross sectioning of side hills.
- Any time there is a difference of 25 ft. in elevation in rolling terrain.

Before starting a bench level circuit (bench loop), the level must be checked for accuracy. A peg test is a standard level (instrument) test, but also check the tripod head and shoes and level rod tape and shoes for wear. If using a total station for setting benchmarks, ensure that the instrument is calibrated. This information should be recorded in the field notes.

In order to verify or establish elevations for benchmarks, they must be looped with a minimum of three benchmarks in the loop (two known).

Minor errors in benchmark elevations should be corrected in a manner that will not materially affect the work and brought to the attention of the engineer.

Major errors or apparent discrepancies found affecting other bench marks, existing plan information, and future work must be immediately brought to the attention of the engineer for correction or interpretation before proceeding with the work.

All field notes will be required for verification. Refer to [CMM 1-60](#) for general field note information.

7-60.3 Horizontal Control

Horizontal control begins with field-locating the control points, traverse points, section corners, etc., set by the original survey. These points will be noted on the plans along with field ties or can be obtained from the engineer. From these control points, the horizontal alignment for construction is established.

Additional control usually needs to be set outside the construction limits and there are special requirements for machine control grading projects as noted in [CMM 7-18](#). Consideration must be given to future use of these control points to prevent loss during the life of the project, provide for easy access, recovery, and inter-visibility. Care should be taken when establishing these reference points to assure their accuracy. When a control point is disturbed or destroyed, new monumentation for the point must be set and new coordinates established before any staking is accomplished in the area controlled by the disturbed or destroyed point. A new point number should be used and the field notes should be updated to note the disturbed or destroyed point, the new point, and their locations.

When the project is staked using coordinates, the staking must be performed using the project control coordinates found in the plan or provided by the engineer. Verify that the coordinates provided are correct by checking the units, datum, and coordinate system used on the project. Field verify coordinates by performing independent checks made from different control point set -ups. Consult with engineer regarding the frequency and areas of the project that horizontal control needs to be maintained.

All additional control points established are to be documented in the field book with the point description, location, coordinates (ground values), and station/offset for use during the life of the construction project. They will be marked in the field for easy recovery. Crossed lath with fluorescent pink ribbon and the control point number legibly written is a standard practice.

7-60.4 Horizontal and Vertical Alignment

After horizontal and vertical control has been verified and established the alignment should be staked. The staking contractor should establish, on the ground, the reference line of the roadway from which measurements are taken for laying out the work and setting the stakes required for control of the work. Since it is obvious any stakes set on the centerline, base line, or reference line will be destroyed during construction operations, this line only needs to be temporarily marked (for example, painted on hard surface or lath in ground).

All horizontal and vertical alignments used on the project need to be checked. Bearings, curve data, coordinates, distances, and elevations need to be verified mathematically and in the field. If coordinates have not been included on the plans, they are generally available from the engineer.

On projects where GPS machine control grading has been performed, horizontal reference lines should be staked or marked. These marks would aid in the quality control of grading work and provide alignment for remaining contract operations.

Warning: during the design process, a number of survey lines may have been established. Assume a point or line is of no consequence until checked out by verification of field ties and/or other control points. Also, the proposed alignment should be checked for its fit with existing entrances and side roads. If the proposed alignment does not fit field conditions, the alignment may have to be adjusted. Notify the engineer immediately so that adjustments may be made.

7-60.5 Radius Points

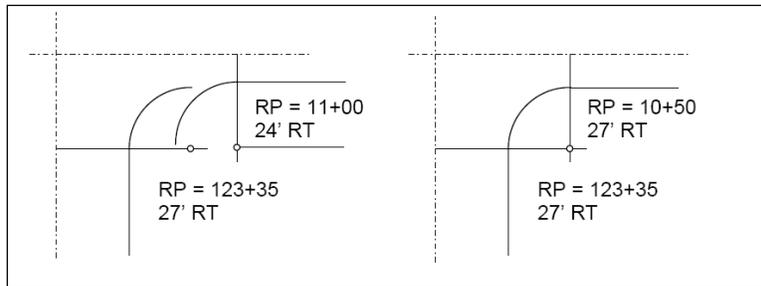
Most plans will have side road radius points located from stationing and offsets with respect to the mainline and/or the side road. It is a necessary check when staking the radius in the field to confirm the station from the mainline and the station from sideroad are actually one point (see example below).

It is important to know what the radius is referenced to (back of curb, face of curb, flange, edge of pavement, islands, medians, etc.). Once the point of reference has been identified, it is necessary to review the offsets and radius length (for example, checking the offset and radius lengths agree with the roadway width). Lane widths and curb dimensions can be found in either the typical sections or paving detail sheets in the plan.

If matching to existing curb or structures, check that the radius fits with existing conditions. A good practice is to set the radius point and do a final check with a tape to ensure the location fits in the field.

Figure 1 shows a common mistake that can be avoided by properly field-checking the radius point. The station and offset on the plan do not actually identify the same point. The staking contractor should verify from both alignments, and then swing a tape to check for field fit.

Figure 1 Field Check of Radius Point



[Figure 2](#) shows the proper marking and placement of radius point stakes.

7-60.6 Clearing and Grubbing/Marsh Excavation Limits

Staking for clearing and grubbing and/or marsh excavation is a similar procedure to slope staking. Limits may be shown on the cross section or in the right-of-way (R/W) plan.

An effort to save trees when possible while still meeting safety requirements may be done by the engineer. The engineer may wish to be present or contacted for input when this staking is being performed.

Additional stakes may be required in heavily wooded areas to insure inter-visibility for the contractor. Always check with the grading contractor and/or clearing and grubbing contractor and engineer for requirements and stake markings. Some contractors may want just centerline stations marked, pulling the offset distances themselves. Caution must be used to stay within the R/W limits.

Discuss the desired format of field notes with the engineer before setting stakes and check with engineer for changes to the approved plans.

Figure 2 Stake Radius Points and Mark Lath

