Section 824. CONTRACTOR STAKING

824.01. Description. This work consists of contractor staking on the project, and developing grades and field notes from data shown on the plans. Provide these grades to the Engineer after calculation and at least 48 hours before beginning related work, or as requested by the Engineer.

The Contractor may request printouts of profile grades shown on the plans and other information related to the development of the grades. This information may not be complete or accurate. Do not use this information as a basis for claim relating to plan errors and omissions.

Submit, for the Engineer's approval, the crew chief's resume, including ability, experience, and education.

824.02. Materials. Provide stakes, planed on both sides, of the following minimum dimensions and type:

A. Grade stakes 1 inch by 2 inches by 36 inches, light colored hardwood;
B. Slope stakes 1 inch by 4 inches by 24 inches, light colored hardwood; and
C. Pavement stakes 1 inch by 4 inches by 36 inches, light colored hardwood.

824.03. Construction.

A. **Control Points.** Witness horizontal control points, including curvature points, tangent deflections, and spiral controls for reestablishment of line and distance to within 0.02 foot. Ensure the measured distance between control points checks with a precision of 1 in 5,000 for road work and 1 in 10,000 for bridge work. Maintain at least three witnesses for each control point, each visible from the other, during construction.

B. **Benchmarks.** Run a level circuit over the entire project to check plan benchmarks and establish new benchmarks. Loop benchmarks with at least three benchmarks in the loop and check within 0.01 foot. During grading, check into benchmarks, within 0.03 feet, at 1,000-foot intervals. Advise the Engineer of bench elevation corrections due to out-of-tolerance checks. Maintain at least two benchmarks at each structure during construction.

C. **Slope Stakes, Subgrade Stakes, Undercut Stakes, Clearing Stakes.** Provide slope stakes, subgrade stakes, undercut stakes and clearing stakes at 50-foot intervals or as agreed by the Engineer, and at

break points due to subgrade transitions, including superelevation transitions and ramp transitions. The Engineer may request subgrade stakes for subgrade inspection, after topsoil stripping and before beginning subsequent grading operations. The Engineer will mark and determine individual tree removal.

D. **Pavement Stakes.** After placing and rough grading the subbase, provide pavement stakes as follows:

1. Place stakes at 50-foot intervals on tangent sections and on curves with radii of at least 1,150 feet.
2. Place stakes at 25-foot intervals on curves with radii of less than 1,150 feet.
3. In addition to yield stakes, set stakes to determine wedging limits for hot mix asphalt pavement. This may include taking cross sections in questionable areas, as determined by the Engineer.

Use pavement grade stakes for finish grading of the subbase, base course, and pavement. Check stakes for grade, realign, and tack before beginning paving operations. Determine the offsets required for Contractor operations and obtain the Engineer's approval.

E. **Drainage Stakes.** Provide grade and location stakes for culverts, sanitary sewers, storm sewers, subsurface drains, drainage structures, sanitary structures, and outlets to ensure positive drainage. Secure the Engineer's approval for adjustments in location and grade for drainage items.

Before installing underdrains, submit a plan for underdrain outlets to the Engineer for approval, including the following information:

1. Distance between outlets;
2. Low point of vertical curves; and
3. Comparison between clay grade, the underdrain grade, the outlet grade, and the ditch grade at each outlet location.

F. **Miscellaneous Staking.** Provide staking for the following:

1. Pump stations,
2. Curb and gutter,
3. Sidewalk,
4. Watermains,
5. Retaining walls,
6. Siphons,
7. Sound walls,
8. Barrier walls,
9. Junction chambers,

10. Guardrail,
11. Sign structures,
12. Signs,
13. Structure under clearance,
14. Crossovers,
15. Restoration items,
16. Erosion control items, and
17. Other staking required to construct the project.

G. **Utility Staking.** Provide bridge and roadway location grades and layout of contract work for use by the utility companies to relocate facilities within the project right-of-way.

H. **Muck Stakes.** Provide muck stakes in accordance with the following, or as modified by the Engineer:

1. Place centerline stakes in accordance with subsection 824.03.D.1, and subsection 824.03.D.2.
2. Place offset stakes at no greater than 50-foot intervals to provide information for construction and determining pay quantities.
3. Ensure each stake displays stationing, offset distance, and ground elevation.
4. To determine the depths of replaced muck, establish a grid, as directed by the Engineer, to establish the amount of peat excavation. A normal grid consists of one cross section every 50 feet along the centerline between the 1:1 slope intercept with the original ground, as shown on the standard plans for treatment of peat marshes.

I. **Temporary Signs.** Place temporary sign stakes or markings as shown on the plans, and to maintain traffic as required. Notify the Engineer after completing temporary staking and marking, before installing temporary signs.

J. **Bridge Approaches.** Develop grades and field notes to construct bridge approaches from data shown on the plans.

K. **Bridge Substructure.** Upon completion of foundation excavation, the Engineer will verify the foundation line and grade.

Carry the line and grade to the bridge seat elevation, aligning and dimensioning forms, and staking substructure work including footing embankment or excavation, pile layout, footings, abutment wall, and anchor bolts.

Before casting pier caps or abutment walls, the Engineer will verify the line, grade, and span lengths. Make adjustments at no additional cost to the Department.

L. **Bridge Superstructure.** Set the following grades required to complete the structure:

1. Deck and rail grades,
2. Screed,
3. Haunch,
4. Bulkhead,
5. Sidewalk,
6. Curb,
7. Fascia,
8. Barrier grades, and
9. Other grades required.

Determine beam elevations, existing deck elevations, or both, to calculate final deck grades, including those for overlay projects. Provide final deck grades and associated calculations to the Engineer before setting the rail grades.

Obtain the Engineer's approval before adjusting the screed to obtain proper slab depth, steel cover, ride quality, drainage, or cosmetic appearance. Provide the Engineer other bridge superstructure grades requiring adjustment before use and stake at no additional cost to the Department. The Department will pay for Engineer directed changes as extra work.

Provide structure clearance measurements to the Engineer for new construction or improvements of existing roadways or structures.

M. **Bridge Overlays.** On overlay projects, determine finished deck grades referenced to a proposed deck profile, and obtain the Engineer's approval before setting expansion joint devices. Set expansion joint grades along the centerline of the expansion joint device in accordance with the proposed deck cross section.

Base the profile at break points across the bridge deck section and at no greater than 25-foot intervals on elevations taken on the existing concrete deck. If the existing deck includes a bituminous overlay, take the existing elevations after removing the bituminous overlay. Unless otherwise shown on the plans, match the proposed deck cross slopes to existing deck cross slopes.

Correct irregularities in existing profile cross section and slope to achieve ride quality and drainage. In determining bridge deck elevations, consider scarifying depths, hydro-demolishing depths, and the minimum thickness of overlay material to avoid overlay material quantity overruns. Calculate the quantity of overlay material required to construct the deck

to the elevations shown on the plans and submit calculations to the Engineer before beginning construction.

N. **Site Adjustments.** Review the plans. Develop grades and notes, after performing checks on the project. If deviations from the plans occur, immediately notify the Engineer and propose a solution. The Engineer will determine the actual solution and provide timely direction.

O. **Final Measurement.** Provide detailed measurements, sketches, and computations of final measurement for earthwork, undercuts, muck excavation, swamp backfill, sand subbase, and topsoil stripping.

P. **Construction Survey and Staking Measurements.** Provide construction surveying and staking to the tolerances specified in Table 824-1.

Table 824-1
Construction Survey and Staking Tolerances

Type	Horizontal	Vertical
Bench Loops	1,000 ft (maximum); 100 ft (minimum) between benchmarks	0.01 ft (maximum)
ROW Stakes	0.01 ft (maximum)	—
Clearing Stakes	0.10 ft (maximum)	—
Slope, Subgrade, Utility Tunnel, and Miscellaneous Stakes	0.10 ft (maximum)	0.03 ft (maximum)
Pavement, Drainage and Bridge Stakes	0.01 ft (maximum)	0.01 ft (maximum)
Cross Sections	25 ft (minimum) left and right; 50 ft (minimum) along centerline (a)	0.10 ft (maximum) on ground shots; 0.01 ft (maximum) on others

a. Distances shown are minimum allowable distances between cross section stakes left and right of centerline and along centerline.

Q. **Preserving Stakes.** Preserve completed staking, as required for Engineer inspection of construction work. Maintain the dimensions, grades, and elevations of the work after the Engineer's inspection and approval of the layout.

Replace lost or destroyed stakes or benchmarks. Ensure the Engineer verifies replacement stakes or benchmarks.

Preserve stakes set by the Engineer. Replace stakes destroyed by Contractor operations at the Engineer's earliest convenience, at no additional cost to the Department.

Unless otherwise required, locate, preserve, and witness government monuments within the project. Ensure a registered land surveyor reestablishes monuments destroyed by Contractor operations or

negligence, as soon as possible and at no additional cost to the Department. Ensure placement of monumentation in accordance with section 823. If the surveying is incomplete, the Engineer will hire a registered land surveyor to complete the work, and all associated costs will be charged to the Contractor.

The Department will not pay for work dependant on lost or destroyed stakes until the Contractor replaces the stakes. The Department will not allow claims for damages caused by the Contractor's replacement of required stakes or benchmarks.

R. **Plan Errors.** Immediately notify the Engineer of a plan error. Document and submit to the Engineer, the efforts and the steps to correct a plan discrepancy. The Engineer will determine the solution and decide if the Contractor or the Department will provide staking for corrective action.

If a plan error results in extra work, the Engineer will issue a work order directing corrective action. Time for staking begins when the crew begins work detailed on the work order, including time for calculations and plotting. Provide written notification to the Engineer when work begins and ends.

S. **Extra Work.** For extra work, the Engineer will provide grades, calculations, or both. The Engineer will determine if the Contractor or the Department will perform required staking.

T. **Staking Changes.** The Engineer will resolve and approve staking changes within 2 working days. The Department will not allow claims for damages or extensions of time during the resolution and approval period for staking changes unless the Contractor shows the changes adversely affect the critical operation and fall outside the approved Contractor Quality Control Plan.

Before making Contractor initiated staking changes, including staking changes resulting from plan error, provide documentation for the Engineer's approval. Documentation for staking changes includes notes, calculations, and drawings.

During staking, perform checks to establish locations and grades to fit the existing conditions as agreed by the Engineer. Correct errors from Contractor operations at no additional cost to the Department.

U. **Staking Documentation.** Sign, check, date, and provide staking documentation and field notes, as approved by the Engineer before beginning work. The Department may inspect field notes and calculation documents any time. Original field notes and grade calculation

documents will become the Department's property upon completion of the work.

Provide original and final plotted cross sections and final volume calculations in a format approved by the Engineer for earthwork, undercuts, muck excavation, swamp backfill, sand subbase, and topsoil stripping. Determine final quantities by plan sheet breakdown.

Provide intermediate plotted cross sections to verify interim earthwork quantities if the Department requests. Provide the Engineer a final "as constructed" full-sized set of plans documenting vertical and horizontal alignment changes, drainage and subsurface changes, and other changes. Ensure plans and cross sections represent the same scale shown on the plans.

V. **Contractor Staking Quality Control.** Provide Contractor Staking Quality Control (CSQC) to ensure compliance with contract requirements, including staking operations performed by subcontractors, keyed to construction sequence.

Perform staking in accordance with Department procedures, or an alternate guidebook approved by the Engineer.

At the preconstruction meeting, provide the Engineer with a CSQC plan detailing the selected guidebook for quality control and measures to detect and minimize construction staking errors.

The Engineer will perform periodic reviews of the CSQC plan with the Contractor during the project. The Department considers these assurance reviews. Allow the Engineer access to in-progress construction staking work and phases of the ongoing CSQC plan.

The Engineer will use assurance reviews to make independent checks on the reliability of quality control procedures as shown on the CSQC plan. Assurance reviews do not constitute the Engineer's acceptance of the work. Correct work related to staking errors.

W. **Contractor Staking Quality Control Plan.**

1. **Plan Manager.** Identify one person as plan manager. Provide a plan manager as the sole contact to the Department for staking quality control. The plan manager is responsible for contractor staking quality control on each phase of the project. Ensure the plan manager is on the project during staking operations.

2. **Equipment Calibration.** Provide copies of equipment certification for levels, transits, lasers, total stations, and GPS units. Check equipment on a semi-annual basis or if equipment accuracy

becomes questionable. Perform tests on a certified stand if possible. If performing field checks, document the method and readings and provide to the Engineer.

3. **Procedures and Records.** Include, in the CSQC plan, a listing of the procedures and records to control the quality of the staking operation. Provide at least the following information:

   a. List of work items for staking,
   b. Description of methods of computing grades and staking,
   c. Description of the checks to detect errors,
   d. Methods of documentation,
   e. Procedure to handle detected errors, and
   f. Final measurement methods and documentation.

4. **Approval of CSQC Plan.** Ensure the Engineer accepts the CSQC plan before beginning staking operations. The Department will review the plan to determine acceptability within five working days. Do not begin work until the Engineer accepts the plan in writing. The Department will not grant extensions of time without liquidated damages for the Contractor's inability to submit an acceptable plan.

5. **Changing the Plan.** If the Department determines the Contractor's performance is unsatisfactory, the Department reserves the right to require the Contractor to make changes in the CSQC plan at no additional cost to the Department. The Department may suspend work operations until the Engineer approves the plan changes.

824.04. Measurement and Payment.

Pay Item	**Pay Unit**
Contractor Staking	Lump Sum
Contractor Staking, Road Only	Lump Sum
Staking Plan Errors and Extras, One Person	Hour
Staking Plan Errors and Extras, Two Person	Hour
Staking Plan Errors and Extras, Three Person	Hour

If the Engineer determines the Contractor will perform staking as extra work, the Department will pay for staking in accordance with subsection 109.07.

If the contract does not include the pay items listed in this subsection 824.04, the Department is responsible for construction layout and the work specified in this section and subsection 104.09 will not apply.

The Department will make partial payments for staking pay items in accordance with the following Table 824-2:

Table 824-2 Staking Schedule of Partial Payments	
Percent of Original Contract Pay Item Earned	**Percent of Contract Unit Price Paid**
Approved CSQC Plan	10%
10%	30%
50%	75%
90%	90%

The Department will retain 10 percent of the relevant contractor staking pay item until the Engineer receives the required documents.

The Department will not make adjustments in the lump sum amount for **Contractor Staking** if the final contract amount for the project is within ±5 percent of the original contract amount or for approved extensions of time. If final contract amount differs from the original contract amount by greater than ±5 percent, the Department will make an upward or downward adjustment to the lump sum amount for **Contractor Staking** by the percentage that exceeds ±5 percent.

If the contract includes the pay item **Contractor Staking**, provide the lines, grades, and elevations specified in subsection 824.03 and subsection 104.09.B for the prosecution, inspection, and final measurement of the work.

If the contract includes the pay item **Contractor Staking, Road Only**, provide the lines, grades, and elevations, except for bridges and approach slabs, as specified in subsection 824.03.J through subsection 824.03.M, for the prosecution, inspection, and final measurement of road work.

The Department will pay for **Staking Plan Errors and Extras** at the unit price bid or at the following rates whichever is less:

A. For one person, $90 per hour;
B. For two people, $120 per hour; and
C. For three people, $150 per hour.

The Department will not pay separately for staking changes approved by the Engineer due to the Contractor's methods.

NOTES