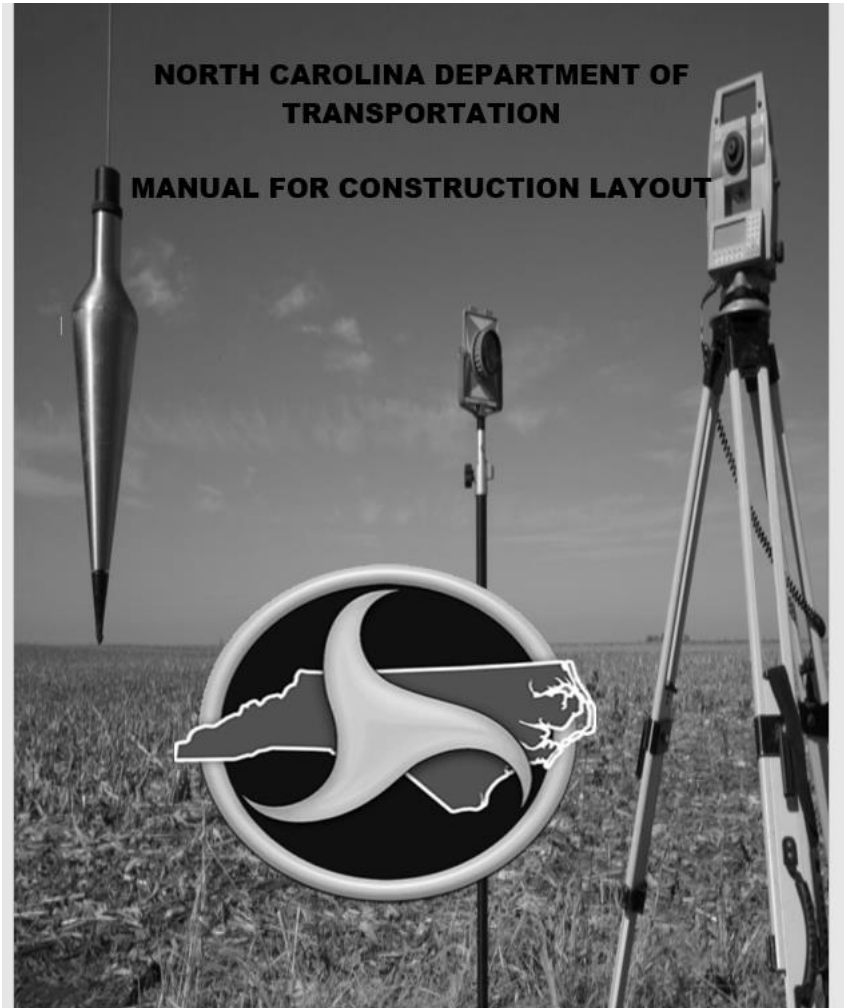


Manual for Construction Layout

Updates



Chapter 1 General Information

1.4 Preconstruction Survey Meeting

Prior to commencing surveying operations on the project and separate to the project preconstruction meeting, a preconstruction survey meeting shall be held.

The meeting should include topics regarding expectations and requirements for submittals, where submittals should be sent for review and who will be reviewing the submittals, review of this manual, anticipated methods for rough and fine grading, the type of equipment and manufacturer's information for the equipment being used for construction surveying, list of qualified personnel performing survey work and the Responsible in Charge for survey layout, and conformity to this manual of labeling stakes.

The Contractor should bring the following to the Preconstruction Survey Meeting:

- Any required rover or equipment to be supplied to the Department
- List of qualified personnel performing survey work and Responsible in Charge
- Any requested survey methods deviating from the manual for the Department's review
- Method of staking control points



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOV. 2008

JAMES H. TROGDON, III
SECRETARY

July 9, 2018

MEMORANDUM TO: Division Engineers
FROM: T. M. Little, PE
Chief Engineer
SUBJECT: 2018 Standard Specification Change for Right of Way, Control of Access and Easements

This is to provide guidance on compliance with Section 801, "Construction Stakes, Lines, and Grade" as included in the 2018 Standard Specifications, specifically Subarticle 801-2(D) "Right of Way, Control of Access and Easements."

In the 2012 Standard Specifications, Subarticle 801-2(D) simply stated to "Validate the position of the markers and permanent easement locations with those detailed in the plans. Report any discrepancies to the Engineer." Subarticle 801-2(D) has been updated in the 2018 Standard Specifications to comply with the requirements of the North Carolina Board of Examiners for Engineers and Surveyors and Title 21 Chapter 56.1602 of the North Carolina Administrative Code. Subarticle 801-2(D) now states "Re-establishment and verification of existing monuments or the replacement of existing monuments with other material (concrete R/W markers, new iron pins, etc.), shall be performed under the responsible charge of a North Carolina Professional Land Surveyor (PLS). Verify all right of way, permanent easement, and control-of-access monument positions after completion of construction with signed and sealed attestation by PLS of said verification in accordance with the *Manual for Construction Layout*."

The *Manual for Construction Layout* is currently being updated to reflect these and other needed changes. The attached "Report of Final RW and Permanent Easement Survey" should be utilized for attestation in the interim.

Prior to the project let, the Location & Surveys Unit will continue to set all iron pins with caps and show that type of symbology on all the Right of Way series plan sheets. That set of plans will be recorded with the Register of Deeds. Should the Division request that concrete monuments be installed in lieu of iron pin with cap, then the appropriate symbology for concrete monuments will be denoted on the final design plan sheets. The attestation referenced above must also denote concrete monuments. The contract surveyor will be required to submit the "Report of Final RW and Permanent Easement Survey" to the Resident Engineer as the official document as to the final R/W monumentation set as a part of the project.

In addition to reflecting the changes noted above, the updated version of the *Manual for Construction Stakeout* will provide the methodology with an illustration for the stakeout of concrete markers. This will require the PLS to install additional reference line stakes to reference the proposed monument location during monument installation to ensure accurate placement, which will still need final verification as previously described.

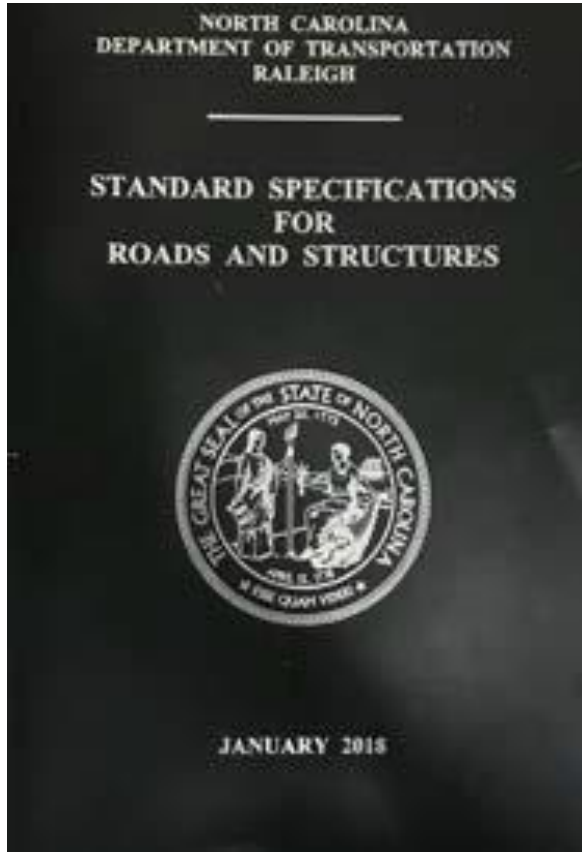
On projects where the Department is self-performing the construction surveying, the same requirements will apply. In the event neither the Resident Engineer's Office nor the Division Office has a PLS on staff, Location & Surveys Unit will provide the R/W attestation.

Should additional information be required regarding this matter, please contact Mr. Lamar Sylvester, State Construction Engineer, at (919) 707-2400.

TML:mls

Attachment: Example Report of Final R/W and Permanent Easement Survey

cc: Mr. J. W. Rouse, PE
Mr. R. A. Hancock, PE
Mr. L. L. Mitchell, PE
Mr. M. L. Sylvester, PE
Mr. B. C. Skeens, PE
Mr. C. M. Werner, PE
Mr. J. D. Burton, PE, PLS



Section 801

(D) Right of Way, Control of Access and Easements

The Department will establish the location of all proposed right-of-way markers, control-of-access markers and permanent easements. Validate the position of the markers and permanent easement locations with those detailed in the plans. Report any discrepancies to the Engineer.

Reference the location of all proposed markers and permanent easements. Restore right-of-way and control-of-access monument positions after completion of construction. Set a right-of-way or control-of-access monument cap on an 18 inch (minimum) long #5 reinforcing bar and a carsonite witness stake unless concrete right-of-way and control-of-access markers are specified in the contract. The Department will provide the monument cap and witness stake. Re-establish location of permanent easements after completion of construction and install a permanent easement cap on 18 inch (minimum) long #5 reinforcing bar for monumentation.

Re-establishment and verification of existing monuments or the replacement of existing monuments with other material (concrete R/W markers, new iron pins, etc.), shall be performed under the responsible charge of a North Carolina Professional Land Surveyor (PLS). Verify all right of way, permanent easement, and control-of-access monument positions after completion of construction with signed and sealed attestation by PLS of said verification in accordance with the Manual for Construction Layout.

Chapter 15 Right-of-Way Markers



Chapter 15 Right-of-Way Markers

15.1 Guideline Information

A rebar and cap will be set at all proposed Right-of-Way monument locations, Control of Access monument locations and Permanent Easement monument locations by a North Carolina Professional Land Surveyor at the time of Right-of-Way approval by the Board of Transportation and prior to recordation of Right-of-Way Plans at the appropriate County Register of Deeds Office. Upon given notice to proceed, the Contractor shall validate the positions of all existing Right-of-Way monuments, Control of Access monuments, and Permanent Easement monuments within the construction limits. The Contractor shall submit to the Resident Engineer for review any monumentation discrepancies between the roadway plans, including any applicable revisions, and the previously established monumentation location established by the Department.

Unless concrete Right-of-Way markers are specified in the Contract, the Contractor shall install a Right-of-Way monument cap, Control of Access monument cap or Permanent Easement monument cap and appropriate carsonite witness stake at each monumentation shown on the plans that needs to be re-established. Mount the monument cap on a minimum 18" long #5 reinforcing bar, which has been driven flush with the top of the ground. Using a hammer, snugly secure the monument cap to the top of the bar. Install an appropriate carsonite witness stake adjacent to the monument and drive it approximately 12 inches (30 centimeters) into the ground. Avoid damaging the top of the monument cap or witness stake. The Department will provide all Right-of-Way, Control of Access, and Permanent Easement monument caps and witness stakes.

If concrete monuments are specified on the design plans, the Contractor under the responsible charge of a North Carolina Professional Land Surveyor shall install concrete monuments by installing appropriate and accurate additional reference line stakes to properly reference the location of the existing cap and rebar monument location during concrete monument installation or replacement. Concrete monument replacement shall be duly noted for each location on the "Report of Final R/W and Permanent Easement Survey" and attested by the responsible North Carolina Professional Land Surveyor in responsible charge.

Right-of-way, Control of Access, and Permanent Easement markers are considered part of boundary lines and property lines. Re-establishment and verification of existing monuments or the replacement of existing monuments shall be performed under the responsible charge of a North Carolina Professional Land Surveyor.

15.2 Submittal Requirements

1. A signed and sealed attestation by a North Carolina Professional Land Surveyor. The attestation shall be verification of all re-established and/or re-placed Right of Way, Permanent Easement, and Control-of-Access monument positions. Verification includes new and existing monuments (including concrete R/W markers, iron pins, caps, etc.). The "Report of Final R/W and Permanent Easement Survey" form shall be completed and submitted to the Resident Engineer upon completion of the installation of all Right-of-Way Markers. Any operations that pose a risk of damage to the location of the markers shall

Unless concrete Right-of-Way markers are specified in the Contract, the Contractor shall install a Right-of-Way monument cap, Control of Access monument cap or Permanent Easement monument cap and appropriate carsonite witness stake at each monumentation shown on the plans that needs to be re-established. Mount the monument cap on a minimum 18" long #5 reinforcing bar, which has been driven flush with the top of the ground. Using a hammer, snugly secure the monument cap to the top of the bar. Install an appropriate carsonite witness stake adjacent to the monument and drive it approximately 12 inches (30 centimeters) into the ground. Avoid damaging the top of the monument cap or witness stake. The Department will provide all Right-of-Way, Control of Access, and Permanent Easement monument caps and witness stakes.

If concrete monuments are specified on the design plans, the Contractor under the responsible charge of a North Carolina Professional Land Surveyor shall install concrete monuments by installing appropriate and accurate additional reference line stakes to properly reference the location of the existing cap and rebar monument location during concrete monument installation or replacement. Concrete monument replacement shall be duly noted for each location on the "Report of Final R/W and Permanent Easement Survey" and attested by the responsible North Carolina Professional Land Surveyor in responsible charge.

Chapter 15 Right-of-Way Markers

15.2 Submittal Requirements

1. A signed and sealed attestation by a North Carolina Professional Land Surveyor. The attestation shall be verification of all re-established and/or re-placed Right of Way, Permanent Easement, and Control-of-Access monument positions. Verification includes new and existing monuments (including concrete R/W markers, iron pins, caps, etc.). The “Report of Final R/W and Permanent Easement Survey” form shall be completed and submitted to the Resident Engineer upon completion of the installation of all Right-of-Way Markers. Any operations that pose a risk of damage to the location of the markers shall also be reported to the Resident Engineer. A copy of the report shall be forwarded by the Resident Engineer to the appropriate Location & Surveys Unit Regional Project Development Engineer for review and approval. An example of this form can be found in the Appendix of this Manual as well as the procedures to be followed. An electronic, fillable form is located on the NCDOT website at:

<https://connect.ncdot.gov/resources/Location/Pages/default.aspx>

Example

Report of Final R/W and Permanent Easement Survey

(Replacement and /or Re-establishing Verification of Right of Way and Permanent Easement Markers
for the North Carolina Department of Transportation)

TIP No.:

Project No.:

County:

Project Description:

Plans Recorded in: <County Highway Plan Book designation, i.e. Map Book, Page>

I certify that this survey was done under my responsible charge in accordance with the **NCDOT Survey Standards** as directed in the **NCDOT Location & Surveys Guidelines and Procedures** and the **Manual for Construction Layout** for the purpose of (re-establishing/replacement) of R/W and/or permanent easement markers. That per the Project Plans of Record the following list of markers were either re-established or replaced at the following station/offset locations:

Line Descriptor (-L,-Y-, etc.)	Station	Offset	Northing	Easting	Re-placed or Re-established	Type and Material of Original Marker	Type and Material of New Marker
Examples L	28+56.23	148.66, Rt.	878,948.23	2,456,128.92	Re-placed	R/W, Iron Pin & Cap	R/W, Concrete
Y	58+72.66	167.89, Lt.	868,785.45	2,456,849.88	Re-established	Easement, Iron Pin & Cap	Easement, Iron Pin & Cap

All bearings and coordinates are referenced to the North Carolina State Plane Coordinate System per Plans of Record.

Witness my signature, registration number and seal this ____ day of _____, 20XX

Professional Land Surveyor (Print Name)

PLS#



Surveyor's Seal

Signature

Automated Machine Guidance





Chapter 19

Automated Machine Guidance

19.1 General Information

If the Contractor elects to use Global Positioning System (GPS) machine control grading it shall be used in conjunction with Section 801 of the Standard Specifications for Roads and Structures. The use of this technology (or similar technology) is referenced as Automated Machine Guidance (AMG). All equipment using AMG shall be able to generate end results that meet the Standard Specifications. Perform test sections for each type of work to be completed with AMG to demonstrate that the system has the capability to achieve acceptable results. If acceptable results cannot be achieved, conform to the requirements for conventional stakeout.

The Contractor shall be responsible for all errors resulting from the use of AMG and shall correct deficiencies to the satisfaction of the Engineer at no cost to the Department.

19.2 Subgrade and Base Controls

If the Contractor elects to use AMG for fine grading and placement of base or other roadway materials, the GPS shall be supplemented with a laser or robotic total station. Include details of the proposed system in the AMG work plan. In addition, the following requirements apply for the use of AMG for subgrade and base construction.

1. Provide control points at intervals along the project not to exceed 800 feet or as recommended by the manufacturer for the equipment in use. The horizontal position of these points shall be determined by traverse connection from the original base line control points. The elevation of these control points shall be established using differential leveling from project benchmarks, forming closed loops where practical. A copy of all new control point information shall be provided to the Engineer prior to construction activities.
2. Provide conventional survey grade stakes at 500' intervals and at critical points such as, but not limited to, PCs, PTs, tapers, changes in roadway width, and other critical points as requested by the Engineer.
3. Provide hubs at the top of the finished subgrade at all hinge points on the cross section at 500-foot intervals. These hubs shall be established using conventional survey methods for use by the Engineer to check the accuracy of construction.
4. Stakes shall be provided prior to the start of fine grading at 100' intervals and at offsets between 3' and 10' from the edge of pavement (edge of asphalt) on the outside shoulder. These stakes shall remain in place until the final lift of pavement is completed. All stakes shall have offset distance and station number provided on the stake. The stakes will provide reference for proof rolling operations, fine grading operations, and paving operations.
5. Slope stakes shall be set regardless of grading methods for slope protection under bridges, cross line pipe, culverts, wetlands, and other jurisdictional boundaries.

19.3 Submittal Requirements

If the Contractor elects to use AMG, a Digital Terrain Model (DTM) of the design surface and all intermediate surfaces shall be developed and submitted to the Engineer for review. At least 90 days prior to beginning grading operations, the Contractor shall submit to the Engineer an AMG work plan to include, but not limited to, proposed equipment, control software manufacturer and version, types of work to be completed using AMG, project site calibration report, repetitive calibration methods for construction equipment and rover units to be used for the duration of the project, how the Contractor will check into bench marks and the frequency of check-ins, and local GPS base station to be used for broadcasting differential correction data to rover units (this may include the NC Network RTK). All surveys must be tied to existing project control as established by NCDOT.

The AMG plan may be submitted as one submittal in its entirety or multiple AMG plans may be submitted for separate operations using machine control. Plans must be submitted for all operations using machine guidance including but not limited to rough grading, fine grading, chemical stabilization, concrete paving, and asphalt paving operations.

Until the DTM and AMG plan are received and approved by the Engineer, the Contractor shall provide conventional stakes and use conventional staking methods for all operations including but not limited to slope stakes, intermediate grade stakes, ditch stakes, and fine grade stakes.

19.4 Inspection

If the surveying /construction layout/oversight plan or machine accuracy control is deemed unacceptable by the Department, during any part of planning, design, or construction, the Contractor may be required to revert to requirements of Section 801 of the Standard Specifications and conventional staking.

The Contractor shall provide the Engineer with one GPS rover unit for use during the duration of the contract. The rover will be loaded with the same model that is used with the AMG and have the same capability as rover units used by the Contractor. The rover will be kept in the possession of the Engineer and will be returned to the Contractor upon completion of the contract. Any maintenance or repairs required for the rover will be the responsibility of the Contractor. Formal training of at least 8 hours shall be provided to the Engineer by the Contractor on the use of the proposed AMG system.

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