



NORTH CAROLINA

Department of Transportation



AGC-NCDOT Workshop 2020

Construction Breakout Session – Roadway Topics

March 5, 2020



- ***REVISED September 1, 2018***
- ***Prior to beginning work on the project conduct a preconstruction survey meeting to discuss:***
 - ***Required submittals***
 - ***Who will review submittals?***
 - ***Survey equipment***
 - ***Method of staking control points***
 - ***Environmentally sensitive areas***
 - ***Digital Terrain Model***
 - ***Will Contractor use AMG?***



Construction Layout



Chapter 8 Pipe Stakes

8.1 General Information

A critical task, on any project, is to construct the drainage so that water. During construction stakeout, the survey crew should identify recommendations for correction to the Engineer. It is the responsibility to ensure that the drainage systems detailed in the plans will function that the drainage system may be inadequate, based upon field observations the Engineer. In accordance with Section 801-2(F)(2), provide construction depicted in the plans in accordance with the *Guidelines for Drainage*.

8.2 Guideline Information

Prior to calculating and staking the drainage system detailed in the plans, perform a field investigation of the proposed area. Consider the locations and elevations of all existing and proposed utilities, proposed utility construction, and existing and proposed drainage systems in the layout of the drainage system. A layout drawing of the drainage system shall be submitted to the Engineer for review and approval prior to the contractor beginning installation of that system. In addition, unless otherwise indicated in the network before submitting any portion of the network for approval. The Drainage plans is for bidding purposes only and shall not be used for stakeout.

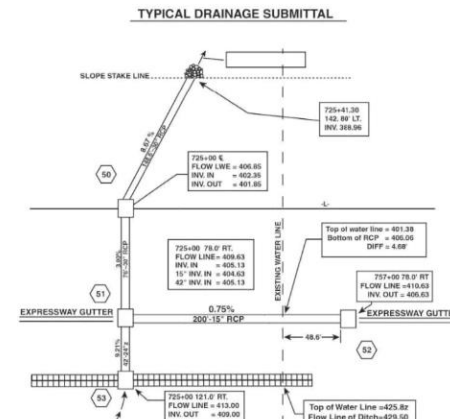
Establish pipe lengths from the drainage structure locations and/or actual locations of existing streams, natural ground or proposed drainage ditches as measured directly and/or layout. To ensure the clear zone recovery requirements are met, when the Engineer if the pipe length is less than the plan length. Use 12" hubs for reference flowline elevation. Pipelines greater than 200 feet will require intermediate hubs on smaller intervals as deemed necessary by the Engineer. The intermediate hubs relative to the pipes invert elevations directly adjacent to the intermediate hubs pipe shall begin with 0+00 at the outlet end of the pipe and advance to the inlet line, consisting of two hubs with corresponding reference stakes, for the inlet first reference hub shall be a minimum of 10 feet (3 meters) from the reference installed at an equal distance from the first hub.

8.3 Submittal Requirements

- 1) Drainage layout shall contain the following at a minimum:
 - a. Station and offset from centerline
 - b. Flow line elevations
 - c. Invert elevations
 - d. Percent grade of drainage networks
 - e. Standard drawing number for drainage structures
 - f. Standard drawing number for frames and grates
 - g. Type and size of drainage pipe
 - h. Length of drainage pipe

A layout drawing of the drainage system shall be submitted to the Engineer for review and approval prior to the contractor beginning installation of that system.

The Drainage Summary provided in the plans is for bidding purposes only and shall not be used for stakeout.



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

LIST OF PIPES, ENDWALS, ETC. (FOR PIPES 18 INCHES & UNDER)

Note: Invert Elevations indicated are for Bid Preparation only and shall not be used for project construction stakeout. See Standard Specifications for Roads and Structures, Section 203-07.

STATIONING	PIPE SIZE	LENGTH	PERCENT GRADE	INVERT	FLOWLINE	TOP OF WATER	BOTTOM OF RCP	DIFFERENCE	REMARKS
725+00	300x15 RCP	150	0.75%	402.35	406.85	401.30	406.00	4.68	
725+00	121.0' RT.			408.00	413.00	425.82			
737+00	78.0' RT.			406.63	410.68				

Exploratory Excavation

(F) Drainage and Utility Construction Systems

(1) General

Where underground conflicts are suspected, contact utility owners and locate all utilities horizontally and vertically. Consider the utilities' locations and elevations in the layout of the drainage systems and utility construction systems. Utilities may exist that are not depicted in the plans.

- When should Exploratory Excavation be Paid
- In the place where utilities may exist that are not depicted on the plans because of unknown location.
- Some Urban projects where we know much of the SUE is unknown might include these items (standard and vacuum exploratory excavation)

18 Exploratory Excavation required to locate a utility will be paid in accordance with
19 Article 104-7.



Chapter 17 Major Structure Stakes

17.1 Guideline Information

All major structures shall be staked with reference lines which contain at least three (3) reference hubs on each side with tacks. These hubs should be spaced equally apart at adequate intervals. Reference hubs shall be checked for accuracy after sitting all winter or as required by the Engineer. If two structures are side by side, then the reference hubs for each bridge should be color coordinated to eliminate confusion.

Bridge Stake Out

Bridge stake out will contain two reference lines for each end bent, interior bent, and the long chord line. (See Figures 17.1a and 17.1b.) Set a minimum of two throughout the entire bridge construction. One bench mark superstructure. On grade separation structures, a point general drawing. If shown on the plans, the elevation layout.

Construction elevations are furnished from Structure E beams and should be used as follows:

Bottom of slab grades will be used to determine girder of each span. (For longer spans 40' or more in the construction elevation printouts.) After camber has been corrected and diaphragm connection bolts tightened, elevations on top of girders at each twentieth point and are used in computing effect of the sun can significantly change girder camber. Levels should be taken the morning or on a completely overcast morning. Deflections should be used in the required computations. Build-up height at a twentieth point is computed as follows:

- + final bottom of slab elevation (provided by Structure Design)
- + deflection due to weight of slab
- + deflections due to weight of parapet, rail, and F.W.S.
- top of girder elevation (determined in field)

The algebraic sum of these values equals the height of build-up above the top of girder. In some cases, this value will be minus indicating the girder flange projects into the slab.

The build-up heights for the entire bridge shall be computed and listed in a field book well in advance of any forming operation. These heights can be marked on the top of girder at the proper twentieth point.

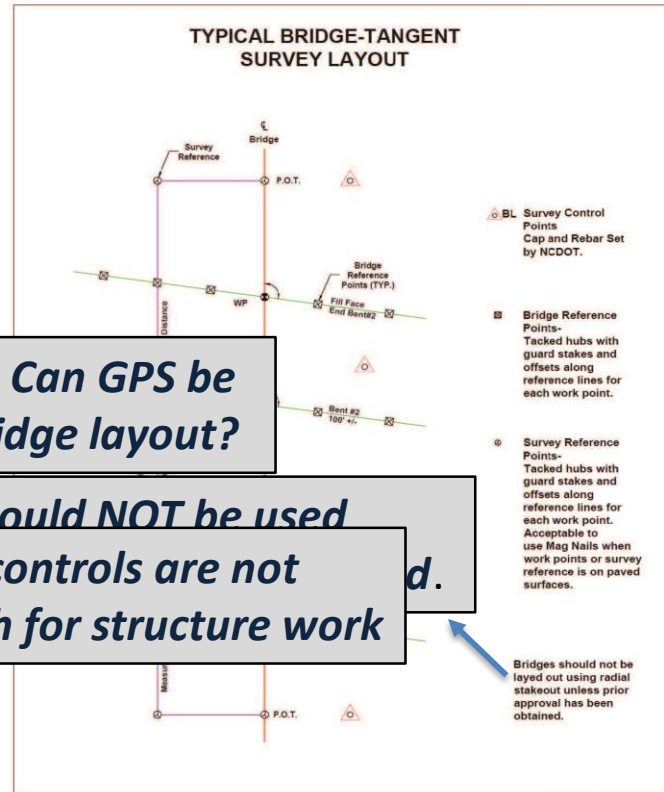


Figure 17.1a

QUESTION: Can we use radial stakeout for bridge layout?

QUESTION: Can GPS be used for bridge layout?

Radial stakeout should NOT be used unless... Vertical controls are not accurate enough for structure work.

Structure Stakeout Check Items

- ✓ *INITIAL LAYOUT – Independent check*
- ✓ *BENCHMARKS – Independent check*
- ✓ *ALIGNMENT OF FOOTINGS, COLUMNS & CAPS*
- ✓ *RR BRIDGES- Check rail elevations shot in the field against bottom of beam elevations at rail separations and compare to vertical clearance shown in plans. Check clearance again after girders are installed*
- ✓ *BRIDGE SEAT ELEVATIONS*
- ✓ *BUILDUP ELEVATIONS – Independent check*
- ✓ *APPROACH SLAB GRADES*

Construction Surveying



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

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.

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

ROW Verification

Must be signed and sealed by a PLS

Questions or Comments?



Project Acceptance/Closeout

- Communication during the life of the project, via construction meetings and on-site meetings.
- Running punch list communicated from Inspection Staff to project Field Personnel (Foreman, Superintendents, etc)
- “Catch it as you go” Approach

Emphasis on Communication in the field

- The industry continues to see some inexperienced staff on both sides (contractor field staff and inspection staff).
- As each learns the construction process- good communication along the life of the project is key.
- Efficient Project Delivery – Time is Money!

Common punch list items

- This is a good tool for them to look over as the project progresses towards completion.
- Trying to avoid any major items of work that would potentially remain on a punch list (especially from subcontractors).
- Communicate any open issues or previous discussions/decisions when staff changes are made throughout the life of the project.

FINAL INSPECTION COMI

Asphalt Pavement

- Good ride quality
- Longitudinal joints in correct
- Transverse and longitudinal
- No fuel spills on asphalt and
- No segregation
- Correct cross slope
- No standing water or water
- Valves and manholes adjust
- Driveways (tie-in, widths)

Concrete Pavement

- All spalls/cracks repaired
- Joint sealed Joint in proper loc
- Ride quality acceptable
- Tining performed to specific
- Correct cross slope
- Acceptable appearance
- Drains adequately

Pavement Marking

- Stop bars/cross walks/ arrow
- Thermoplastic/paint workma
- marking removed, not place
- Retroreflectivity of thermoplas
- Roadway delineators (flexibl

Signs

- Installed per plan
- Correct orientation
- Cleaned
- Metals Engineer list complet
- Overhead lighting inspector
- Overhead sign anchor bolts/

Grading

- No standing water in ditches
- Slopes graded to correct cro
- Project properly vegetated c
- All washes repaired and see
- No more than one inch drop
- Mowing and topdressing has
- Erosion control measures removed unless otherwise direct

Guardrail/Guiderail/Barrier

- Proper installation per St
- Cross slope per standard
- Clear roadside recovery z
- No tack on rail end units
- Workmanship (correct h
- good finish on barrier, ck

Drainage

- Drainage structures clear
- Pipes are flush with insid
- Pipes sealed properly
- Frames and boxes groute
- Correct type of grate
- Grate does not rock
- Steps installed
- Pipes clean
- Not missing expansion jo
- Aprons are not damaged
- Pipe near subgrade level

Miscellaneous Concret

- Sidewalk (good finish, jo
- Curb and gutter (good fir
- sealed, joints sealed)
- ADA Handicap ramps in c

Fence

- No damaged areas
- Tree/ debris removed

Signals

- Inspected by Division Tr
- No stone in bottom of pu
- Signal head clearance
- Improper welding or grot

Overhead Lighting

- Inspected by Division Traffic Services
- Burn period performed

Borrow/Waste

- Pits reviewed with property owners
- Plan matches actual final condition of pit
- All erosion control measures removed unless otherwise directed
- Pit has been seeded with stand of grass established
- Graded to drain
- All washes repaired and seeded

General

- Rocks and asphalt/concrete chunks removed
- All stockpile areas cleaned and seeded and mulched
- Trash picked up
- Mail boxes adjusted/relocated

Structures

- Check guardrail anchor system – patch spalling from drilling operation, tighten nuts, make sure proper number of posts (even field drilling the rail to install end post near at backwall
- Install barrier delineators
- Clean tops of caps and epoxy caps as required by plans – check and repair damaged epoxy as needed
- Properly install pvc pipe, nuts, washers, and burr threads on anchor bolts
- Remove all forming materials from end bent joints
- Remove from fins from bottom of interior bent caps, bottom of overhangs, and other chamfered edges
- Patch overhang jack holes
- Point and patch substructure as needed (deep air bubbles larger than a dime). Make sure final surface finish is uniform – avoid spotty looking patchwork
- Review end bent caps and around perimeter of slope protection for scour holes – fill with flowable fill as needed
- Trim top of permanent casing on drill shaft to elevation of concrete and remove column forming support aids Paint deck drain pipes and /or extend them on steel girder bridges
- Recess and seal expansion joint material between cored slabs and end blocks and interior bents
- Install expansion joint material or backer rod in barrier at rail at interior bents and seal

This list is not all inclusive of the items needed for final acceptance and should serve as a list of common items needing attention prior to the Department performing a final inspection.

Scheduling Final Inspections

- The Contractor should make a request to the Resident Engineer for Final Inspection within **2 – 3 weeks** of the project or portions, as provided in [Article 105-17](#), being complete.
- Make sure the proper people are invited to the Final; DCE/ACE/REU/(PM/PE/SUPER), Division Maintenance Staff, etc
- Can be a good time to discuss upcoming Project Closeout Procedures...

Communicate!

- Most of the time it is more effective to pick up the phone and talk to someone directly to solve a problem!
- Make sure to take these talking points back to the field staff (Inspectors, Foreman, Superintendents, etc)
- Good teamwork means good communication. Be responsive and be available.

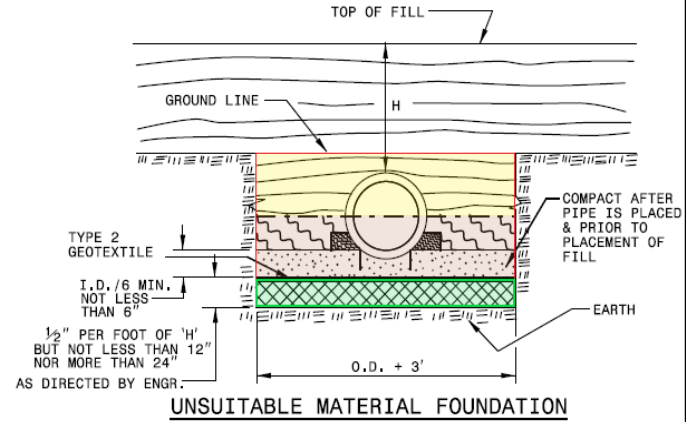


Questions or Comments?



Pipe backfill when unsuitable soils are encountered....

- We know how to how pipe foundation and material up to the spring line of the pipe; per the Specifications and Standard Drawings.
- What about the material above the pipe line that is deemed unsuitable and has to be replaced?
- How should this be handled on comprehensive grading projects?



PIPE IN TRENCH

STATE OF NORTH CAROLINA
DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH, N.C.

1-18

ROADWAY STANDARD DRAWING FOR
METHOD OF PIPE INSTALLATION

RIGID PIPE

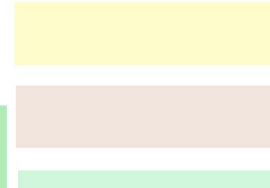
The select bedding and backfill material will be included in the cost of the installed pipe. Where unclassified excavation or borrow material meets the requirements for select bedding and backfill, no deductions will be made to these pay items to account for use in the pipe installation.

Removal of Unsuitable material above the pipe invert is considered incidental to new pipe culvert installation. (Article 300-9)

Undercut excavation (CY by average end method) and paid at double the contract unit price for Unclassified Excavation,
or
No direct payment for Undercut if Foundation Conditioning Material, Minor Structures is used. Payment at the contract unit price is full compensation for all work of pipe undercut excavation.

Excavation

If using local material, Unclassified or borrow material depending on the source of conditioning material or Foundation Conditioning Material, Minor Structures (Ton) and Foundation Conditioning Geotextile (SY)



Backfill

GENERAL NOTES:

- I.D. = THE MAXIMUM HORIZONTAL INSIDE DIAMETER DIMENSION.
- O.D. = THE MAXIMUM HORIZONTAL OUTSIDE DIAMETER DIMENSION.
- H = THE FILL HEIGHT MEASURED VERTICALLY AT ANY POINT ALONG THE PIPE FROM THE TOP OF THE PIPE TO THE TOP OF THE EMBANKMENT AT THAT POINT.

DO NOT OPERATE HEAVY EQUIPMENT OVER ANY PIPE CULVERT UNTIL THE PIPE CULVERT HAS BEEN PROPERLY BACKFILLED AND COVERED WITH AT LEAST 3 FEET OF APPROVED MATERIAL.

- TAKE CARE TO FULLY COMPACT HAUNCH ZONE OF PIPE BACKFILL.
- LOOSELY PLACED SELECT MATERIAL CLASS III OR CLASS II, TYPE 1 FOR PIPE BEDDING. LEAVE SECTION DIRECTLY BENEATH PIPE UNCOMPACTED AS PIPE SEATING AND BACKFILL WILL ACCOMPLISH COMPACTION.

- SPRINGLINE OF PIPE
- SELECT BACKFILL MATERIAL CLASS III OR CLASS II, BELOW SPRINGLINE.
- APPROVED SUITABLE LOCAL MATERIAL ABOVE SPRINGLINE.
- UNDISTURBED EARTH MATERIAL
- SELECT MATERIAL CLASS V OR VI FOR FOUNDATION CONDITIONING. ENCAPSULATE WITH TYPE 2 GEOTEXTILE AS DIRECTED BY THE ENGINEER.

SHEET 2 OF 3

300.01

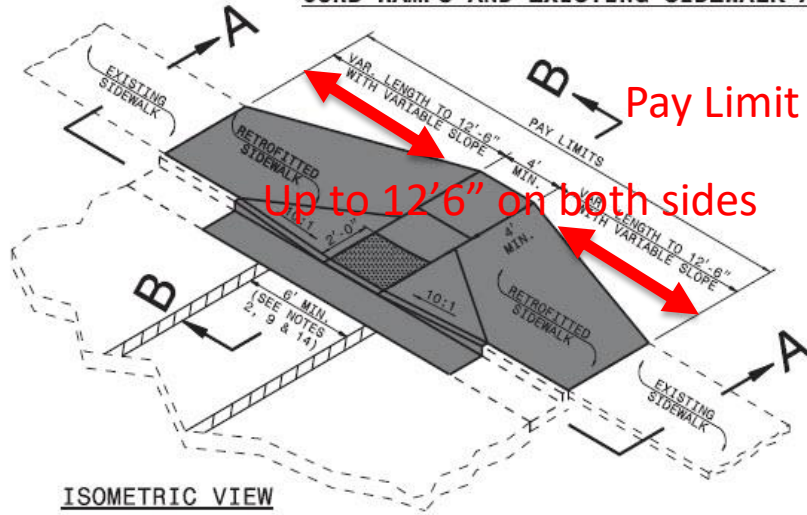
Questions or Comments?



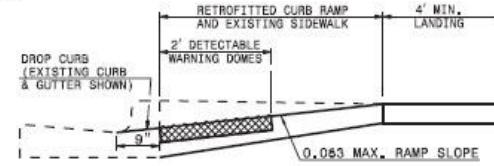
ADA Curb Ramps and Sidewalks

- Standard Curb Ramps
 - STD 848.05 and 848.06
 - Can be used for new construction or retrofit
- Alternative Curb Ramps
 - Included in Resurfacing or Sidewalk Projects
 - <https://connect.ncdot.gov/resources/Specifications/Pages/2018-Roadway-Standard-Drawings.aspx>
- Concrete Driveway Turnouts
 - Must maintain ADA compliant Cross Slope and width when sidewalk is present.

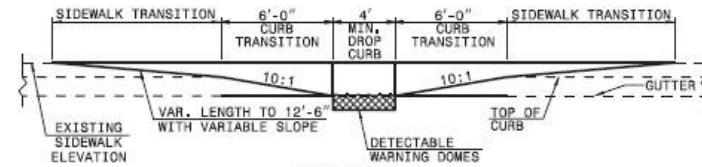
CURB RAMPS AND EXISTING SIDEWALK ADJACENT TO CURB



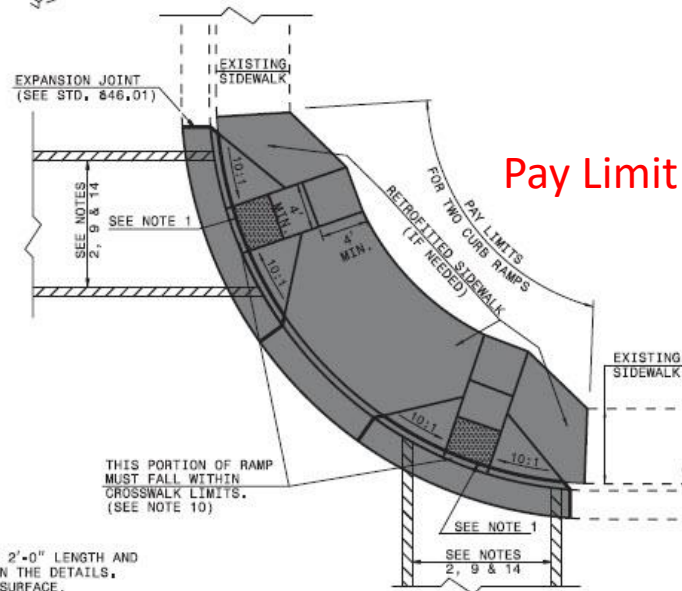
ISOMETRIC VIEW



SECTION B-B



SECTION A-A

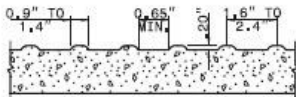
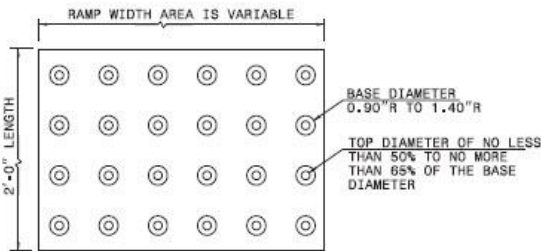


Pay Limit 2 WCR

PLAN VIEW

DUAL RAMPS
ANY RADII
(40" MIN. FLOOR WIDTH)

PAY LIMITS OF CURB RAMP



DETECTABLE WARNING DOMES

NOTES:

1. PLACE DETECTABLE WARNING DOMES TO COVER 2'-0" LENGTH AND FULL WIDTH OF THE RAMP FLOOR AS SHOWN ON THE DETAILS.
2. OBTAIN VISIBLE CONTRAST WITH ADJOINING SURFACE, EITHER LIGHT-ON-DARK, OR DARK-ON-LIGHT SEQUENCE COVERING THE ENTIRE RAMP.

STATE OF NORTH CAROLINA
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RALEIGH, N.C.

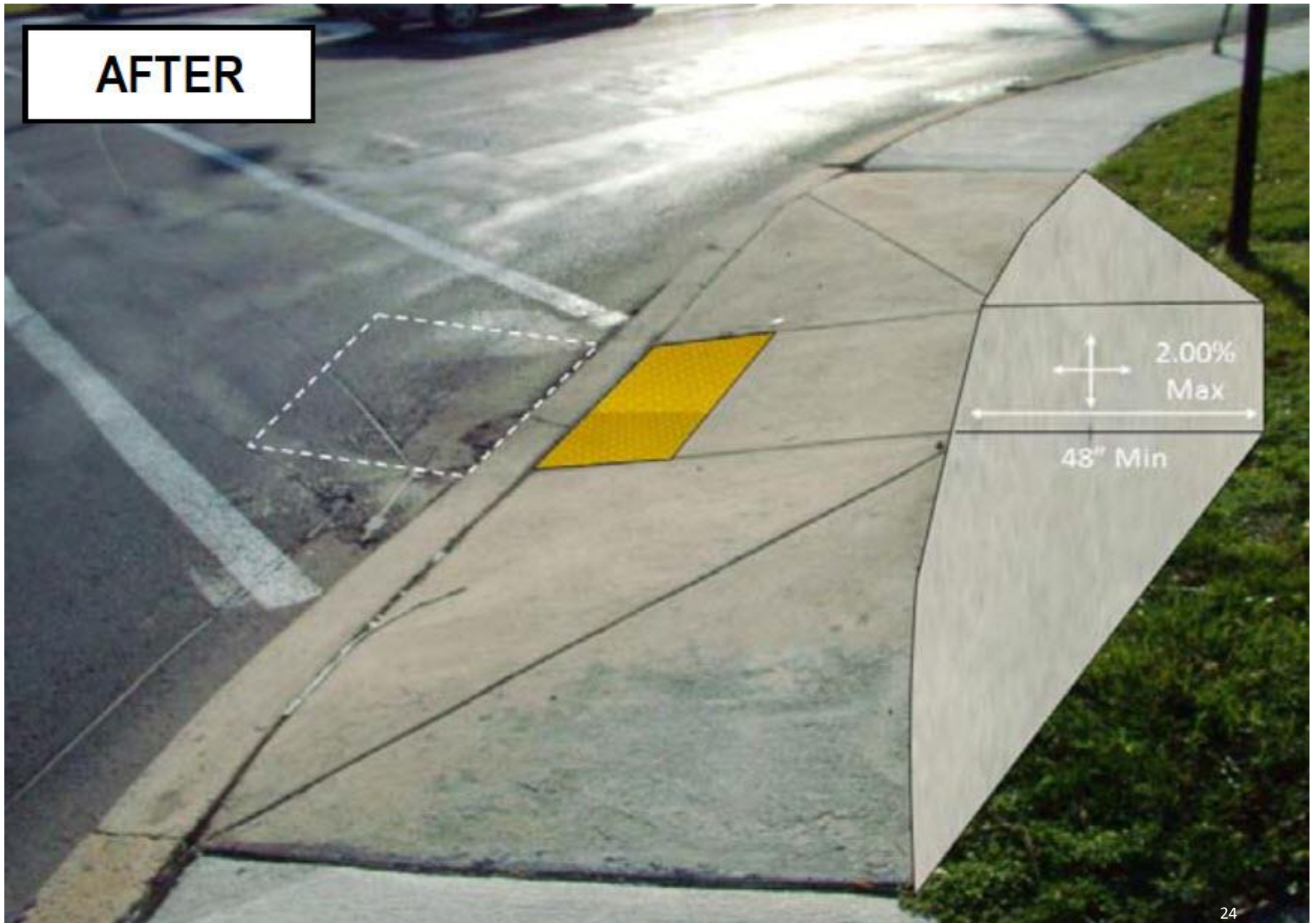
ROADWAY STANDARD DRAWING FOR
CURB RAMP
EXISTING CURB AND GUTTER

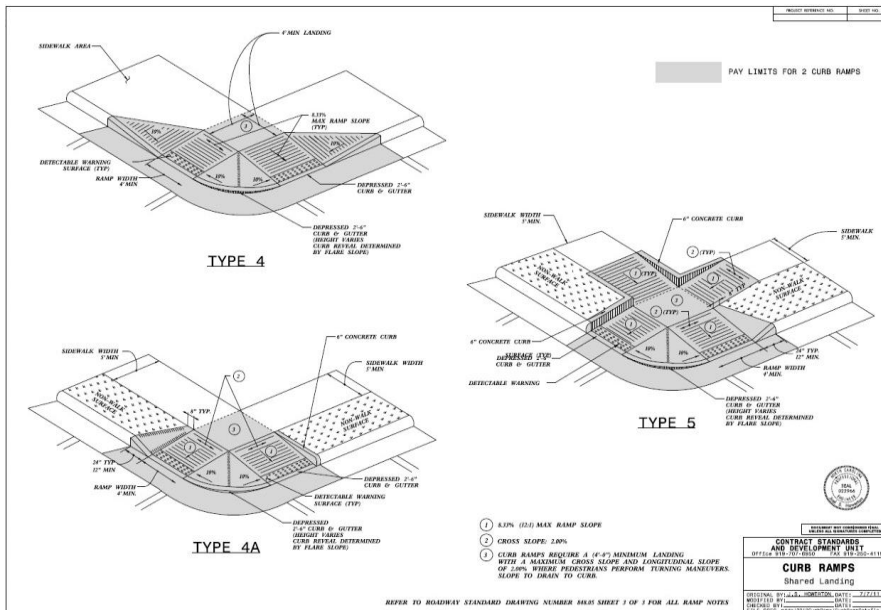
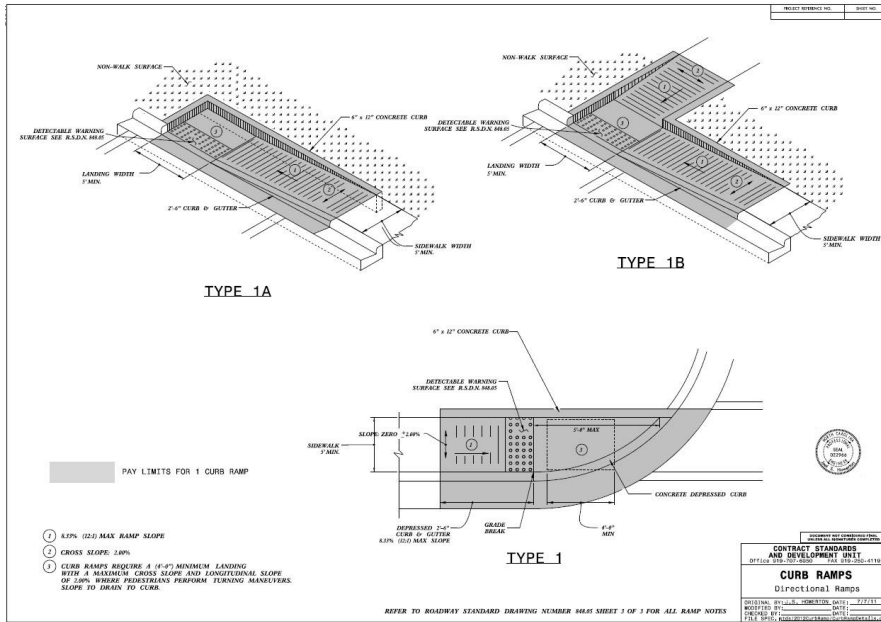
SHEET 2 OF 5
848.06

BEFORE

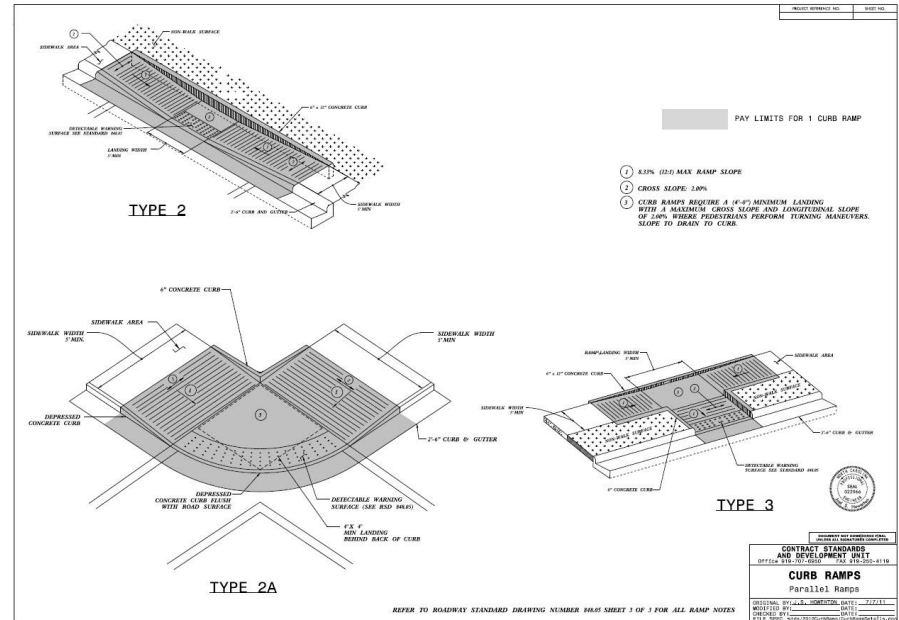


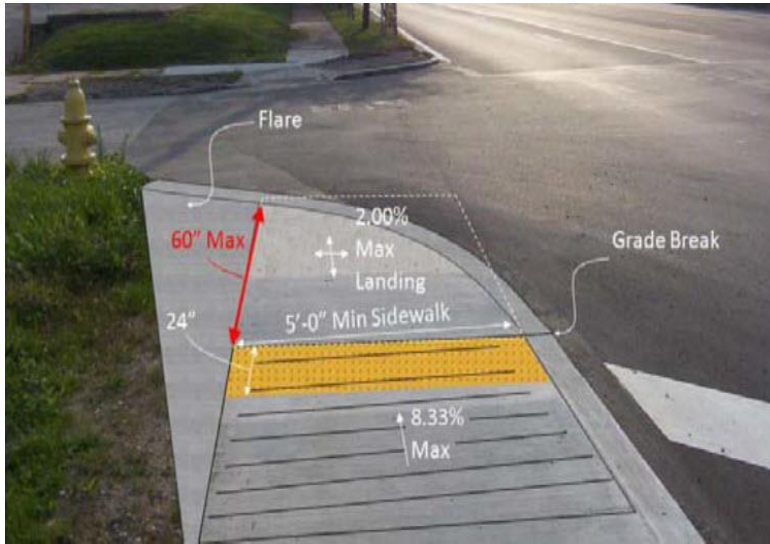
AFTER





Alternative Curb Ramps





Type 1



Type 3



Type 2





Work Zone Traffic Control

- Make sure that accommodations are met if you have existing sidewalk or if a worn walking path is present.
- A detour is not required when there is no continuity to the sidewalk.



The sign should read
"ADA LAWSUIT AHEAD"





Would you block a vehicular travel lane with this sign? Then why do you block a sidewalk?

Value Management Team

Alyson Tamer, PE, CPM



Clare Fullerton, PE



Haadi Sadaghiani



Roe Brybag, PE

Value Management Office



Value
Engineering
Program



Constructabil
ity Review
Program



Value
Engineering
Proposal
Program



Risk Assessment
Program



CLEAR Program

Constructability Review Program

Benefits

- Work out potential field issues while the project is still being designed
- Provide a better understanding between design and construction
- Provide contractor input on design issues (coordinate with the AGC)
- Potential cost savings, risk reduction and/or time reduction



Research

- **Ongoing project:** Review and enhancement of Constructability Review process and program.
 - Please participate in interviews if you are contacted by the research team out of ITRE.
- **Upcoming project:** Establish guidance on Constructability of DMUIIs and Use of 4D model techniques (adding time/schedule to 3D geometry)
 - Interested in participating on the committee or being a friend of the committee?
Contact Clare Fullerton, PE

Value Engineering Proposal

A Value Engineering Proposal (VEP) brings an innovative idea and savings to the Department from a Contractor.

- Contractor Idea
- Savings split 50/50 between NCDOT and Contractor
- Minimum \$10,000 savings threshold
- Contractor covers cost associated with proposal submission



Value Engineering Proposal

- Article 104-12 (2018 Standard Specifications for Roads and Structures)
- Review is coordinated by Value Management

Benefits

- Use of Contractor specific equipment or methods to enhance construction projects
- Reduce construction costs
- Reduce construction schedules
- Introduce innovations into projects

Value Engineering Proposal

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

STANDARD SPECIFICATIONS
FOR
ROADS AND STRUCTURES

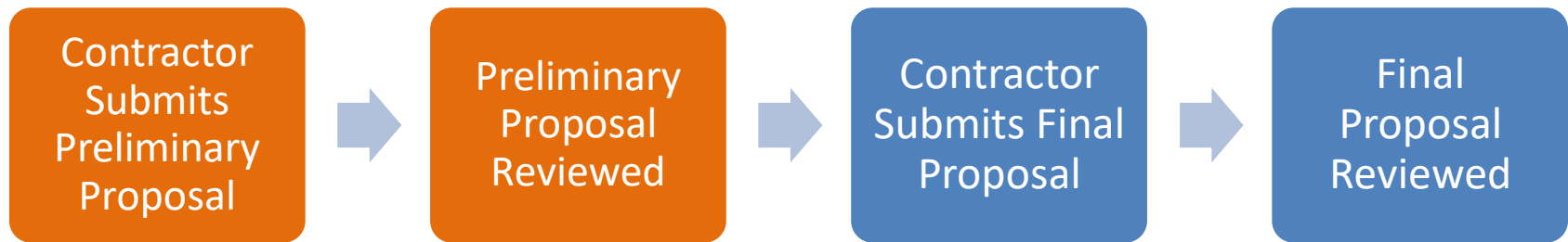


JANUARY 2018

8 104-12 VALUE ENGINEERING PROPOSAL

9 This value engineering specification is to provide an incentive to the Contractor to initiate,
10 develop and present to the Department for consideration, any cost reduction proposals
11 conceived by him involving changes to the contract. This specification does not apply unless
12 the proposal submitted is specifically identified by the Contractor as being presented for
13 consideration as a Value Engineering Proposal (VEP). Submittals that propose material
14 substitutions of permanent features, such as, but not limited to, changes from rigid to flexible
15 or flexible to rigid pavements, concrete to steel or steel to concrete bridges will not be
16 considered acceptable VEPs. Depending on the complexity of evaluation and
17 implementations, VEPs that provide for a total savings before distribution of less than
18 \$10,000 may not be considered.

VEP Process

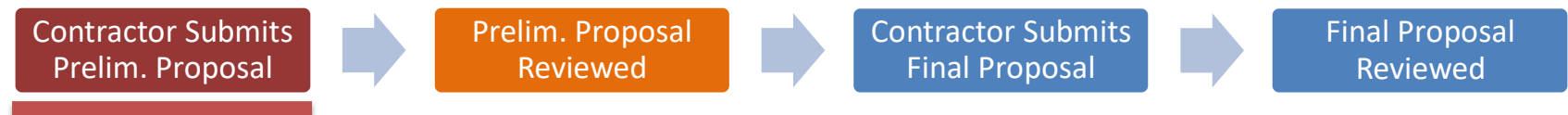


Contractor Submits Preliminary Proposal

Proposal should include:

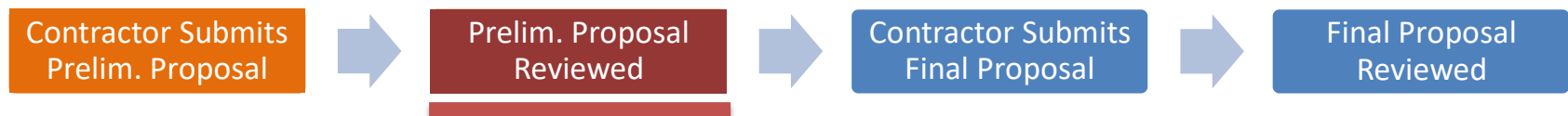
- Description of proposed change, including benefits
- Estimated cost savings with breakdown
- Sketch, mark-ups on existing plan sheets

Benefit is to see if idea has merit before developing fully.



Preliminary Proposal Reviewed

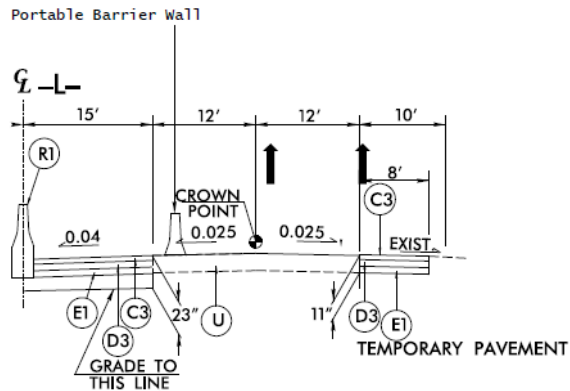
- Reviewed by Resident Engineer, Value Management Office, and Technical Units
- Review the validity of the VEP
- If accepted – Contractor prepares Final Proposal



Example of Back-up Document

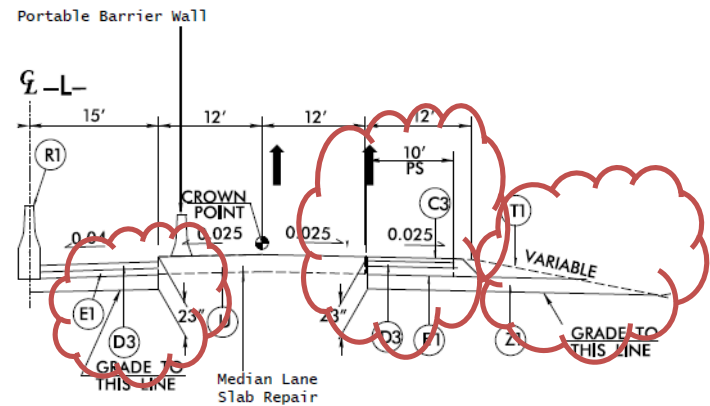
ORIGINAL PROJECT DETAILS

Two Travel Lanes Open



CONTRACTOR PROPOSED CHANGES

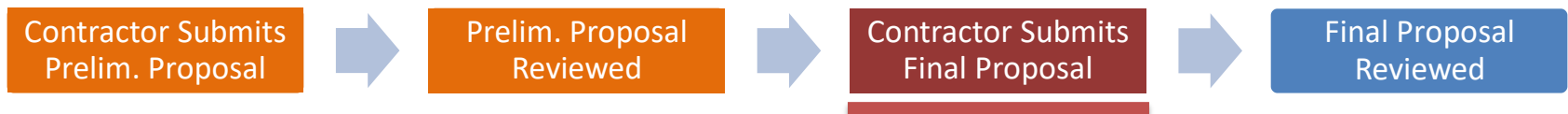
Two Travel Lanes Open



Contractor Submits Final Proposal

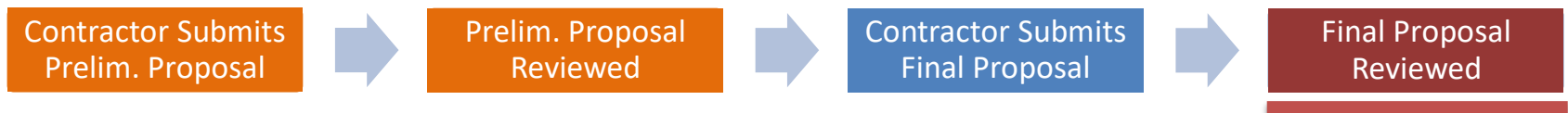
Final Proposal must include:

- Design Calculations
- Contract Plan Sheet Modifications
- Contract Document Changes
- Cost Savings Estimate based on Contract line items



Final Proposal Reviewed

- Reviewed by the Division Resident Engineer, Value Management Office, Technical Unit
- Construction Unit signs off on approval
- Supplemental Agreement executed, includes the portion of the cost savings owed to the Contractor



CLEAR

Communicate Lessons,
Exchange Advice, Record.



- Program to support internal communication, knowledge sharing, creativity, and innovation.

WHY was CLEAR developed?



Feedback loops created between regions and units.



Innovations shared and vetted.



Institutional knowledge stored.



Ideas on any topic related to NCDOT.

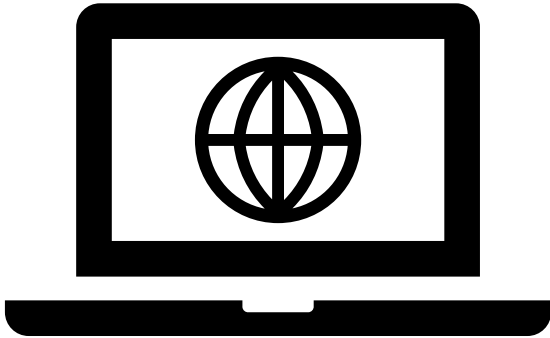


Approved submissions searched and shared.



Enhanced communication and knowledge share.

CLEAR is found on a SharePoint Site



- Connect Site
- NCDOT Employees
- Mobile friendly
- Data Analytics



NCDOT personnel with NCDOT email can submit any Lesson Learned, Best Management Practice, or Request for a Solution.



This submission goes through the Value Management Office and is reviewed.

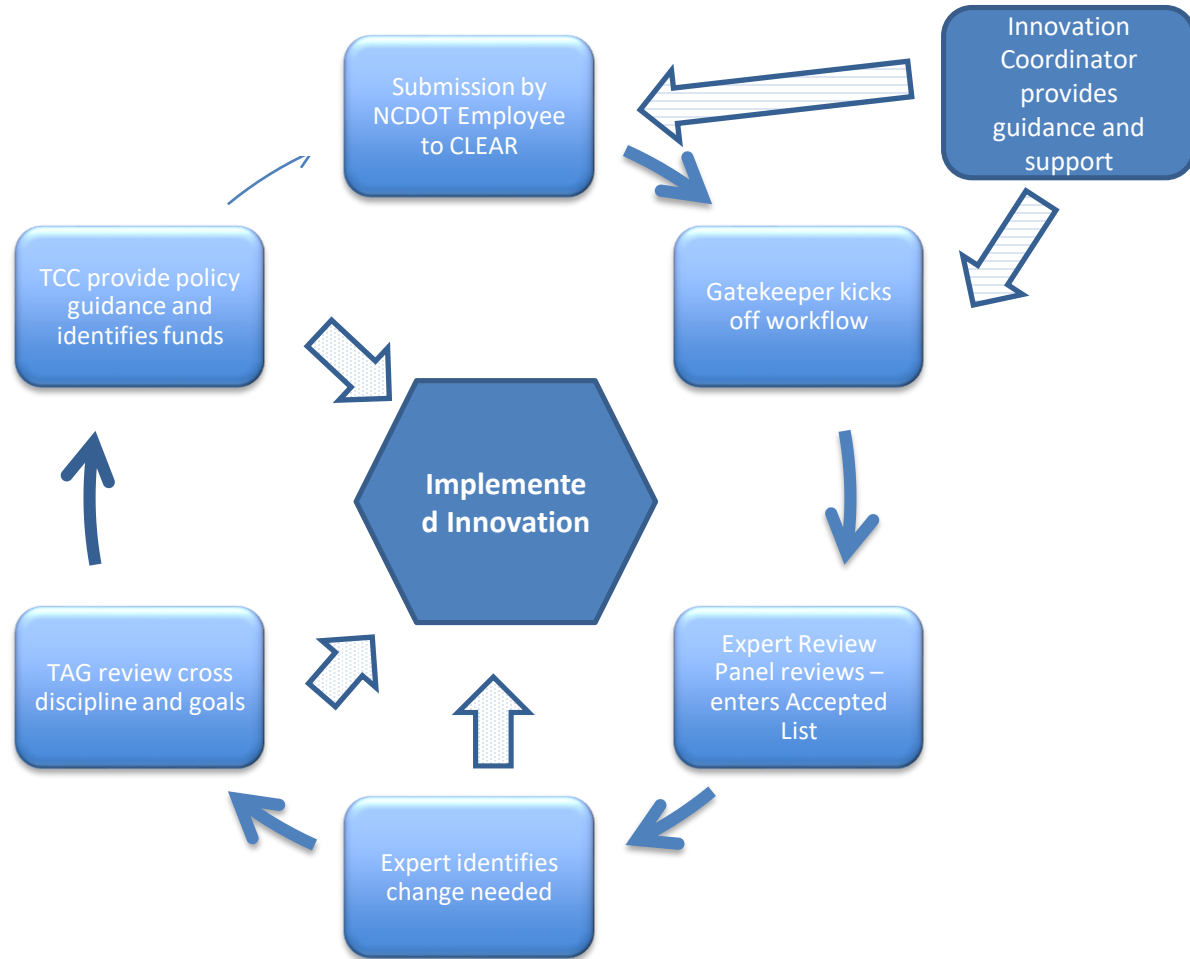


The submission is then sent to the experts to review and provide their expertise and guidance.



Accepted submissions are published in the accepted lists that can be keyword searched, reviewed, filtered, and alerts can be set up for items.

What happens after its accepted?



CLEAR FORM



Did you overcome a challenge in work, have a suggestion to solve an obstacle, or have a best practice to share?

Please fill out the form so we can...

... share your lessons learned, advice or best practice.

... make improvements based on your lesson learned, shared advice and best practices.



After review, this will be included in the CLEAR database. You will be informed of the workflow

Program	Contact
Communicate Lessons, Exchange Advice, Record Program (CLEAR) Constructability Review Program (CRP)	Clare Fullerton, PE cefullerton@ncdot.gov 919-707-6683 CLEAR@ncdot.gov
Risk Assessment Program (RAP) Value Engineering Program (VEP)	Haadi Sadaghiani hsadaghiani@ncdot.gov 919-707-6681
Risk Assessment Program (RAP) Value Engineering Program (VEP) Value Engineering Proposal Program (VEPP)	Roe Brybag, PE rbrybag@ncdot.gov 919-707-6684
State Value Management Engineer	Alyson Tamer, PE, CPM awtamer@ncdot.gov 919-707-6682 valuemanagementunit@ncdot.gov