2008 Construction Engineer’s Conference

Structure Breakout Session

Agenda

- **Change in Areas for Bridge and Roadway Construction Engineers**
- **Anchor Bolts for Poles**
- **Low Strength Concrete Procedures**
- **Grading of Sidewalks and Parapets**
- **Epoxy Hangars**
- **Equipment and Storage of Materials on Decks**
- **Vertical Clearance and Completion of Structure Letters**
- **M & T Inspection Procedures**
- **Inspector Training**
- **Continuous Flight Auger Piles**
- **MSE Wall Update**

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March 2008

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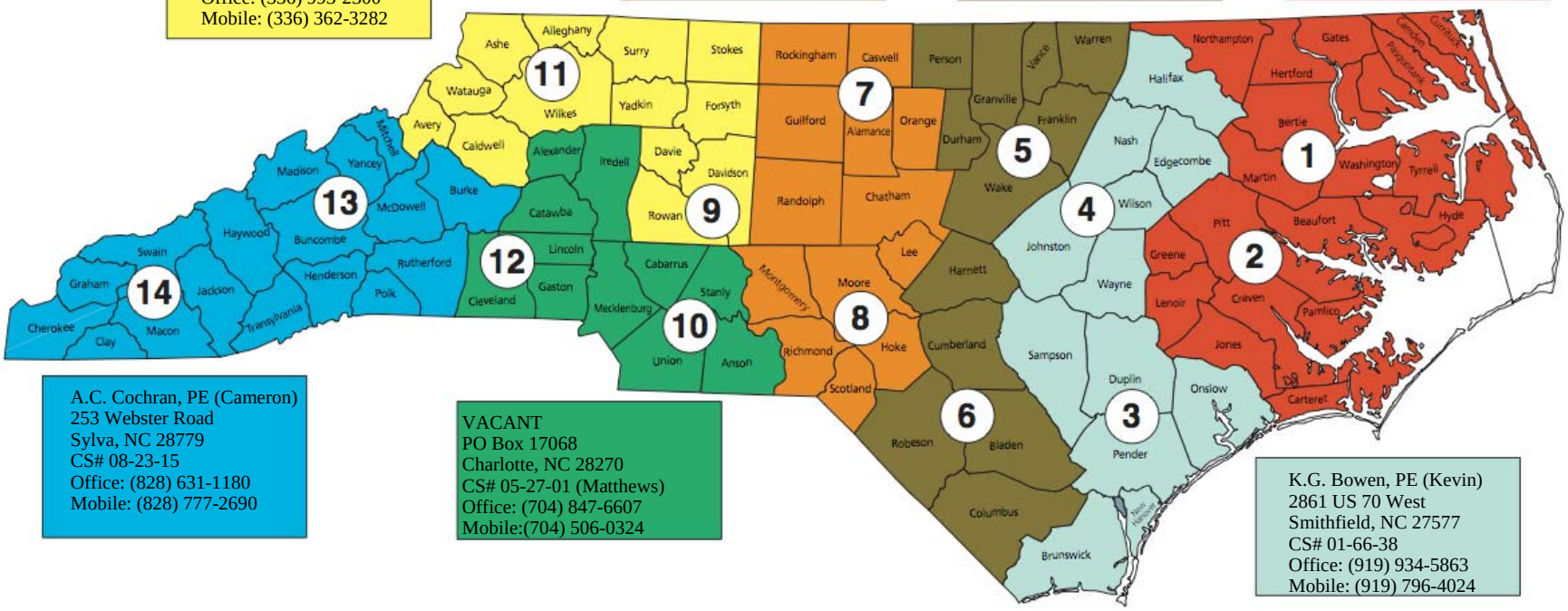

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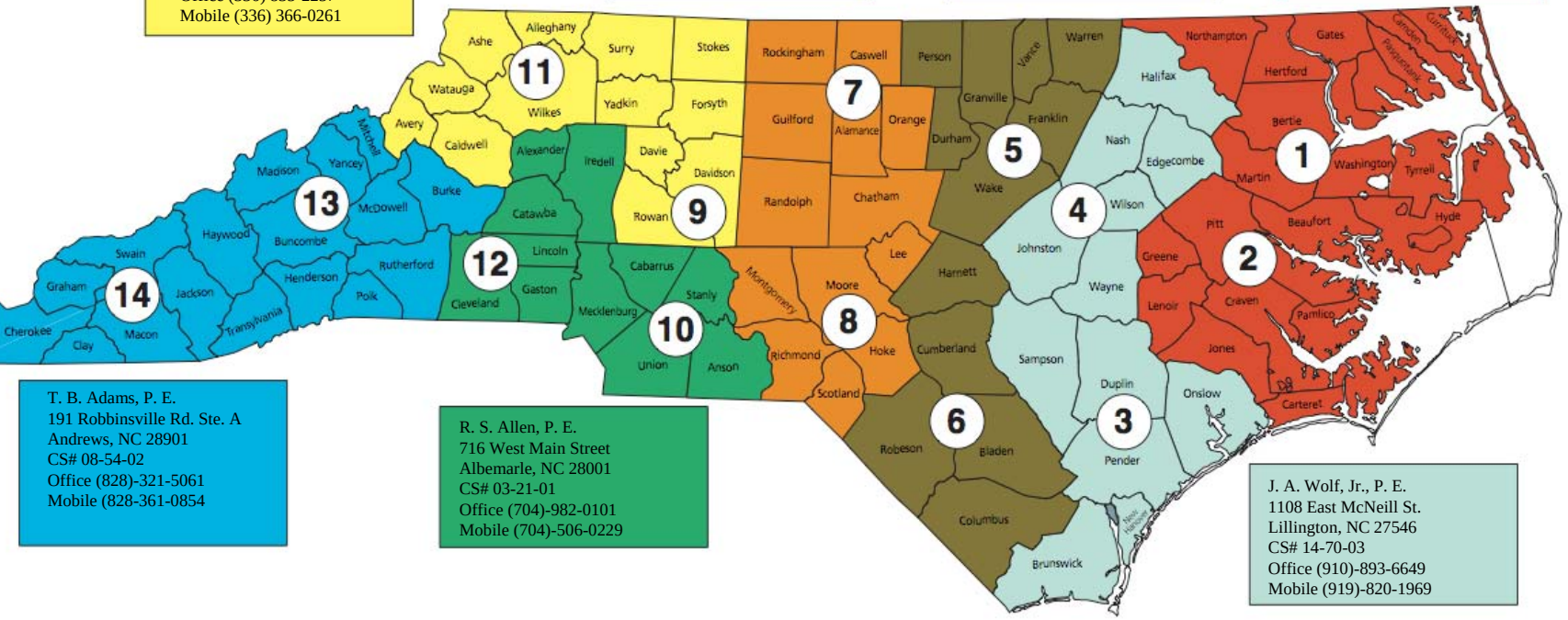

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Anchor Nut Tightening Procedure for Overhead Signs/Poles

Lee Puckett

Bridge Const. Engineer

Div. 9&11

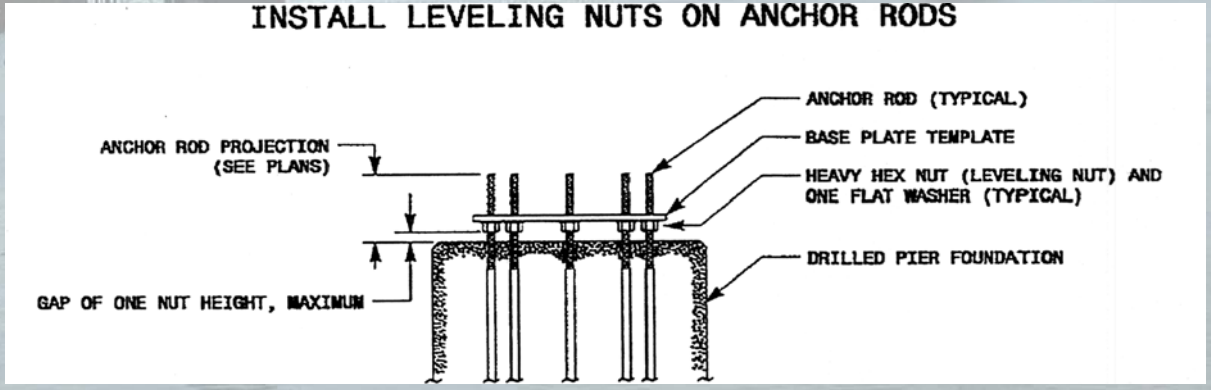
Memorandum from Chief Engineer Varnedoe

- On September 1, 2004 Division Engineer’s were sent a memorandum by Chief Engineer Varnedoe detailing a procedure on tightening anchor nuts for overhead signs, signal, and light foundations.

- Memorandum was to be effective immediately due to recent inspections of sign connections that revealed loose connections that were a result of improper initial installation.

2004 Procedure Highlights

- Place leveling nuts and washers on the anchor rod and install a template on top of the leveling nuts to verify that the nuts are level and uniformly contact the template. Verify that the distance between the bottom of the leveling nuts and the top of the concrete is a maximum of one nut height.

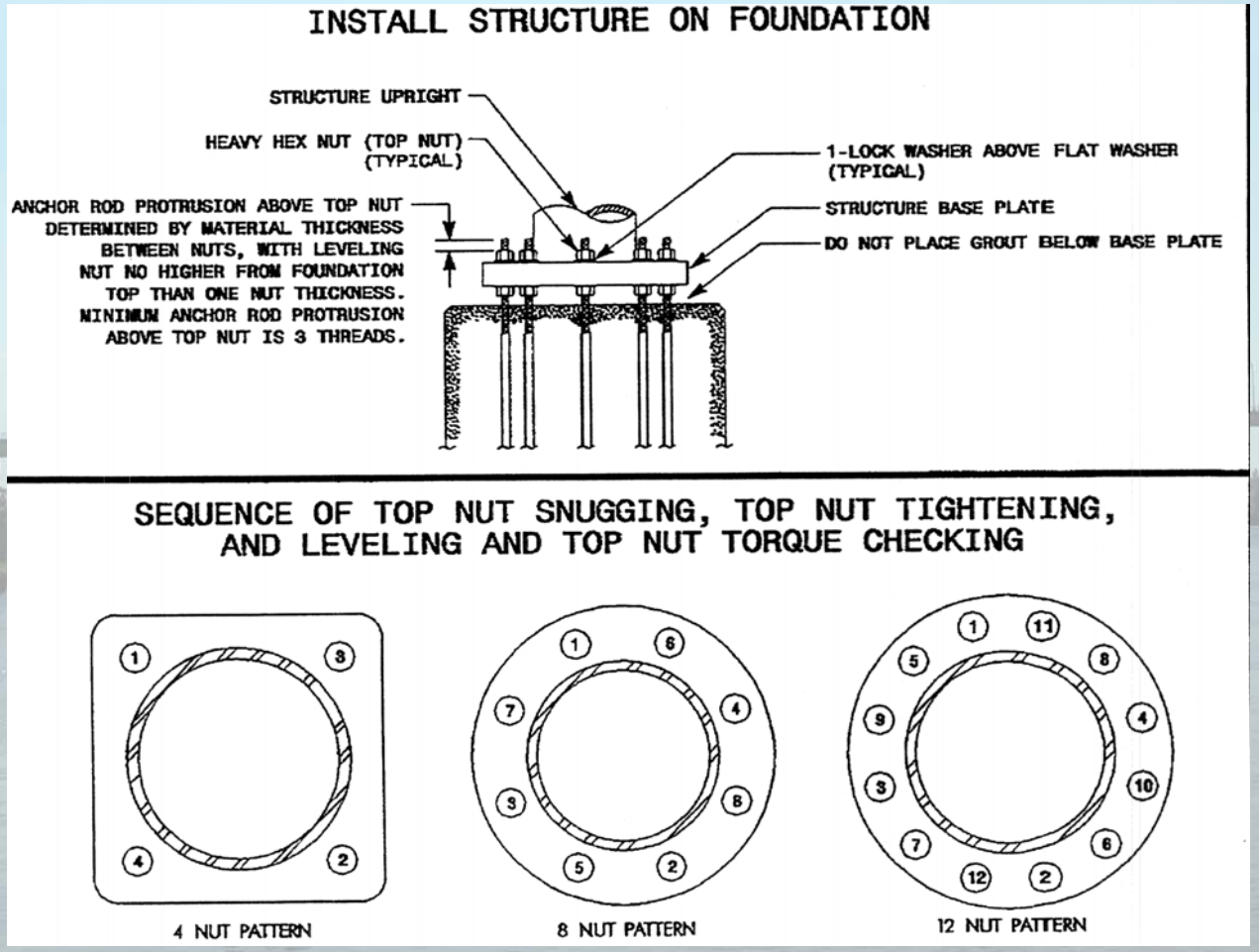


2004 Procedure Highlights

- Install the base plate and structural element to which it is attached. Use beveled washers if the leveling nuts cannot be brought into firm contact with the base plate.

- Install top nuts and washers, using beveled washers if the nuts cannot be brought into firm contact with the base plate. Both a lock washer and flat washer are required under the top nut (lock washer on top of the flat washer). Lubricate threads of the top nuts and tighten to a snug-tight condition with a spud wrench following a star pattern. (using at least two increments)

2004 Memorandum Highlights

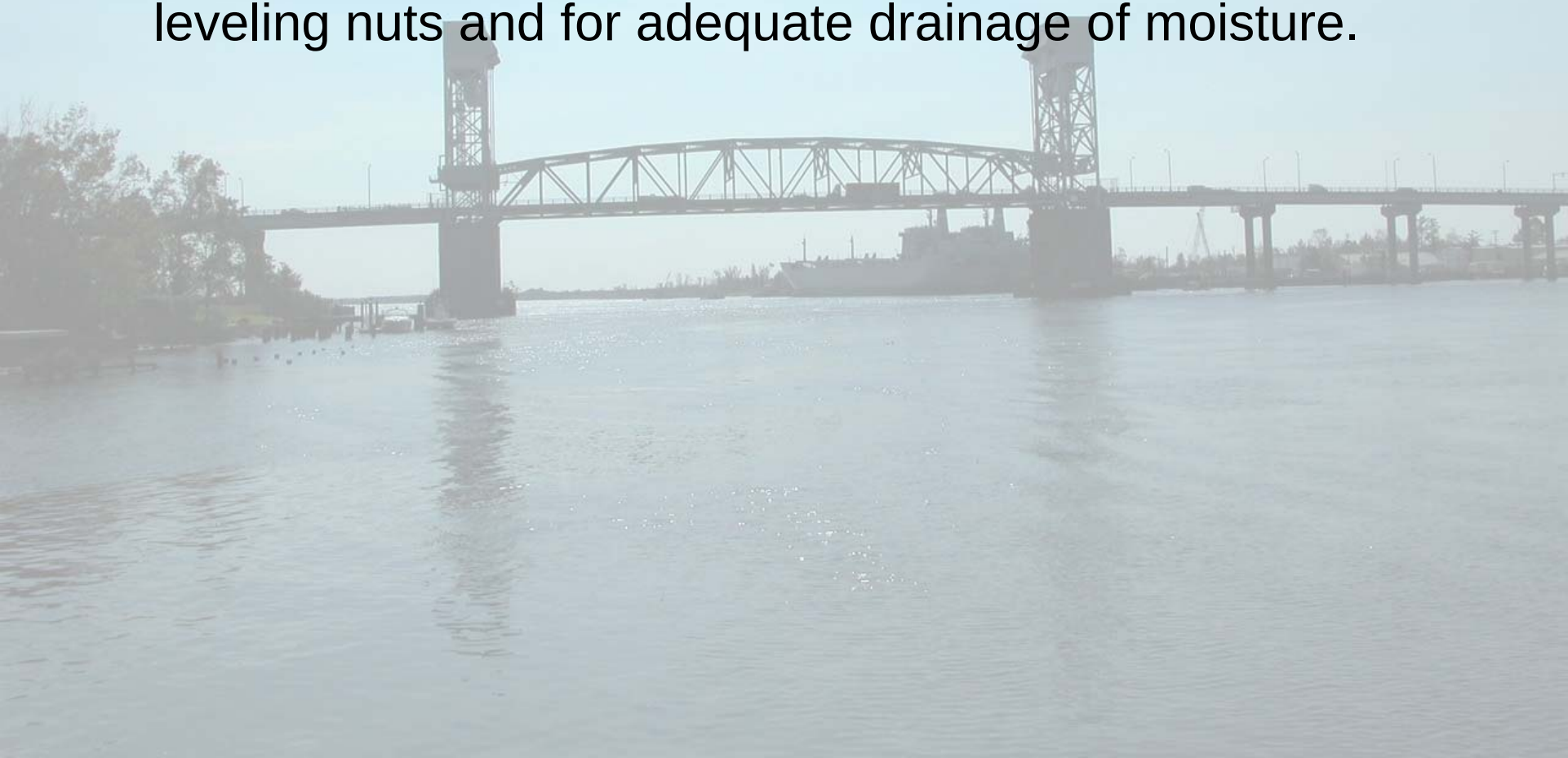


2004 Memorandum Highlights

- Prior to further turning of the nuts, mark the reference position of the top nut in the snug-tight condition by match marking each nut, bolt shank, and base plate. Use ink or paint that is not water soluble.
- Turn the top nuts in increments using the star pattern (using at least two full tightening cycles) to 1/6 of a turn. Verify that the lock washers are flat at all connections and if not, continue tightening until they are flat.
- Use a torque wrench to verify that at least 600 ft-lbs is required to further tighten the top and leveling nuts.
- At least 48 hours after the entire structure and any attachments are erected, use a torque wrench again to verify that at least 600 ft-lbs is still required to tighten the top and leveling nuts.

2004 Memorandum Highlights

- Do not place non-shrink grout between the base plate and foundation. This will allow for future inspection of the leveling nuts and for adequate drainage of moisture.



Procedure Revision

- Due to construction issues with the 2004 memorandum, a new procedure for tightening the anchor nuts for signs, signals and light foundations has been drafted.

- Current and future projects will need to incorporate this new outlined procedure to ensure proper connections are obtained.

New Procedure for Tightening of Anchor Nuts

- **<u>Prior to installation</u>**

- Protect the anchor rod threads from damage prior to installation and during installation.

- Prior to installation of the rods in the foundation, turn nuts onto and off the rods, well past the elevation of the bottom of the leveling nuts. Turn by the effort of one worker using an ordinary wrench without a cheater bar. Report to the Engineer thread damage requiring unusually large effort.

New Policy (cont'd)

- **<u>During installation</u>**

- Place leveling nuts (bottom nuts) on the anchor rods.

- Place leveling nut washers on top of the anchor rod leveling nuts.

- Place a rigid template on top of the leveling nuts to check the level of the nuts. If the anchor nut and washer cannot be brought into firm contact with the template, then beveled washers shall be used.

New Policy (cont'd)

- Verify that the distance between the bottom of the leveling nut and the top of the concrete foundation is no more than one anchor rod diameter. If an upright is required to be back-raked, then the distance between the bottom of the leveling nut and the top of the concrete foundation should be no more than one anchor rod diameter, averaged over the anchor rod group.
- Place the base plate and structural element to which it is attached. However, do not attach to the upright element, during tightening of the anchor nuts, cantilever beams or arms with span in excess of 10 feet.
- Place top nut washers.

New Policy (cont'd)

- Do <u>not</u> use lock washers.
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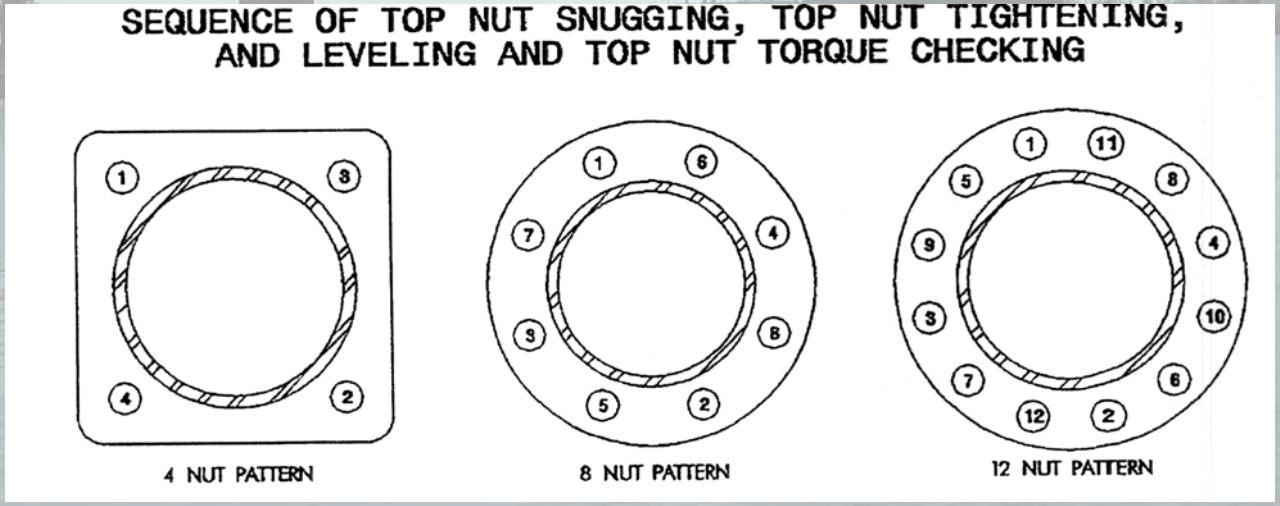
New Policy (cont'd)

- Tighten top nuts to snug tight. A snug-tight condition is defined as the washer and nut being in full contact with the base plate, and the application of the full effort of a workman on a 12-inch wrench. Turn top nuts in increments following a star pattern (using at least two full tightening cycles).



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New Policy (cont'd)

- For overhead sign assemblies: The span type truss or the cantilever truss may be placed on the uprights or attached to the upright at this time. For signal support structures: The span wires or mast arms may be attached to the upright at this time.

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- Calibrate, at least annually, the torque indicator on the wrench used for tightening the nuts. Provide the Engineer a certification of such calibration.

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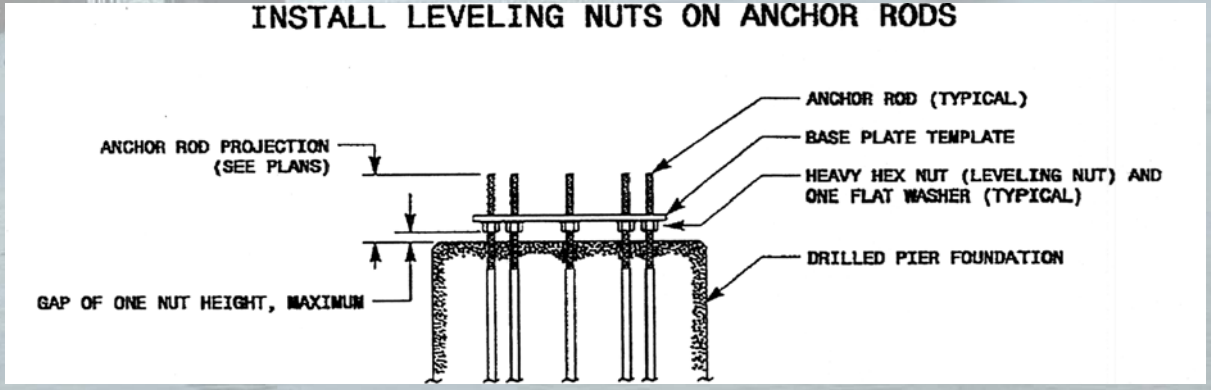

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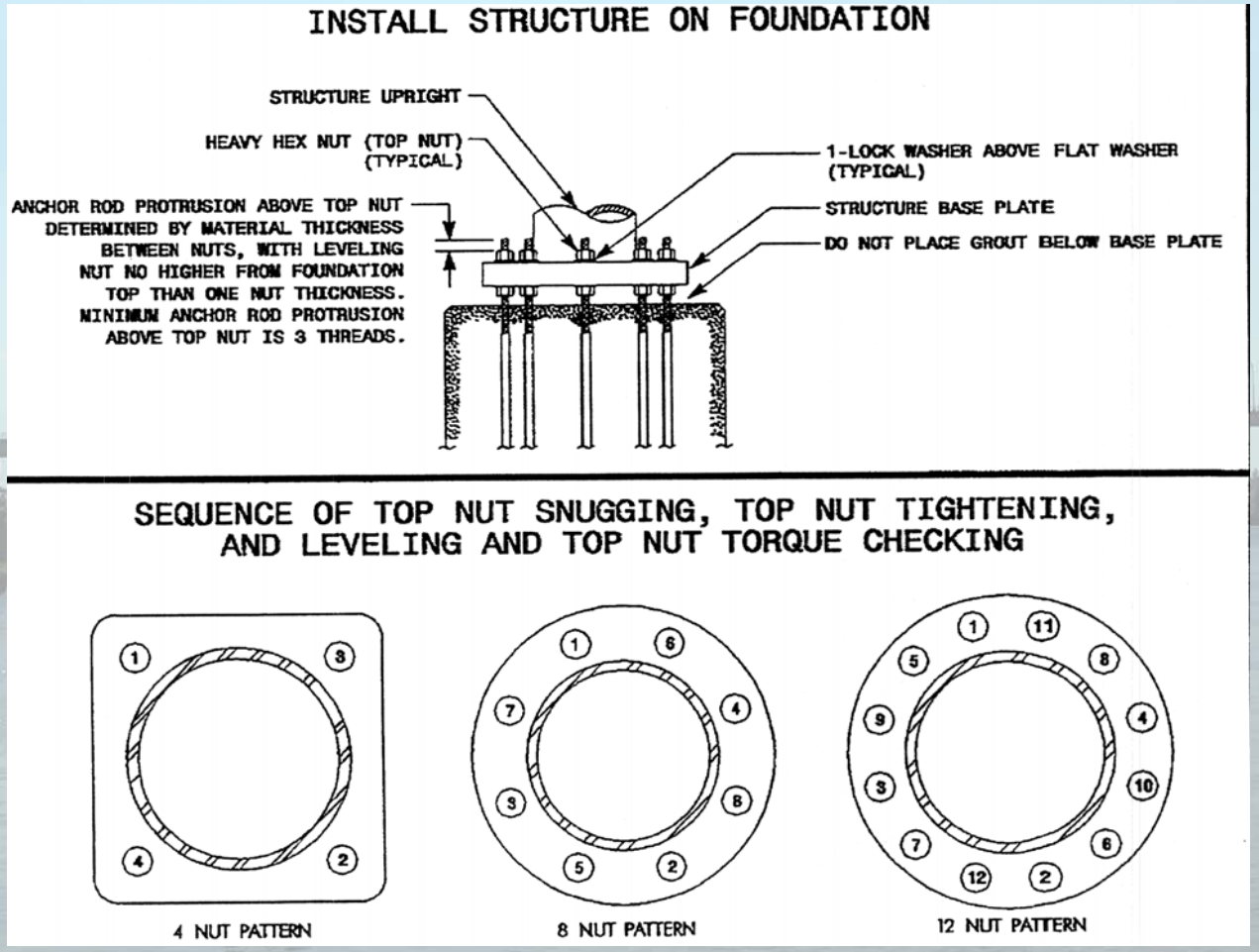

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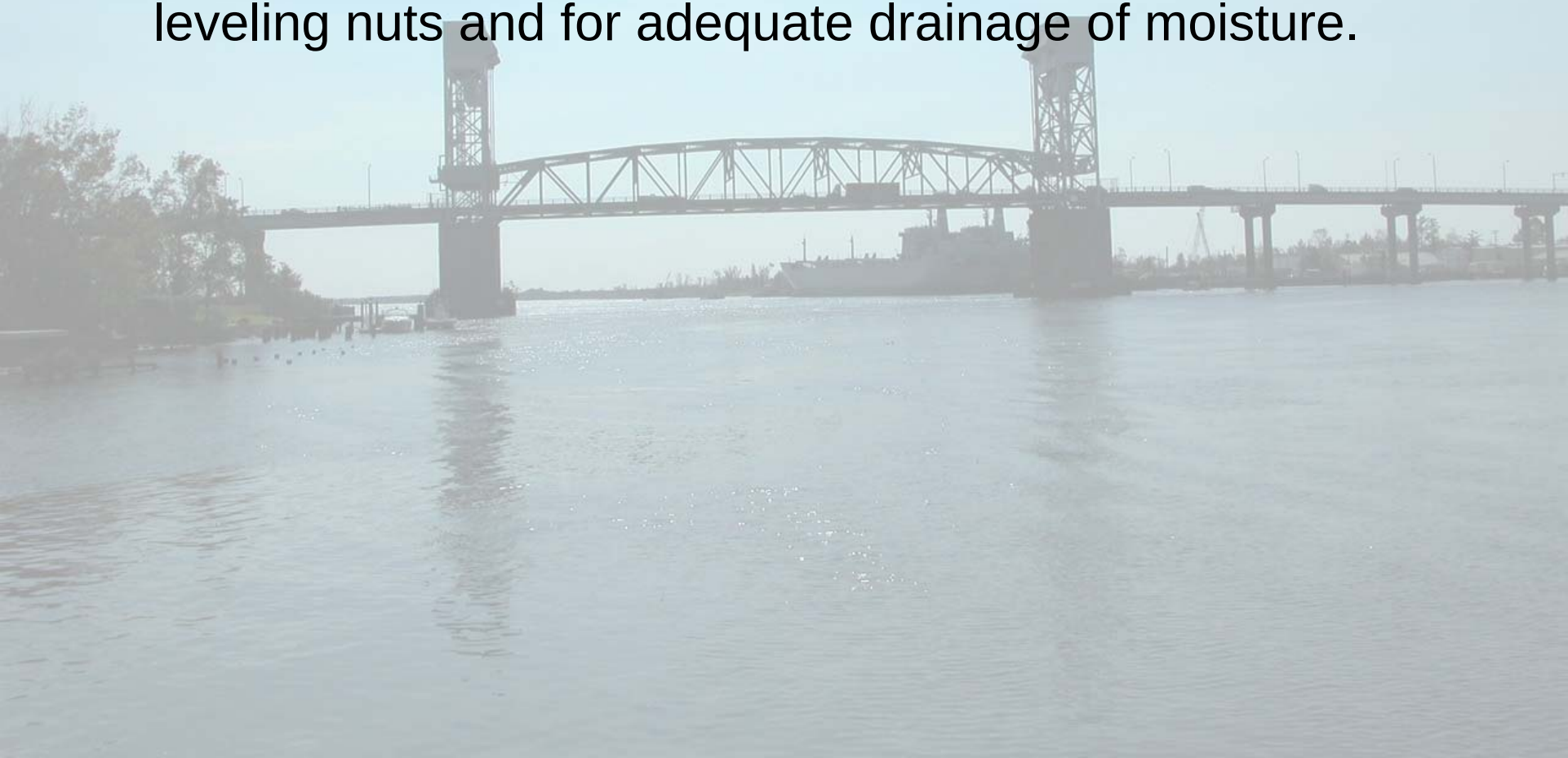

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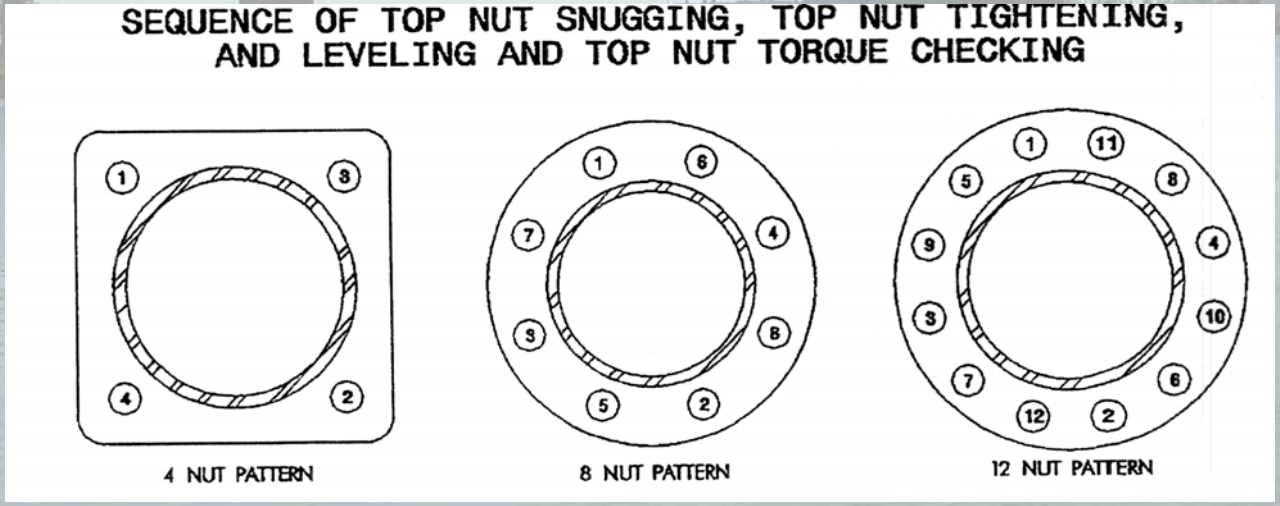

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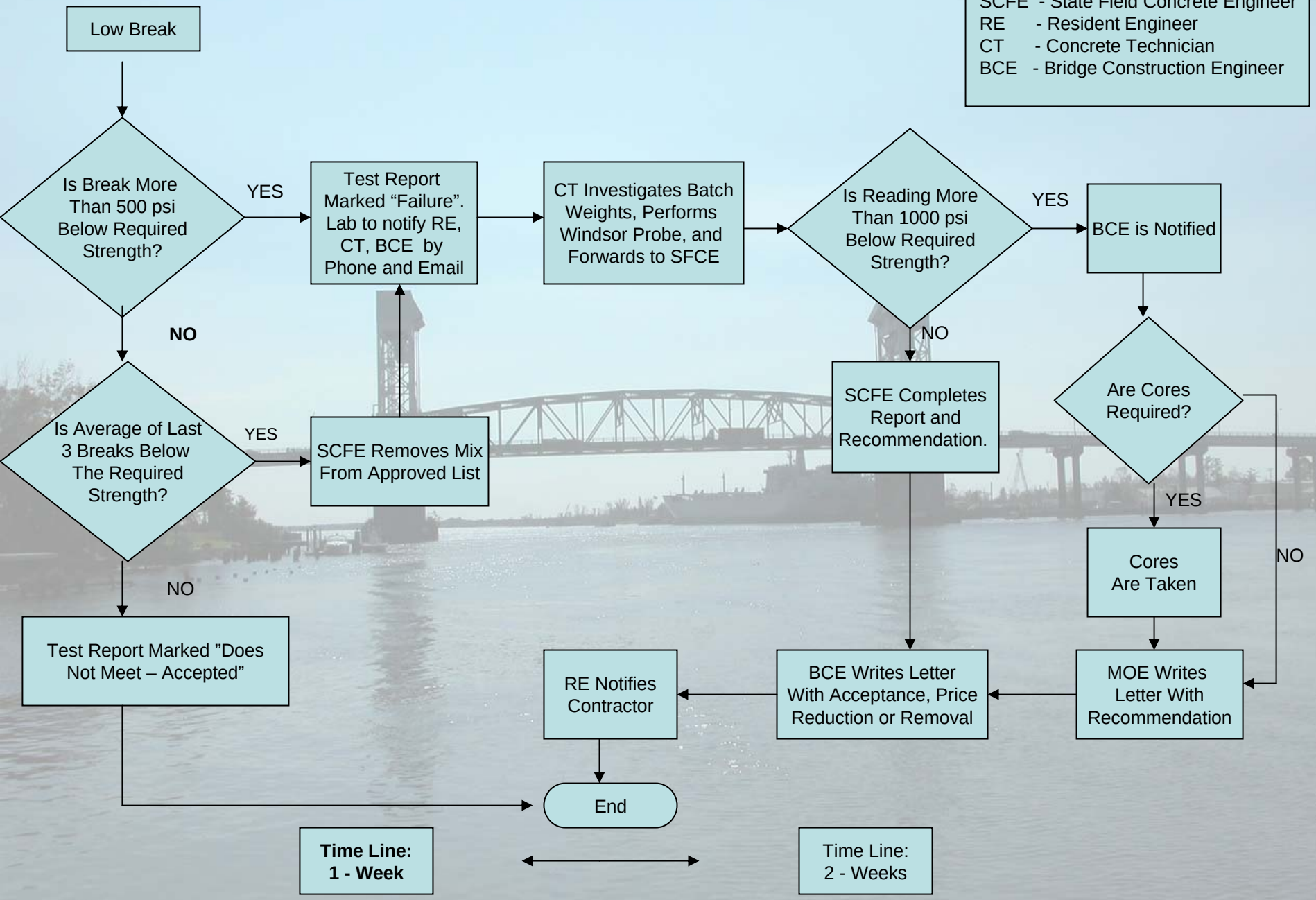
Low Strength Concrete Procedures

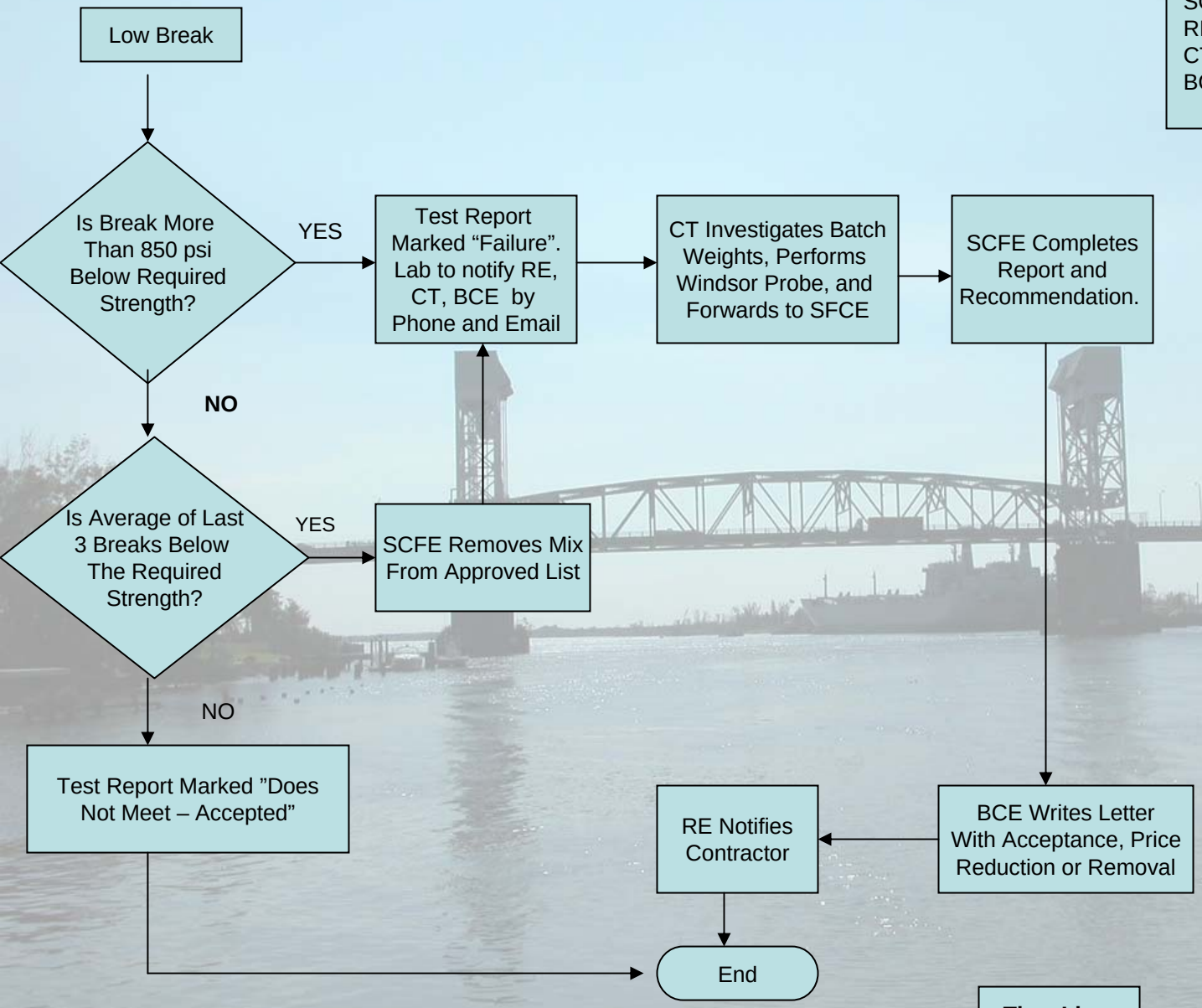
Class A & AA Low Cylinder Investigation

MOE - Materials Operations Engineer
FOE - Field Operations Engineer
SCFE - State Field Concrete Engineer
RE - Resident Engineer
CT - Concrete Technician
BCE - Bridge Construction Engineer



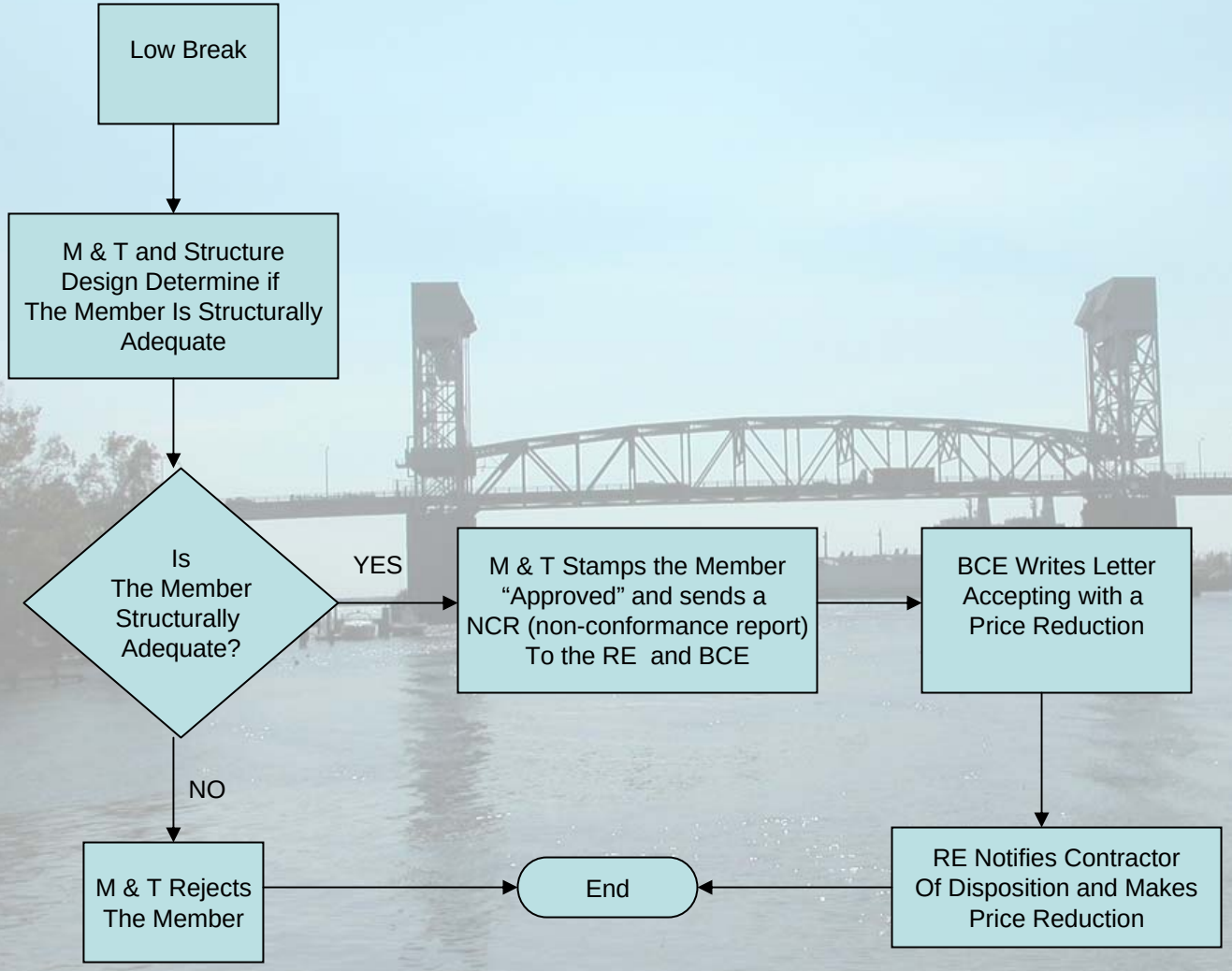
Class B Low Cylinder Investigation

MOE - Materials Operations Engineer
FOE - Field Operations Engineer
SCFE - State Field Concrete Engineer
RE - Resident Engineer
CT - Concrete Technician
BCE - Bridge Construction Engineer



Time Line:
1 - Week

Low Strength Concrete Procedures : Precast Members



Calculation of Cost Reduction

Need to know: Required strength
Cylinder strength
Yards of concrete

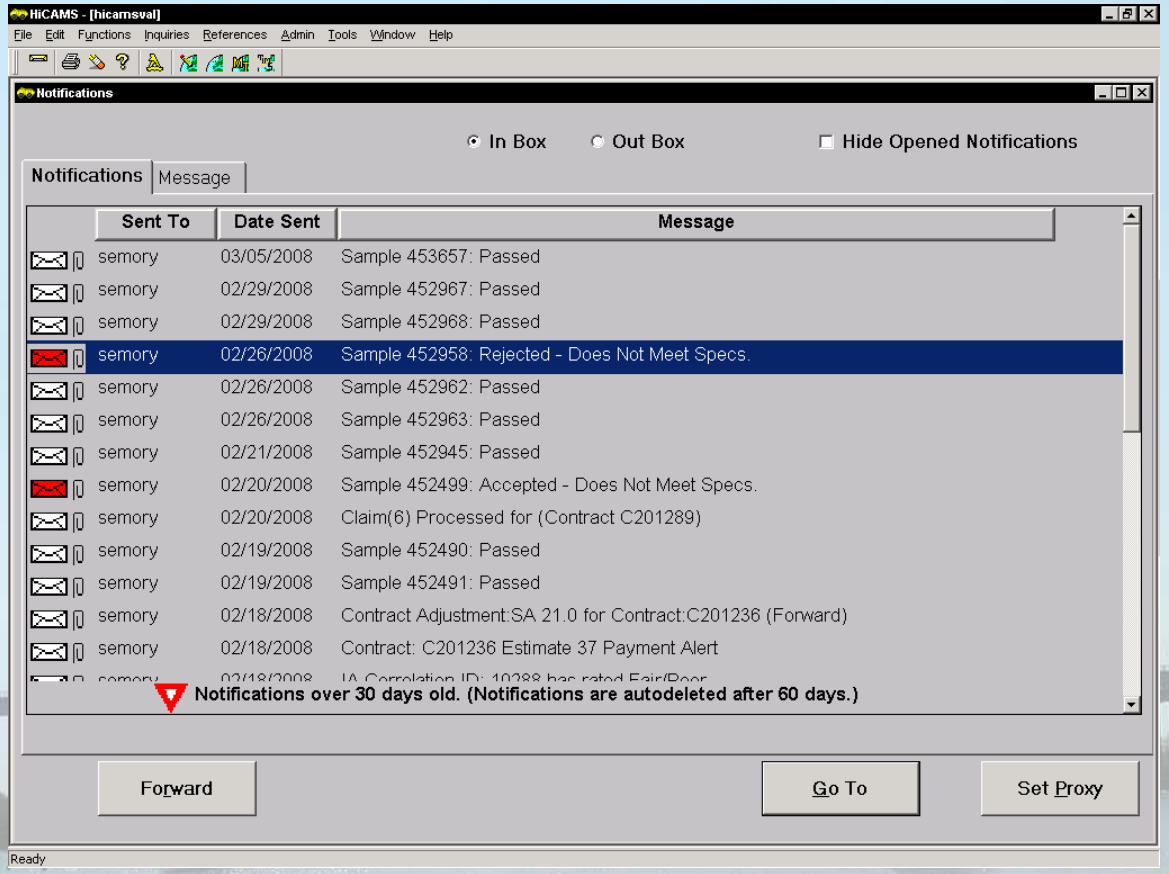
Example:

$$10 \times 120 \left[1 - \left(\frac{3800}{4500} \right)^{2} \right] = 344.30$$

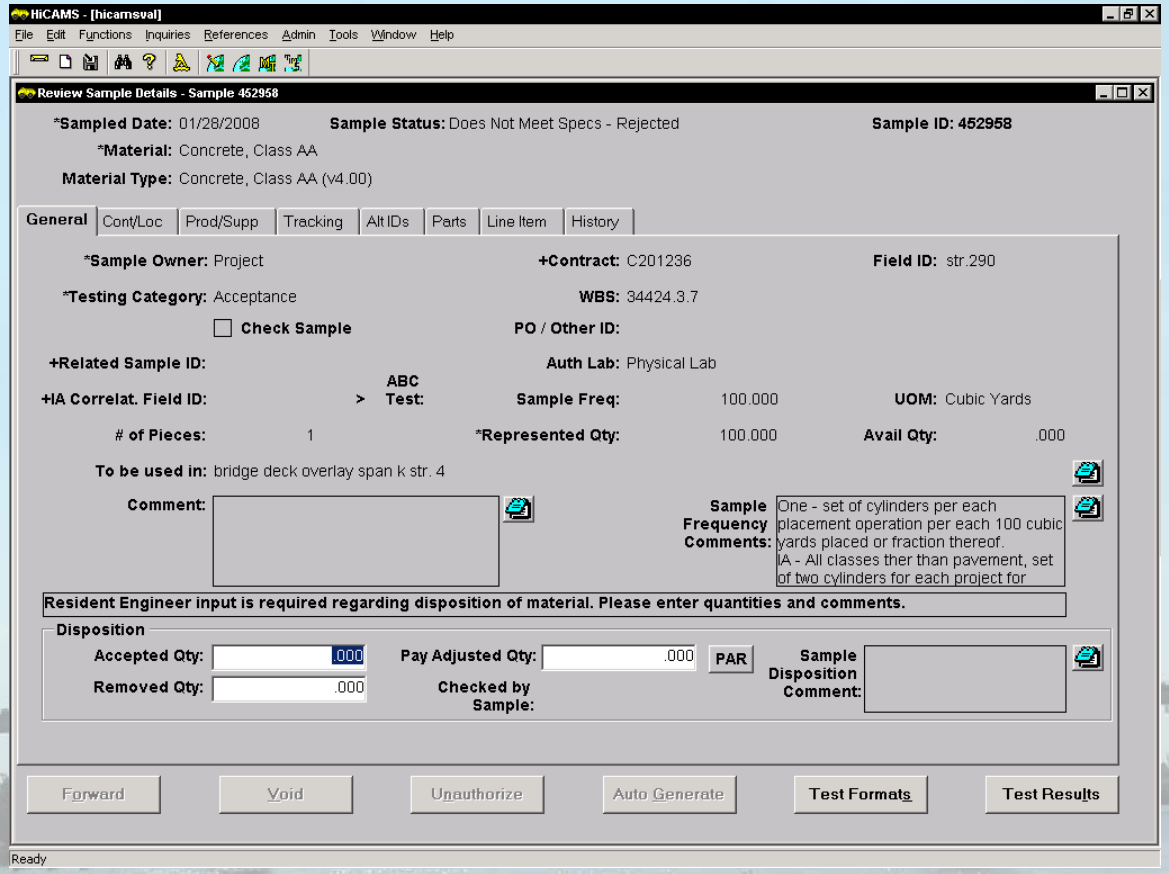
344.30	Reduction due to strength
+ 1000.00	Investigative costs
$1344.30	Total reduction

Notes:

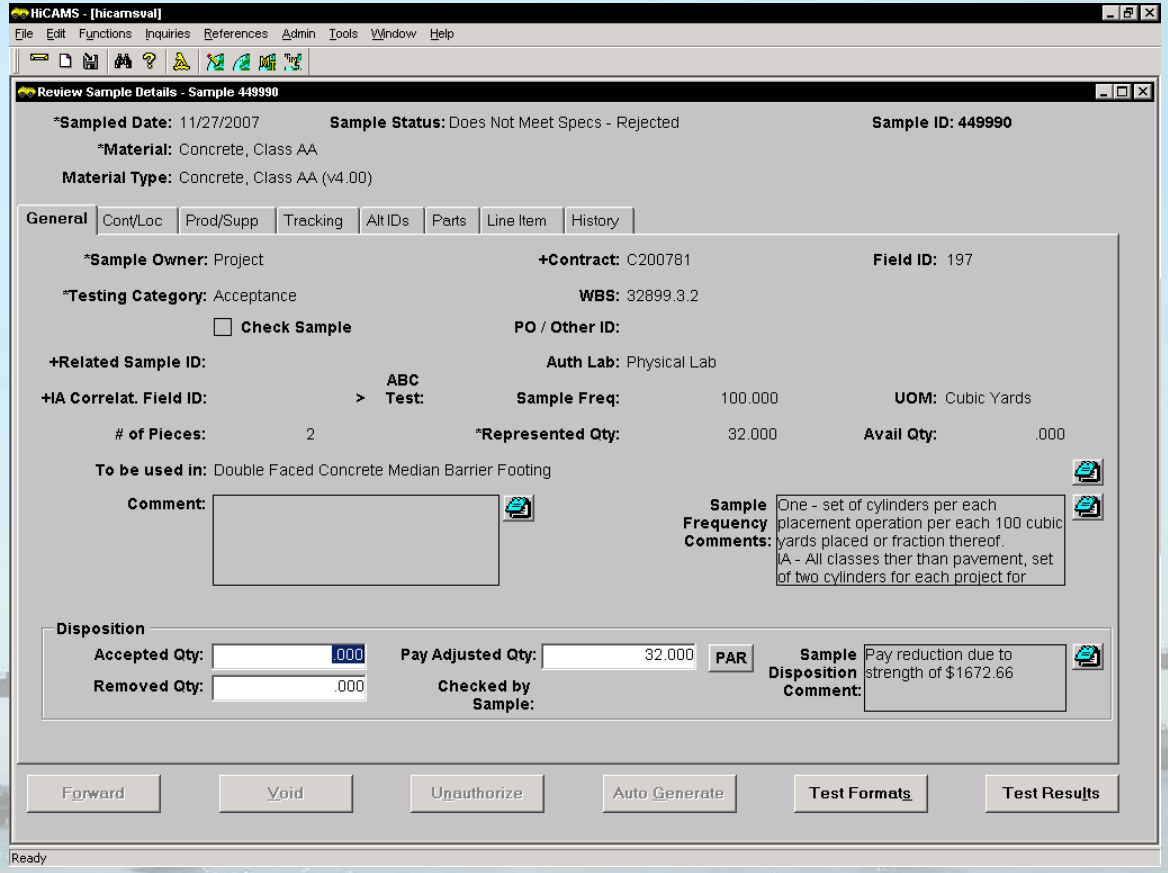
1. Yards of concrete - the quantity of concrete used in the entire member being cast, even if you have other cylinders. Ex.drilled shaft (entire shaft), deck (entire deck), precast (all members in the bed)
2. Assumed cost of concrete - use $120/cy for all concrete
3. Cylinder break strength - use the 28 day cylinder strength, <u>not</u> swiss hammer, windsor probe or core strength
4. Specified strength for the class of concrete used
5. Investigative costs - these costs are applied to all price reductions. On cast-in-place concrete, they are $1000. For precast concrete, the investigative costs are $350.



This is what the notification looks like. Use the Go To button to access the sample details.



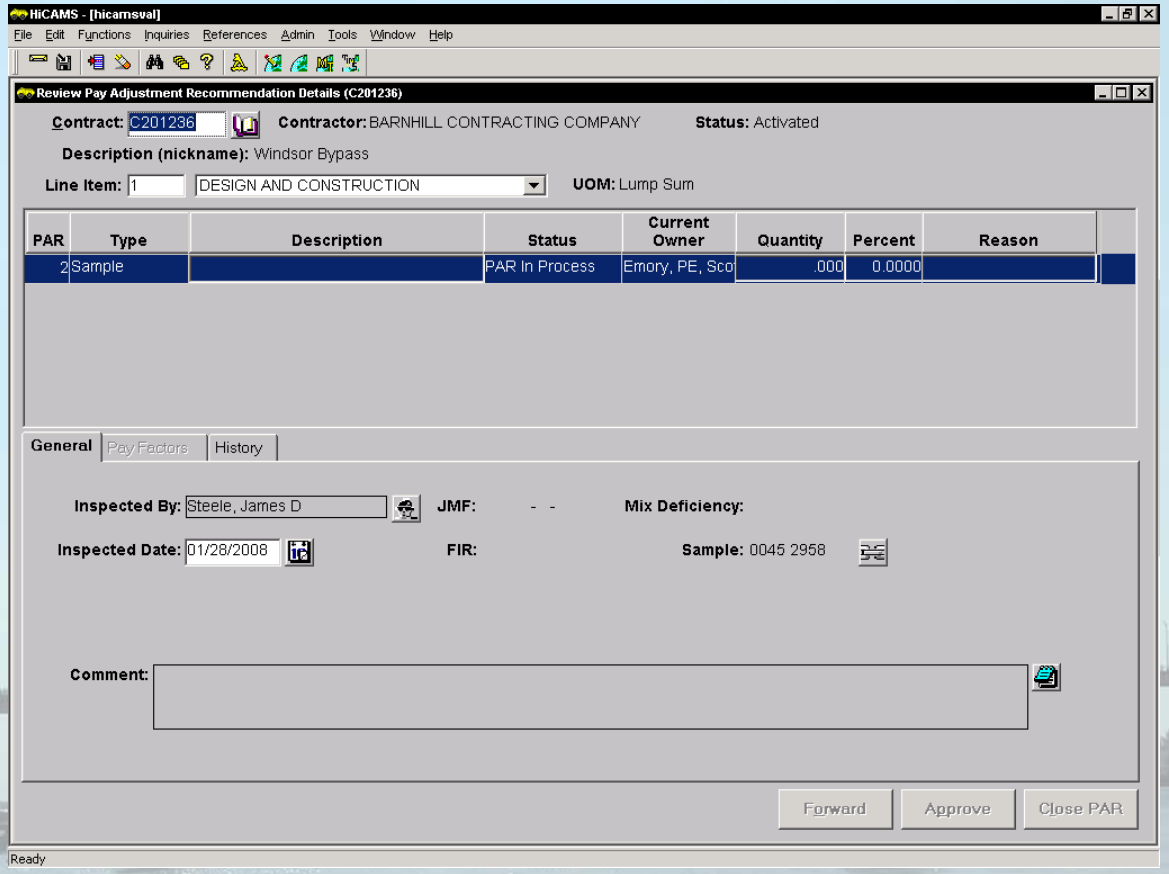
This is how a sample that needs disposition quantities and comments appears. The quantities entered in the Accepted, Removed, and Pay Adjusted Qty fields must total the Represented Qty.
Any sample that is not Meets Specs requires the Disposition Quantities and a comment to be entered.
If the Sample requires a Pay Adjustment, click on the PAR button to create the skeleton record, linked to the sample.



This is how the sample appears after the Disposition quantity fields and comment are entered.

Use the PAR button to navigate to the PAR.

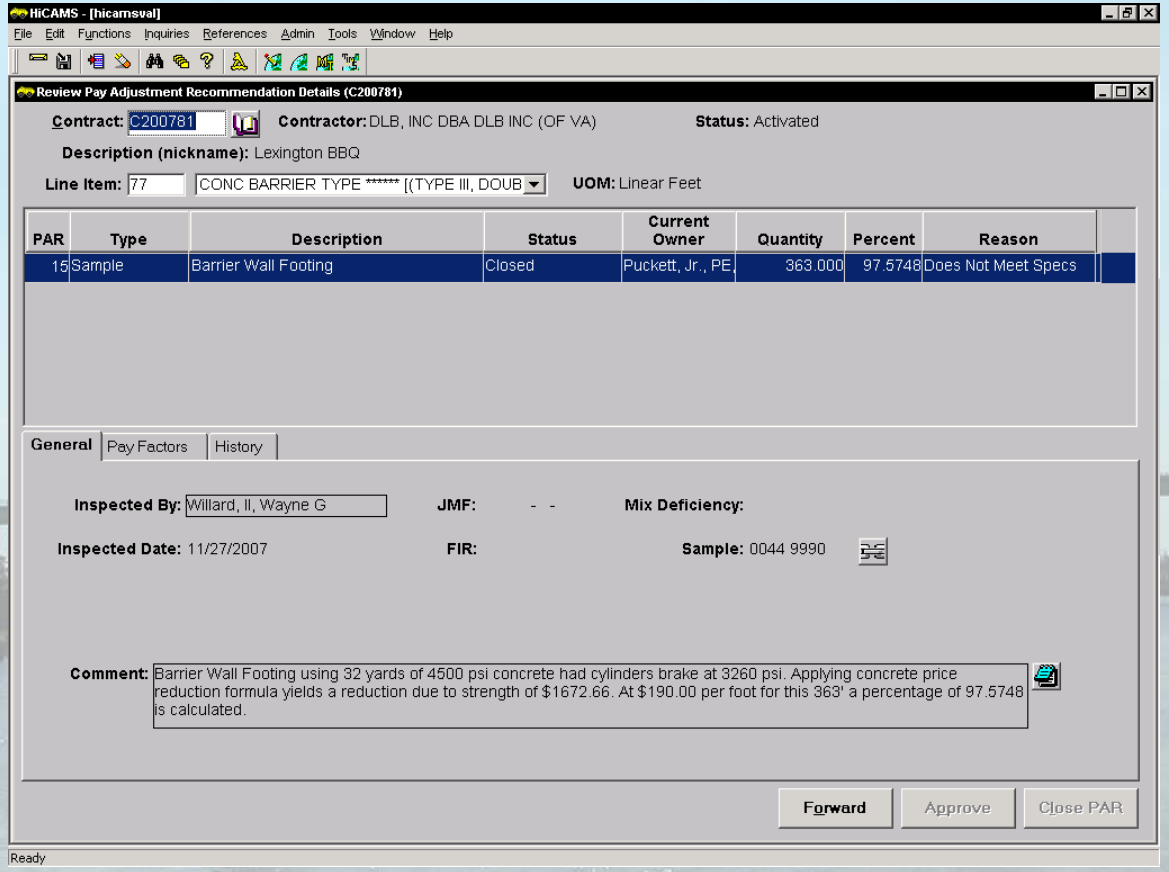
NOTE: The PAR button is not available for Inquiry users. A change request has been submitted for a correction of that omission.



This is how the PAR window looks when navigated to using the Sample PAR button. The description, quantity, percent, and Reason must be completed. Once that is done, the PAR is forwarded to the Bridge Construction Engineer.

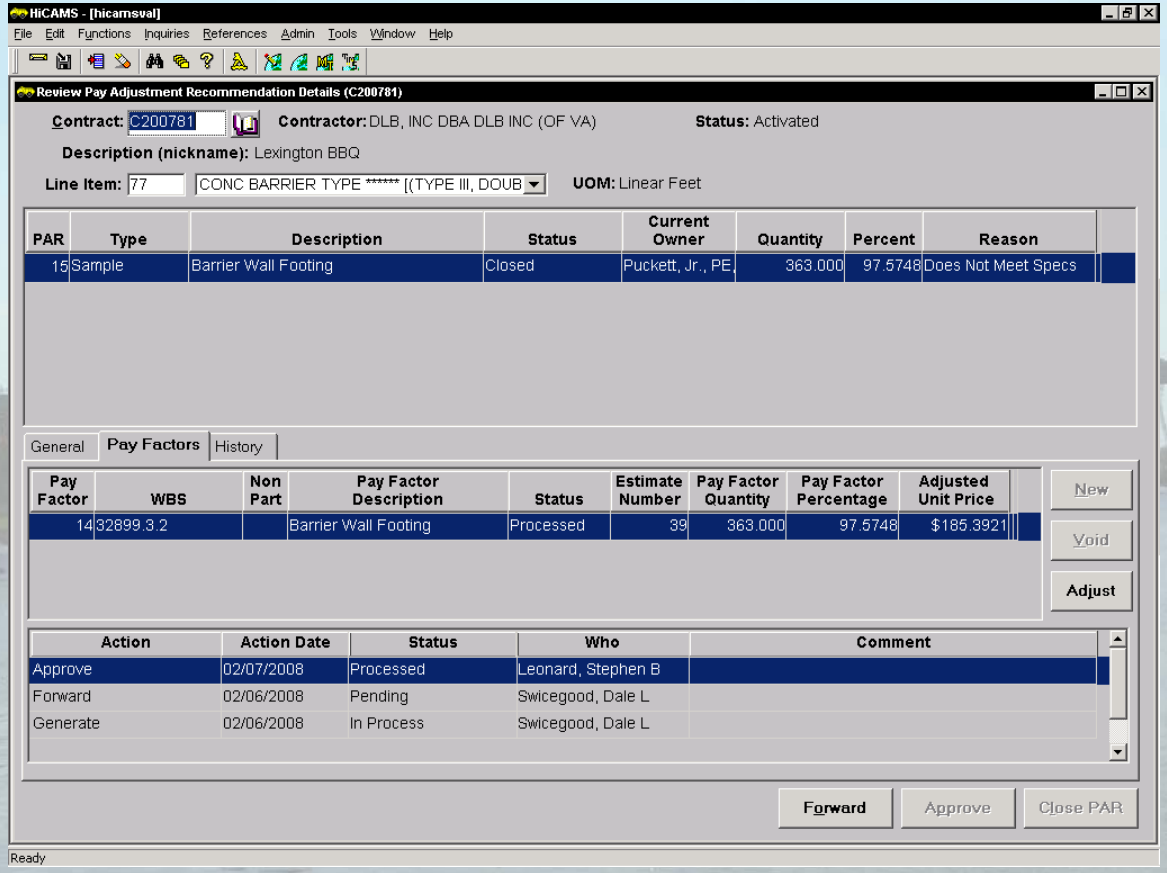
NOTE: For design build projects, contact the Construction Unit to add a Penalty Line Item to the contract.

After the PAR is approved, it is forwarded back to the Resident Engineer and the Penalty is assessed by creating a Pay Factor.
Here is the General Tab after the Pay Factor has been processed on an Estimate - the PAR is closed automatically when the Estimate is Paid.
Notice the comment explaining out the percent was calculated.



Example calculation for C200940: Bridge deck represented qty was 866.3 M2
Penalty was $550.00 Unit price = $200.00/M2
866.3 M2 * $200.00/M2 = $173,260.00 value of deck payment
$550.00/173,260.00 = 0.003174
100.0000 - 0.3174 = 99.6826
866.3 M2 backed out at $200.00/M2 + 866.3 M2 added in at $199.3652/M2
$173,260.00 - 172,710.07 = $549.93 penalty "Close enough for State Work"

This is how the Pay Factor Tab looks.



Establishing Grade for Sidewalks & Parapet Walls

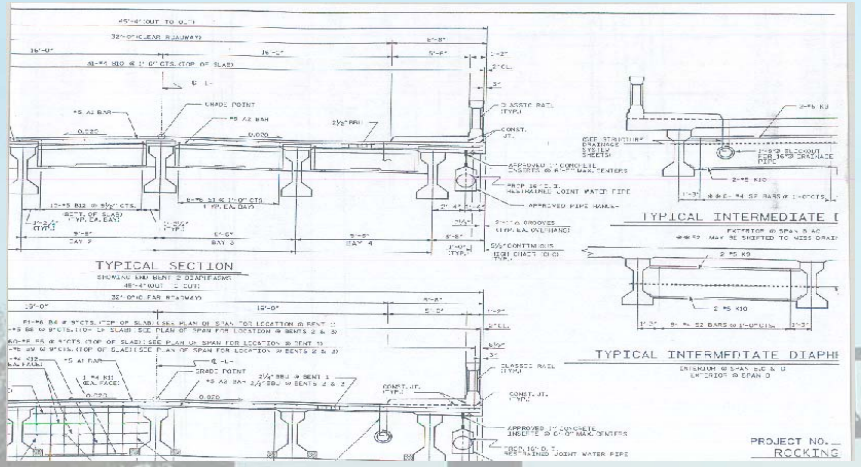
Different Parapets with Sidewalks

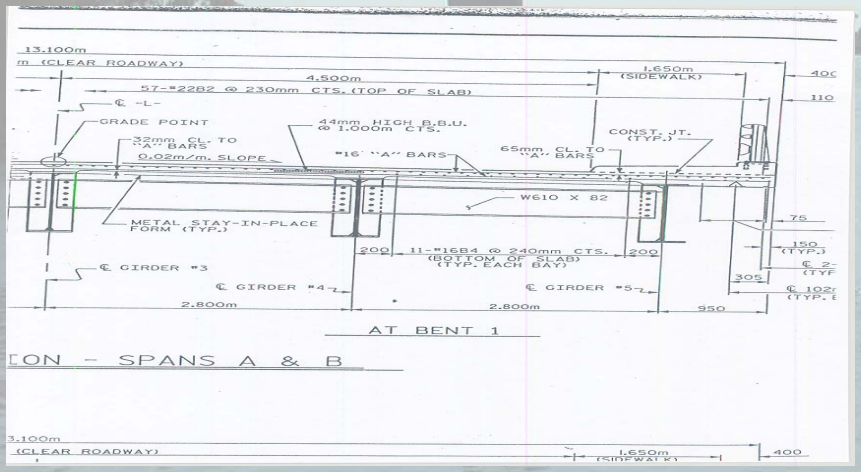
Sidewalk & Parapet with Three Bar Metal Rail

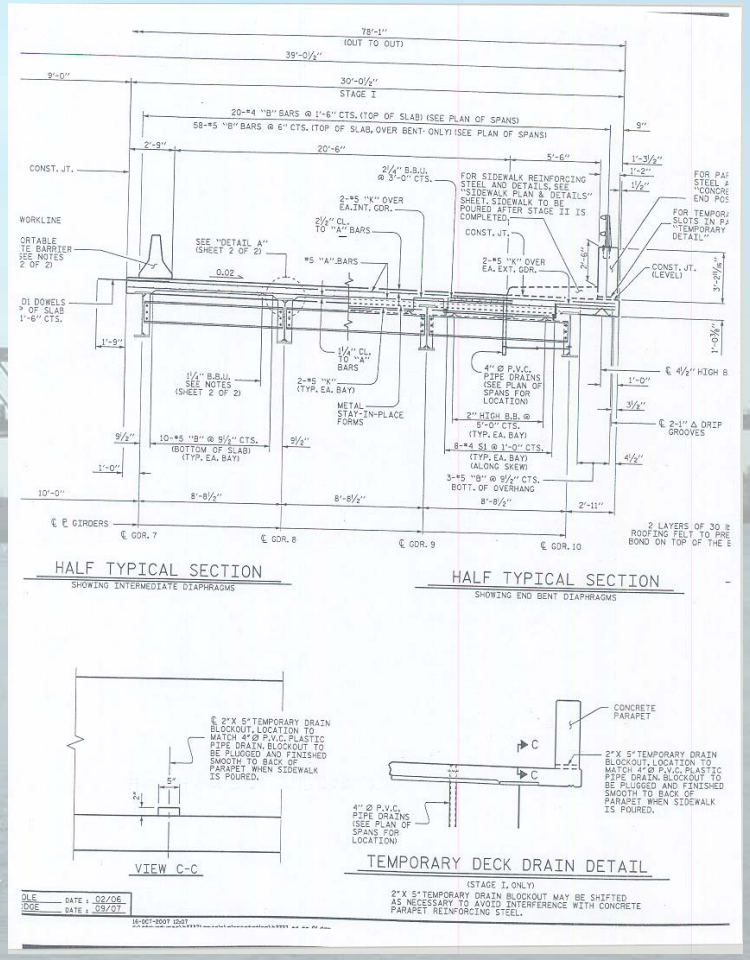
Sidewalk & Parapet with Two Bar Metal Rail

Sidewalk with Church/Classic Rail

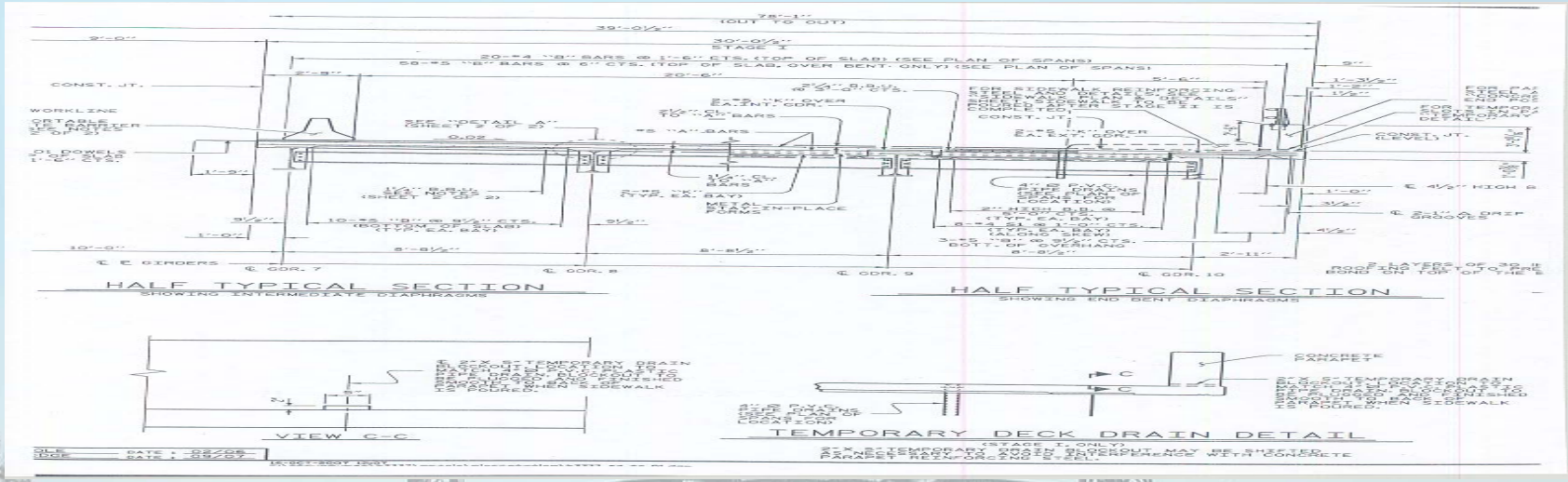
Different Combinations on Plans





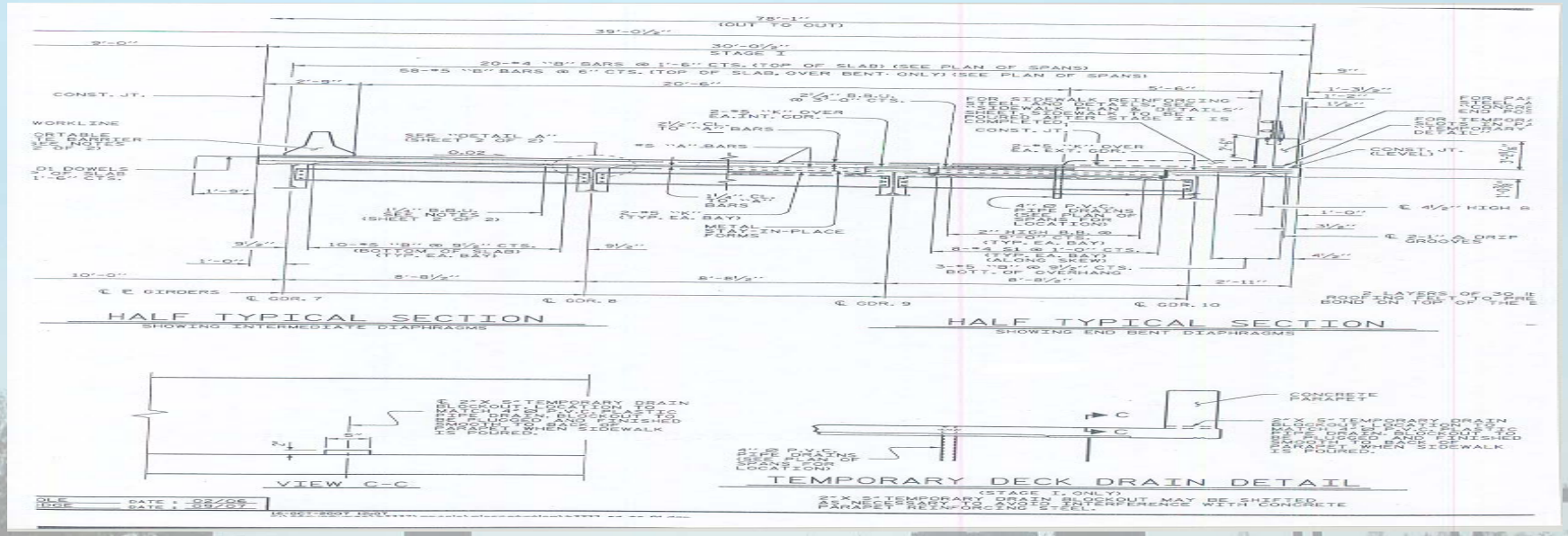


Establishing Grades for Parapet Walls



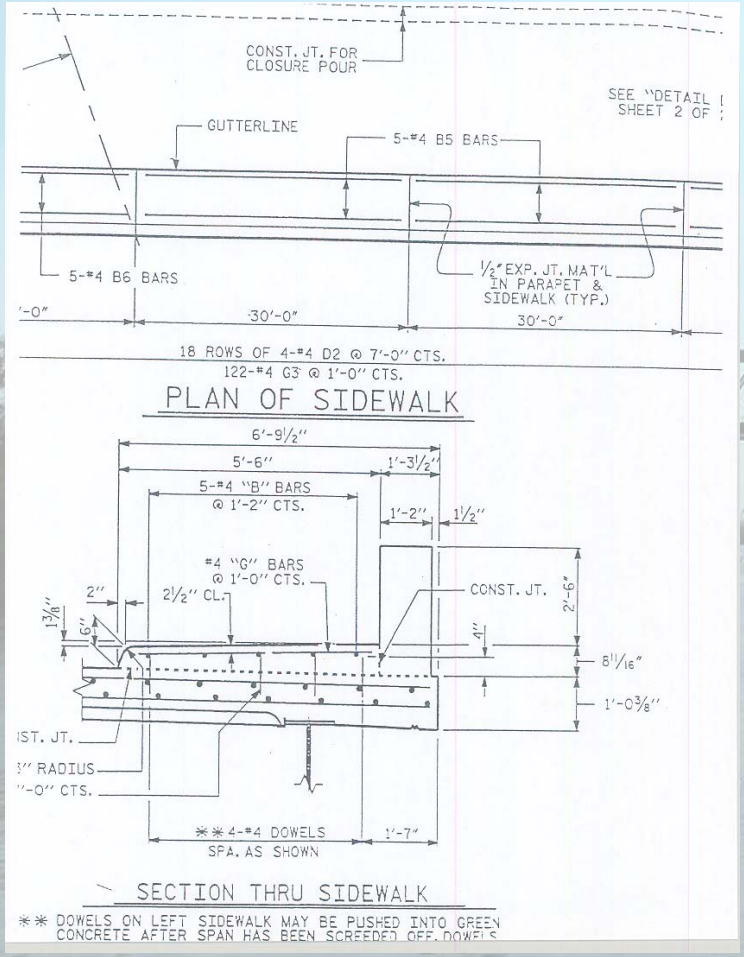
- Compute proposed top of deck elevation at parapet wall using the proposed elevations at grade point and subtracting/adding the superelevation (for the distance from grade point to the parapet wall).
- Elevation = 300.00 – (23.25’)(0.02 ft/ft)
- Elevation = 300.00 – 0.47 = 299.53*
- Elevation for Top of Parapet Wall = Proposed top of deck elevation + height of parapet wall.
- Elevation = 299.53 + 3’-2 11/16” = 299.53 + 3.22 = 302.75

Establishing Grades for Parapet Walls



- Mark the edges of the proposed parapet wall according to the plans. (Compare these elevations to the proposed elevations that were calculated based on construction elevations)
- Read the existing elevation of the top of deck at this point.
- Recommend marking the amount of “Fill” from this point to the top of the proposed parapet wall.
- Fill to the Top of Parapet = Top of Parapet Wall Elevation – Existing Elevation of Deck
- Mark the Fills for the Contractor at intervals that will provide uniform grade. Check the proposed “Fills” to the top of the parapet wall reinforcing steel to make sure that there is proper cover.

Establishing Grades for Sidewalks



- Compute top of sidewalk elevation by adding the plan thickness of the sidewalk (at the edge of parapet wall) to the proposed top of deck elevation.
- Example: 299.53 + 8 11/16”
- Top of Sidewalk = 299.53 + 0.72 = 300.25
- Read the existing elevation of the top of deck at the edge of the parapet wall. Note that the previous elevation used for the parapet wall cannot be used due to the weight of the parapet wall.
- Fill to the Top of Sidewalk = Top of Sidewalk Elevation – Existing Elevation of Deck
- Mark the “Fills” for the Contractor at intervals that will provide uniform grade.

Grade for Cored Slab/Box Beams

- Grade for parapet walls and sidewalks **cannot** be set by measuring up from the top surface of the cored slab or box beam.
- Use the proposed profile grade to determine the grades.
- Recommend that grades be set at the mid-span first. This will help ensure proper cover in the middle of the span.
- Profile grades can then be projected along the edge of the span.

Additional Things to Remember

- Bridge Construction Elevations are only provide grade point elevations at certain stations along the deck. Elevations along the grade point at other stations will have to interpolated to establish intervals that will provide uniform grade.
- Determine the actual elevation of the deck along the grade point and compare it to the proposed grade point elevations. These elevations should be fairly close. If not, contact your Bridge Construction Engineer.
- Look at the build ups for the exterior girders to see of the camber is close to the camber called for on the “Dead Load Deflection” plan sheet. This will also affect the “fills” for the parapet wall.
- If you have a sidewalk, pay close attention to the superelevation of the construction joint underneath the sidewalk.
- If you have problems and/or questions, call your Bride Construction Engineer for assistance.

Adhesive Anchoring Systems in Sustained Tensile-Load Applications

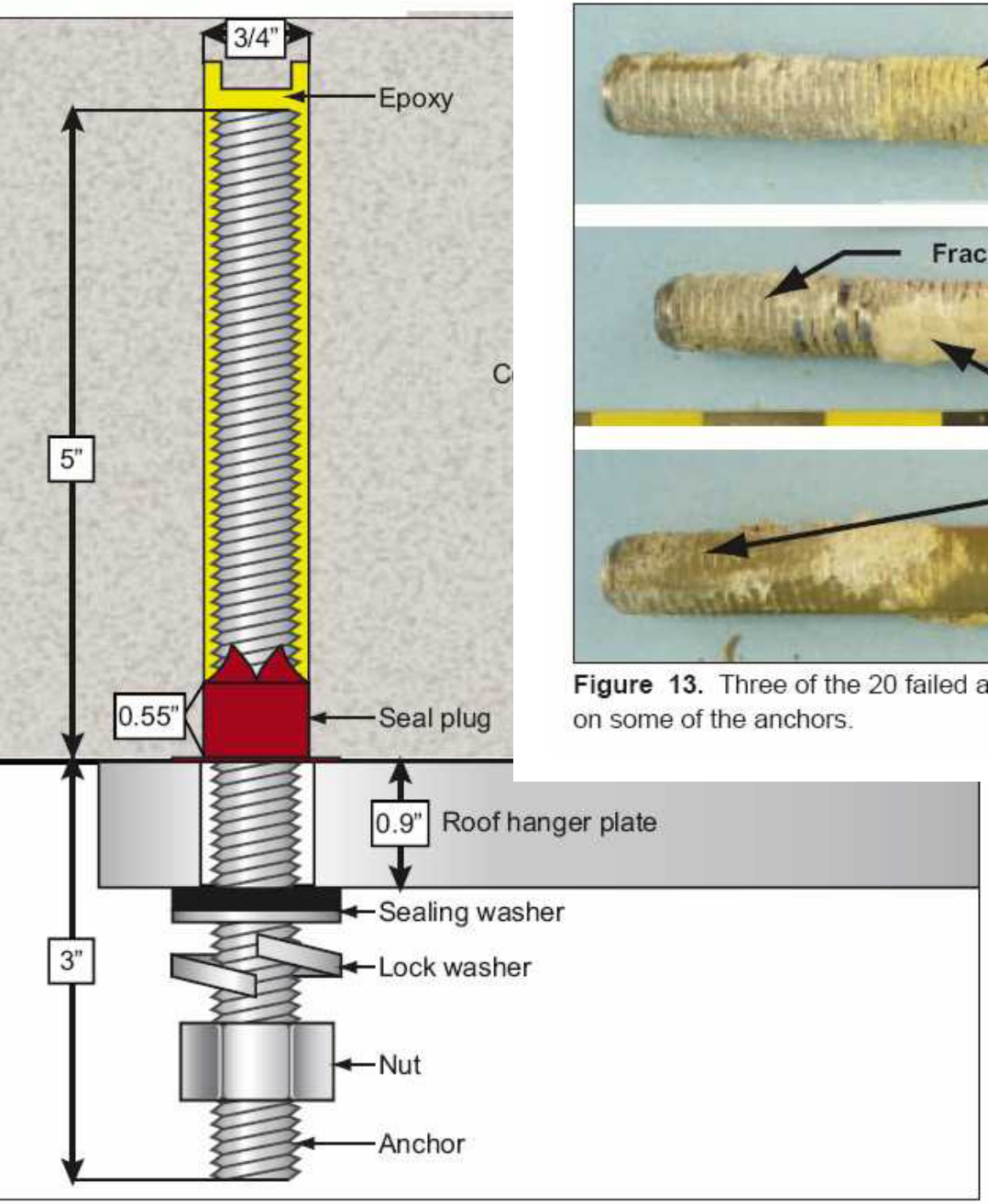
Construction Engineers Conference

March 26, 2008

I-90 Tunnel Liner Failure

- Ceiling Collapse on July 10, 2006
- One Fatality
- NTSB Report of July 10, 2007
  - Probable Cause – Epoxy Anchor Adhesive with Poor Creep Resistance

Figure 1. Postaccident scene with the crushed passenger car barely visible under the wreckage. The open area in the ceiling is the original location of the concrete panels. (Photograph courtesy Massachusetts State Police)



ypical adhesive anchor and roof hanger plate assembly.

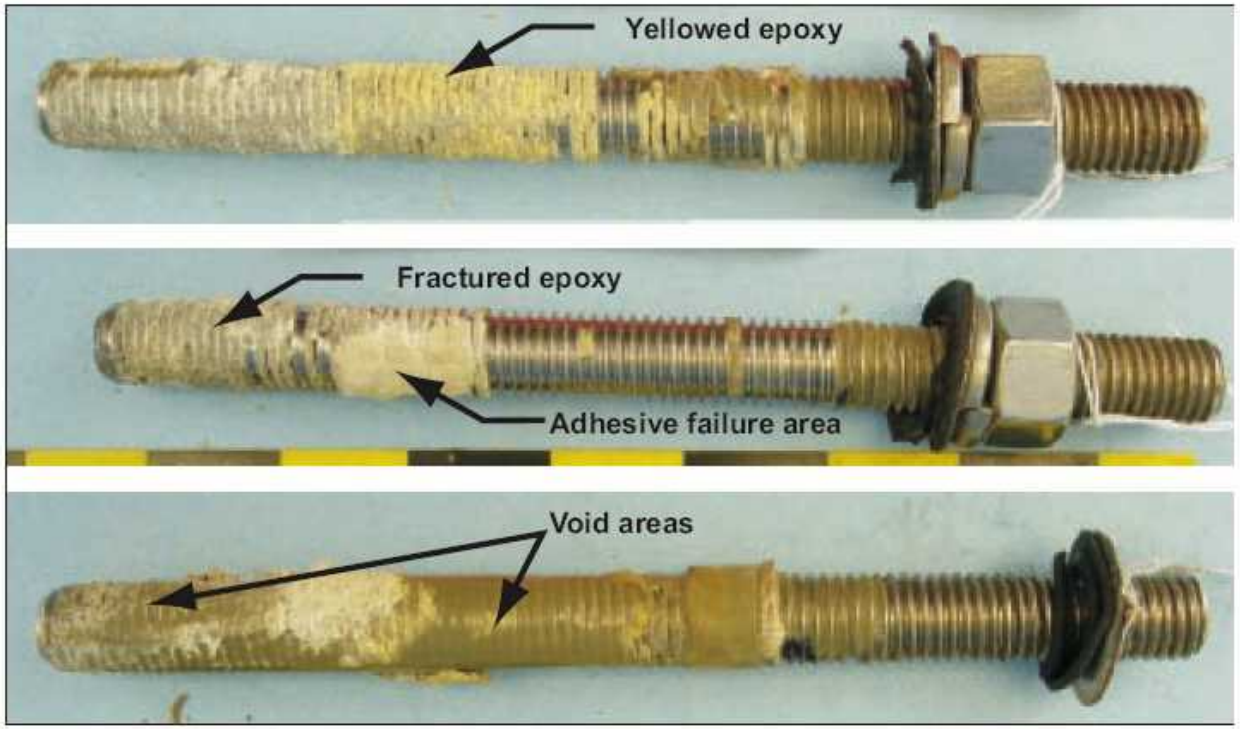


Figure 13. Three of the 20 failed anchors from the accident site illustrating epoxy features founc on some of the anchors.

NTSB Safety Recommendation

- 19 Safety Recommendations
- Two Specific to State DOTs
- August 3, 2007 Letter to Secretary Tippett
- Requested NCDOT Reply

Recommendations

- Prohibit use of adhesive anchors in sustained tensile-load overhead applications
- Review use & implement inspection and repair program

4" CARLON PVC CONDUIT TYPE D 68615

NCDOT Risk

- Utility hangers on existing structures
- Not typically installed by DOT
- Approved by encroachment agreement
- Significant time investment to inspect
  - days vs. hours
  - Underdeck inspection equipment
  - Traffic control on grade crossings

Structure Design Actions

- New Policy (June 15) effective with October letting
- Two levels of testing
- Specifically prohibits adhesive bonding systems for overhead use

Bridge Maintenance Actions

- Initiated review of use in sustained tension loading (other than utility hangers)
- Requested information about any utility hanger failures
- Will determine extent of risk

National Efforts

- NCHRP 20-7 Problem Statement
  - Development of Testing Protocols
  - Developed August 15, 2007
  - Funding approved
  - Work Underway
- NCHRP RPS 2009 D-17
  - Long Term Performance of Epoxy Adhesive Anchors
  - Being Balloted by States

National Efforts

- FHWA Technical Advisory
  - Discourage use of Fast Set Epoxy
  - Discourage use of any epoxy anchor systems in sustained tension use
  - Retrofit/Replace with mechanical system any Fast Set Epoxy found
  - Initiate rigorous & regular inspection program

NCDOT Response

- Agree with NTSB Recommendations
- Taken action to prohibit use on new construction
- Initiated review of existing systems
- Add specific inspection item on “inhouse” Inspection Reporting forms
- Prepare technical bulletin with wide distribution within DOT and to utility owners

Impact to RE Office

- Do Not Allow Use of Epoxy Anchors in Sustained Tensile Loading
- Consult with Division, BCE, Design or others if Not Sure

Questions

PLACING LOADS ON BRIDGES

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHEAL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

September 5, 2007

MEMORANDUM

TO: Division Engineers

FROM: Mr. W. S. Varnedoe, P. E.
Chief Engineer-Operations

SUBJECT: Loads on Bridges During Construction and Maintenance Activities

Article 420-20 of the Standard Specifications requires submittals for review and acceptance prior to placing construction loads on any part of a bridge. Examples of construction loads that fall under this requirement are material and debris storage and placement of heavy equipment not legally allowed on a roadway. Heavy equipment includes, but is not limited to, crawler cranes, truck cranes and concrete pumping trucks operated with outriggers down, scrapers, off-road dump trucks, proof rollers, automatically controlled fine grading machines, and concrete paving machines.

In administering this requirement, the following review authority applies:

1. The Structure Design Unit will review plans for bridges that have been or are being constructed under an active contract.

2. The Bridge Maintenance Unit will review plans for placing loads on existing bridges. The Division Bridge Maintenance Engineer will submit plans for maintenance activities including but not limited to repairs, partial removal of decks, and rehabilitation to the Bridge Maintenance Unit for coordination and review.

3. The Designer of Record will review and accept plans for detour bridges on construction projects that have been designed by the Contractor or consultant working for the Contractor. In this case, the Contractor must provide a letter to the Resident Engineer from the Designer of Record indicating that the proposed plan is acceptable. Details of the proposed operation must be submitted and sealed by the Design Engineer of Record.

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
CONSTRUCTION UNIT
1543 MAIL SERVICE CENTER
RALEIGH NC 27699-1543

TELEPHONE: 919-733-2210
FAX: 919-733-8441

WEBSITE: WWW.DOT.STATE.NC.US

LOCATION:
TRANSPORTATION BUILDING
1 SOUTH WILMINGTON STREET
RALEIGH NC

4. The Resident Engineer or Division Bridge Maintenance Engineer as appropriate will review all proposals to cross bridges with construction equipment that can legally cross a bridge but may cause damage to the bridge deck and joints. This includes, but is not limited to, asphalt paving machines and steel wheel rollers.

In order to expedite the review, the following information should be obtained and submitted with the request:

- Location, dimensions, and weight of stored materials or debris
- Make and model of the equipment including the manufacturer's catalog cuts
- General dimensions of the equipment, including width and length of tracks and spacing center to center of tracks or number and spacing of axles
- Type of work being performed and weight of load to be lifted or carried by the equipment while on the bridge
- Size of construction mats to be used under the tracks or outriggers
- Spans that the equipment will be traveling on exact locations on the spans
- Any other equipment, vehicles, or materials that will be on the span at the same time
- Proposed method for protecting joints or joint blockouts

Under no circumstances should construction loads be allowed on a bridge deck without prior approval. Upon completion of the work or crossing, the deck should be inspected and any damage reported to the reviewing authority for further investigation.

cc: Mr. J. G. Nance, PE
Mr. E. C. Powell, Jr., PE
Division Maintenance Engineers
Division Construction Engineers
Resident Engineers
Division Bridge Maintenance Engineer
Bridge Construction Engineers
Roadway Construction Engineers
Mr. G. R. Perfetti, P. E.
Mr. D. D. Holderman, P. E.
Mr. Tom Drda

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

March 10, 2008

MEMORANDUM TO: Division Engineers

FROM: W. S. Varnedoe, P.E.
Chief Engineer – Operations

SUBJECT: Inspection of New Bridges

The State Bridge Management Unit is required to make an initial inspection of new structures within ninety (90) days of opening a structure to traffic in order to comply with the National Bridge Inspection Standards (NBIS). This initial inspection is performed by NBI course certified inspectors.

In order to meet the time frame for the inspection, timely notification of structure completion is necessary. As a new structure nears completion, the Resident Engineer should notify the State Bridge Management Unit of the anticipated completion date and the anticipated date of opening the structure to traffic. The attached form should be used for this notification.

Timely notification will allow the most efficient use of resources and will ensure the Department is in compliance with the inspection requirements.

If you need additional information, please contact Michael Robinson, State Bridge Construction Engineer at (919) 733-2210.

WSV/msr

Attachment

cc: Bill Rosser, P.E., State Highway Administrator
Jon Nance, P.E., Director of Field Operations
Lacy Love, P.E., Director of Asset Management
Dan Holderman, P.E., State Bridge Management Engineer
Ellis Powell, Jr., P.E., State Construction Engineer
Bridge Construction Engineers
Resident Engineers

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
CHIEF ENGINEER'S OFFICE
1537 MAIL SERVICE CENTER
RALEIGH NC 27699-1537

TELEPHONE 919-733-7621
FAX 919-733-4141

WEBSITE WWW.DOH.DOT.STATE.NC.US

LOCATION:
TRANSPORTATION BUILDING
1 SOUTH WILMINGTON STREET
RALEIGH NC

Notice of New Structure Completion

Instructions

- **For new bridges or sign structures: Complete form as soon as an estimated completion date is known. If the anticipated date of opening to traffic is unknown, leave blank and send a revised form when the date is known.**
- **Provide as much information as possible to identify the structure location.**

Submit to: State Bridge Management Engineer / Inspections
Copies to: Division Engineer, State Construction Engineer

Reported By: _____ **Date:** _____

Division: _____ **County:** _____

Bridge #: _____ **TIP Project #:** _____

Location: Structure on _____ **over** _____ **between** _____ **and** _____

Additional Information Regarding Location:_____

_____

_____

Check below where applicable:

- ❑ Bridge
- ❑ Overhead Sign Structure
- ❑ Cantilever Sign Structure
- ❑ Other – explain _____

Anticipated Date of Structure Completion: _____

Anticipated Date of Opening to Traffic: _____

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

March 10, 2008

MEMORANDUM TO: Division Engineers

FROM: W. S. Varnedoe, P.E.
Chief Engineer – Operations

SUBJECT: Notification of Vertical Clearance Change

In order to ensure safe passage on our roadways, the State Bridge Management Unit is required to maintain an up-to-date database of the vertical clearances on all roadways. This database is used to evaluate proposed routes for oversized loads. To assist in the maintenance of the database, the Resident Engineer must notify the State Bridge Management Unit when changes in overhead clearances occur. Both increases and decreases should be reported.

The attached form should be used for notification of vertical clearance changes.

If you need additional information, please contact Michael Robinson, State Bridge Construction Engineer at (919) 733-2210.

WSV/msr

Attachment

cc: Bill Rosser, P.E., State Highway Administrator
Jon Nance, P.E., Director of Field Operations
Lacy Love, P.E., Director of Asset Management
Dan Holderman, P.E., State Bridge Management Engineer
Ellis Powell, Jr., P.E., State Construction Engineer
Bridge Construction Engineers
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FAX: 919-733-4141

WEBSITE: WWW.DOH.DOT.STATE.NC.US

LOCATION:
TRANSPORTATION BUILDING
1 SOUTH WILMINGTON STREET
RALEIGH, NC

Resident Engineer's Notice of Vertical Clearance Change

Instructions

- **For new bridges or sign structures:** verify and report plan minimum vertical clearance immediately after members are erected.
- **For construction or resurfacing under existing structures:** report when work is complete.
- **For divided multilane facilities:** provide minimum clearance values for each direction of travel. Also, list collector / distributor lanes separately.
- **For removal of existing structures:** report when the existing overhead obstruction is removed
- Report values in English Units and round down to the nearest inch.
- Bridge # is the Bridge Maintenance number shown on the plans.
- Provide as much information as possible to identify the structure location.

Submit to: State Bridge Management Engineer
Copies to: Division Engineer, State Construction Engineer, Assistant State Bridge Management Engineer/Inspections, Director Oversize/Overweight Permit Unit

---

Reported By: _____ **Date:** _____

Division: _____ **County:** _____

Bridge #: _____ **TIP Project #:** _____

Location: Structure on _____ **over** _____ **between** _____ **and** _____

Additional Information Regarding Location:_____
_____
_____

Check below where applicable:

- ❑ Bridge
- ❑ Overhead Sign Structure
- ❑ Cantilever Sign Structure
- ❑ Resurfacing
- ❑ Other – explain _____

Measured Vertical Clearance: _____

Plan Minimum Vertical Clearance: _____

North Carolina Department of Transportation

Materials and Tests Unit

Pipe Video Inspection and Drilled Shaft Inspection

Special Investigation Truck

- 24,000 GVW
- Hydraulic Power Pack
- Generator
- Air Compressor

Pipe Video Inspection Equipment

Quick View Camera

- Safe Operation from Road
- Access Pipes Up to 24 Feet below Road Elevation
- Single Operator
- 75 Feet Visibility in 6-inch Pipe
- 250 Feet Visibility in 60-inch Pipe
- Photo/video

Pipe Video Inspection Equipment

Pipe Rover

- 24” Diameter Pipe and Larger
- Photo/Video/Audio

Transporter

24” Diameter Pipe and Larger

Applications

- Inspection of Pipe Lines
  - Concrete
  - Metal
  - Plastic
- Inspection of Shallow Bridge Foundations
- Inspection of Box Culverts
- Inspection of Masonry Drainage Structures
- Large Utility Lines (> 6”)

Solutions

- Identify Improper Installation Practices
- Identify Structural Inadequacies
- Identify Performance Characteristics
- Identify Potential Foundation Scouring (Shallow Depths Only)

Inspection Requests

- Pipe Inspection Request Form
  - http://www.ncdot.org/doh/operations/materials/matops/rinvestigations.html
- Materials and Tests Website:

http://www.ncdot.org/~mtu

North Carolina Department of Transportation
Materials and Tests Unit
Research & Investigations Section

PIPE INSPECTION REQUEST FORM

Date								
Name								
Title								
Telephone Number (Office)								
Telephone Number (Cell)								
County - Division								
Project Number								
Pipe Location								
Directions to Meeting Point (Pipe Location or Office)								
Number of Lines to be inspected (Use extra sheet if necessary)	Line 1	Line 2	Line 3	Line 3	Line 4	Line 5	Line 6	Line 7
Length of Pipe (Linear Feet or Meter, Specify)	000	000	000	000				
Pipe Diameter (Inches or Millimeter, Specify)								
Type of Pipe (RCP, CMP, Plastic, Specify)								
Reason for Inspection (brief description of pipe problem , broken down per pipeline)	Line 1: _____ Line 2: _____ Line 3: _____ Line 4: _____ Line 5: _____ Line 6: _____ Line 7: _____							
Notes/Comments								

If you have questions about this form, please contact Hesham El-Boulaki @ (919) 329 4223, o hel-boulaki@ dot.state.nc.us

Drilled Shaft Inspection

SHAFT INSPECTION REQUEST FORM

- Shaft Inspection Request Form
  - http://www.ncdot.org/doh/operations/materials/eforms.html

SHAFT INSPECTION REQUEST FORM

Date Request Made										
DATE & TIME Inspection Requested										
Request By (Name)										
Title										
Telephone Numbers										
Project Contact (Name)										
Project Contact Telephone Numbers										
County - Division										
Contract Number										
Directions to Meeting Point (Project Location or Office)										
Number of Shafts to be inspected	**Total Number of Shafts**	**Shaft Location**								
		Bent #								
		Shaft #								
Notes/ Comments										

If you have questions about this form, please contact Hesham El-Boulaki @ (919) 329 4223, or hel-boulaki@dot.state.nc.us

Inspection Requests

- Contact Information
  - Materials Operations Engineer
    - Office Phone: (919) 733-7091
    - Cell Phone: (919) 291-2319
    - Email: rpace@dot.state.nc.us
  - Research & Investigations Engineer
    - Office Phone: (919) 733-7091
    - Cell Phone: (919) 271-0070
    - Email: hel-boulaki@dot.state.nc.us
  - Local Section Materials Specialist

Miscellaneous Items

- Technician Assessments
  - Target Date of July 1 for Aggregates and Asphalt
  - Target Date of January 2009 for Concrete
- Response Times -
  - Shaft Inspections and Low Cylinders Investigations are our priority
- Written Documentation of Inspections and Investigations

March 18, 2008

MEMORANDUM TO: David B. Black , P.E.
Resident Engineer

FROM: Hesham El-Boulaki., M.C.E., P.E.
Research and Investigations Engineer

SUBJECT: Pier Inspections for: Week of March 10th - 14th, 2008
Project Contract Number: 33598.3.2
TIP Number: B-42565
Division: 9 County: Rowan

Please see the following inspection information for the subject piers:

Shaft Location/Inspection Information			
Bent #	2	2	2
Pier #	1	2	3
Date of Inspection	3/10/2008	3/10/2008	3/10/2008
Inspection Finding: Does Drilled Pier meet Applicable NCDOT Special Provision* ?	Yes	Yes	Yes
Remarks	Passed the first time	Passed the first time	Passed the first time
Total Number of Piers	3		

* Passing Inspection Criteria:
Pier Bottom Cleanliness must meet the Drilled Piers Special Provisions (1 & 2):
1- At least 50% of the pier bottom has material that is less than13 mm (1/2 inch) AND
2- No Area of the pier bottom has material that is more than 38 mm (1-1/2 inch)

A copy of the post-inspection form with the above findings was handed to your project representative at the conclusion of the inspection.

* Questions

* Comments

Thank You

2008 Training

BOLTING TRAINING

- Target Audience
- Instructor
- Scheduling
- Materials

Bolt Training Outline

1. Explain reasons for training
   a) Review proper storage and handling
   b) Review required Field Testing and Reporting
   c) Review proper installation procedures
   d) Review inspection procedures

2. Show 5 minute video

3. Storage and handling
   a) All components to remain in original watertight containers
   b) Use components (bolt, nut, and washer) from the same Rotational Capacity Test lot (RCT)
   c) Re-seal containers after removing components

4. Testing and Reporting
   a) Rotational Capacity Tests are performed by the supplier and verified by Materials and Tests. No additional RCT are required in the field if all components are properly stored. Components exposed to the elements must be segregated and Rotational Capacity Tested and assigned a new RCT number.

4.1. Field Verification Testing of DTI
   a) Equipment
      1) Calibrated Bolt Tensioning Measuring Device (Skidmore-Wilhelm)
      2) 0.005 inch tapered thickness gage
      3) Three DTI assemblies (bolt, nut, washer, and DTI) for each diameter, length, RCT lot and DTI lot.
      4) Three DTI assemblies with three long bolts for testing short bolts.
         Note: A long bolt is defined as a bolt with adequate length to be properly installed in a calibrated bolt tension measuring

device. A short bolt is defined as a bolt too short to be tested in the device.

5) Wrenches- Two wrenches required, a handle extension may be required and is acceptable. Use of an impact wrench for this test is not allowed.

4.2 Testing Procedure (Long Bolts)

a) Long bolt DTI assemblies are installed in the tension measuring device with sufficient length so that 3-5 threads are located behind the bearing face of the nut- (see figure 2). Additional washers may be required.

b) Tighten the nut until the bolt tension reading on the dial of the device reaches the minimum required tension as shown in Table 2. Use the second wrench to hold the bolt head to prevent rotation while tightening the nut.

c) Determine and record the dial reading and the number of refusals using the 0.005-inch gage on the M&T Form DTI-07. If the number of refusals is greater than the maximum specified in Table 3, the DTI fails the verification test.

d) The bolt shall be further tightened to the minimum number of refusals for the bolt size listed in Table 440-3. Record the dial reading on Form M&T DTI-07.

e) The bolt shall be further tightened until the 0.005-inch gage is refused at all spaces, but a visible gap exists in at least one of the spaces. Record the dial reading on Form M&T DTI-07. This tension must be less than or equal to the minimum bolt tensile strength given in Table 4. If the recorded tension is more than the minimum bolt tensile strength, the DTI assembly fails the verification test.

f) Remove the bolt assembly from the bolt-tensioning device. Turn the nut onto the full length of the threads, excluding the thread run out. If this can be done, the DTI assembly has passed the test.

g) If anyone of the three DTI's fail the verification tests, the lot is considered to be in non-compliance with the specification and should not be used.

h) Bolts, nuts, washers, and DTI's used for testing should not be incorporated in the work.

4.3 Testing Procedure (Short Bolts)

a) Install bolt, nut, washer, and DTI into a steel section or in a joint in the project material.
b) Bolt shall be tightened until the 0.005-inch gage is refused at all spaces, but a visible gap exists in at least one space.
c) Remove the assembly and turn the nut onto the full length of the threads of the bolt. If this can be done, the assembly passed the verification tests. The results should be recorded on Form M&T DTI –07

Note; DTI's are to be placed under the unturned element unless otherwise approved by the engineer. If the DTI is placed under the turned element, three additional tests are to be performed using this orientation.

5. Installation

a) Use only bolt assemblies taken from containers stamped " NCDOT APPROVED"
b) Bolt assemblies must be free of visible rust
c) Bolt assemblies must have a thin coat of lubricant at the time of installation
d) Apply beeswax or stick paraffin to the threads of galvanized bolts just prior to installation.
e) Do not install bolt assemblies until Field Verification Tests have been performed.
f) DTI to be placed under the bolt head unless approved by the Engineer.
g) Remove only the amount of bolts that can be fully tensioned that day.
h) If necessary to leave bolts loose, apply wax lubricant to the bolts prior to installation.
i) Snug tighten all bolts prior to compressing DTI's.
j) Tighten bolts to proper tension as determined by the minimum space refusals as shown in table 440-3
k) Do not over tighten. Leave a visible gap in at least one space.

6. Inspection

a) Visually inspect 100% of each connection

b) **Test 10% of the DTI's in each connection (at least 2 per connection) using the 0.005-inch gage, per Table 440-3.**

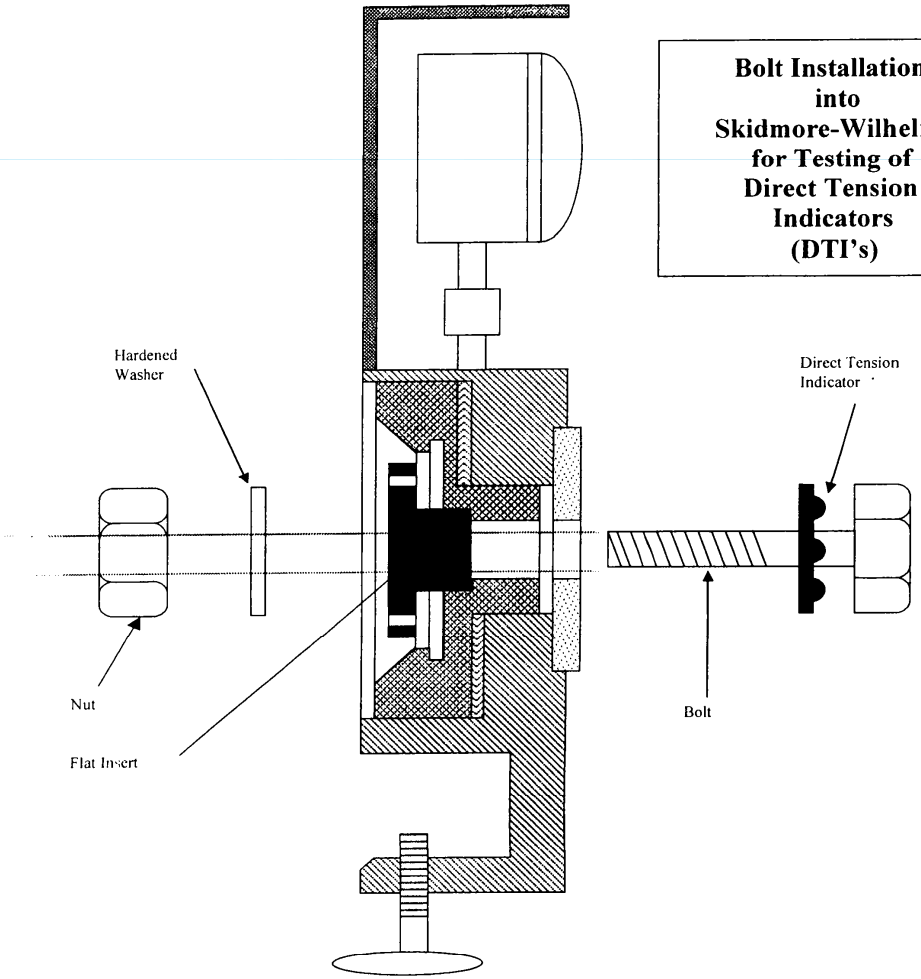
TABLE 4

Minimum Bolt Tensile Strength in Kips (1 kip = 1000 lbs.)									
Bolt Dia. (in.)	1/2	5/8	¾	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
ASTM A325 (AASHTO M164)	17	27	40	55	73	80	102	121	148
ASTM A490 (AASHTO M253)	na	na	50	69	91	114	145	173	na

TABLE 2

Minimum Required Bolt Tension in Kips (1 kip = 1000 lbs.)									
Bolt Dia. (in.)	1/2	5/8	¾	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
ASTM A325 (AASHTO M164)	13	20	29	41	54	59	75	89	108
ASTM A490 (AASHTO M253)	na	na	37	51	67	84	107	127	na

Bolt Installation into Skidmore-Wilhelm for Testing of Direct Tension Indicators (DTI's)



Direct Tension Indicator Under "UNTURNED" Element

Figure 2

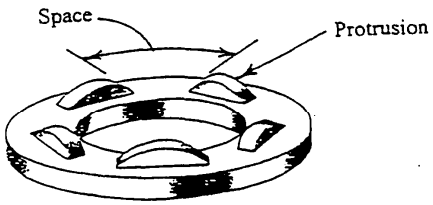


Figure 1
(Direct Tension Indicator)

TABLE 1

	Number of Spaces								
DTI Dia. (in.)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Type 325	4	4	5	5	6	6	7	7	8
Type 490	na	na	6	6	7	7	8	8	na

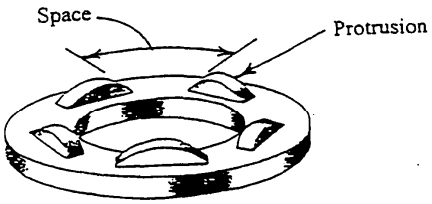
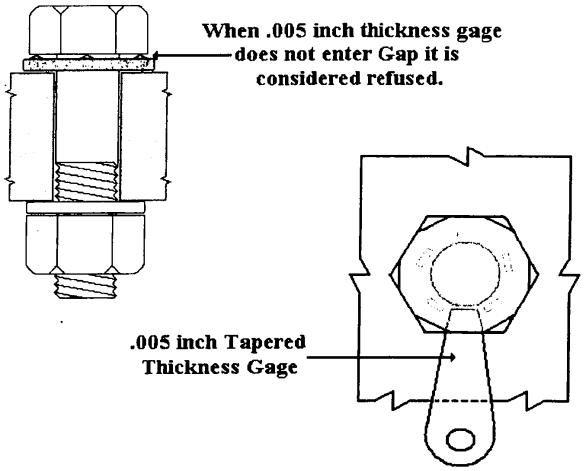


Figure 1
(Direct Tension Indicator)

TABLE 1

	Number of Spaces								
DTI Dia. (in.)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Type 325	4	4	5	5	6	6	7	7	8
Type 490	na	na	6	6	7	7	8	8	na



(Measuring Gap with Thickness Gage)

Figure 3

05

TABLE 3

Verification Criteria					
	No. of Spaces on DTI				
	4	5	6	7	8
Max. No. of Spaces Refused: • All Plain DTI's • Coated* DTI's under "unturned" element	1	2	2	3	3

When using direct tension indicators, proper tension of bolts is inspected by the Engineer by inserting a 0.005-inch thickness feeler gage into the openings between adjacent flattened protrusions of the direct tension indicator. Proper tension is obtained when the number of spaces for which the gage is refused is equal to or greater than the value shown in Table 440-3.

TABLE 440-3
Direct Tension Indicator Gap Refusal

Number of Spaces in Washer	Number of Spaces Gage is Refused*
4	2
5	3
6	3
7	4

* The gage shall be refused in all spaces when the direct tension indicator is used under the turned element.

When using direct tension indicators, do not tighten bolts to a no visible gap condition.

Inspections of direct tension indicator installations are made by the Engineer by the use of the metal feeler gauges provided by the Contractor. At least 10%, but no less than two of the bolts in each connection are inspected with feeler gauges. Additionally, all remaining bolts in each connection are visually inspected for proper tightening.

INSPECTOR TRAINING

- Notification
- Locations
- Topic
- Agenda
- PDH’s

First Use of CFA Piles by NCDOT

- What are CFA (Continuous Flight Augered) Piles?
- Advantages and Disadvantages of CFA Piles
- Use of CFA Piles for B-4164 Bridge Replacement
- QC for CFA Piles
- Future Uses and Advice

CEC2008 CFA Piles

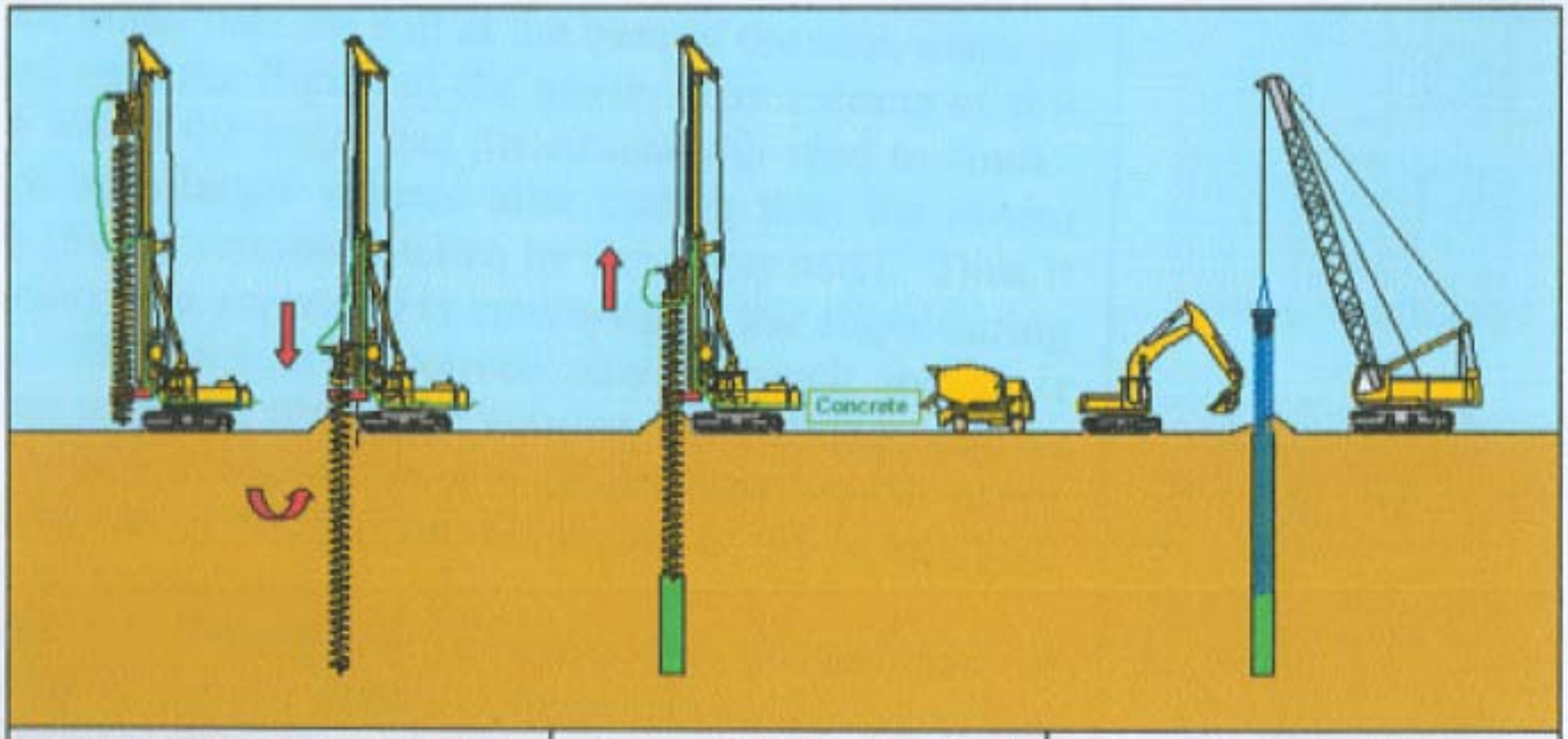
Chris Kreider

NCDOT - GEU

What are CFA Piles?

- CFA Piles are a type of drilled foundation in which the pile is drilled to its final depth in one continuous process. As the augers are withdrawn, concrete or grout is placed by pumping through the hollow center of the auger pipe to the base. The grout is placed as the auger is removed so the hole is never left open or unsupported.
- A deep foundation alternate to driven piles or drilled shafts.

Drilling With Continuous Flight Auger (CFA)



Drilling with CFA auger. Soil is continuously transported from the tip of the auger upwards by the flights.The borehole is stabilized by the auger filled with soil	After reaching the final depth the auger is withdrawn and concrete is pumped through the hollow stem with the concrete pump.	Remove the excavated soil with a hydraulic excavator. Push or vibrate the reinforcement cage into the freshly poured pile.

Figure 1 Schematic of CFA Pile Construction

Advantages vs. Disadvantages

- No casing or slurry needed
- Speedy Installation
- Reduced noise and vibration over driven piles
- Good dense sands, stiff clays, and residual soils
- Many applications – piles, pile supported embankments, noise walls, retaining walls, low headroom applications, signal poles, and light poles

- Need specialty subcontractor
- High mobilization cost
- Need flat dry area to drill
- Not good in very loose sands, very soft clays, or rock
- Use as bridge foundation needs high level of QC
- Must control drill spoils

General CFA Info

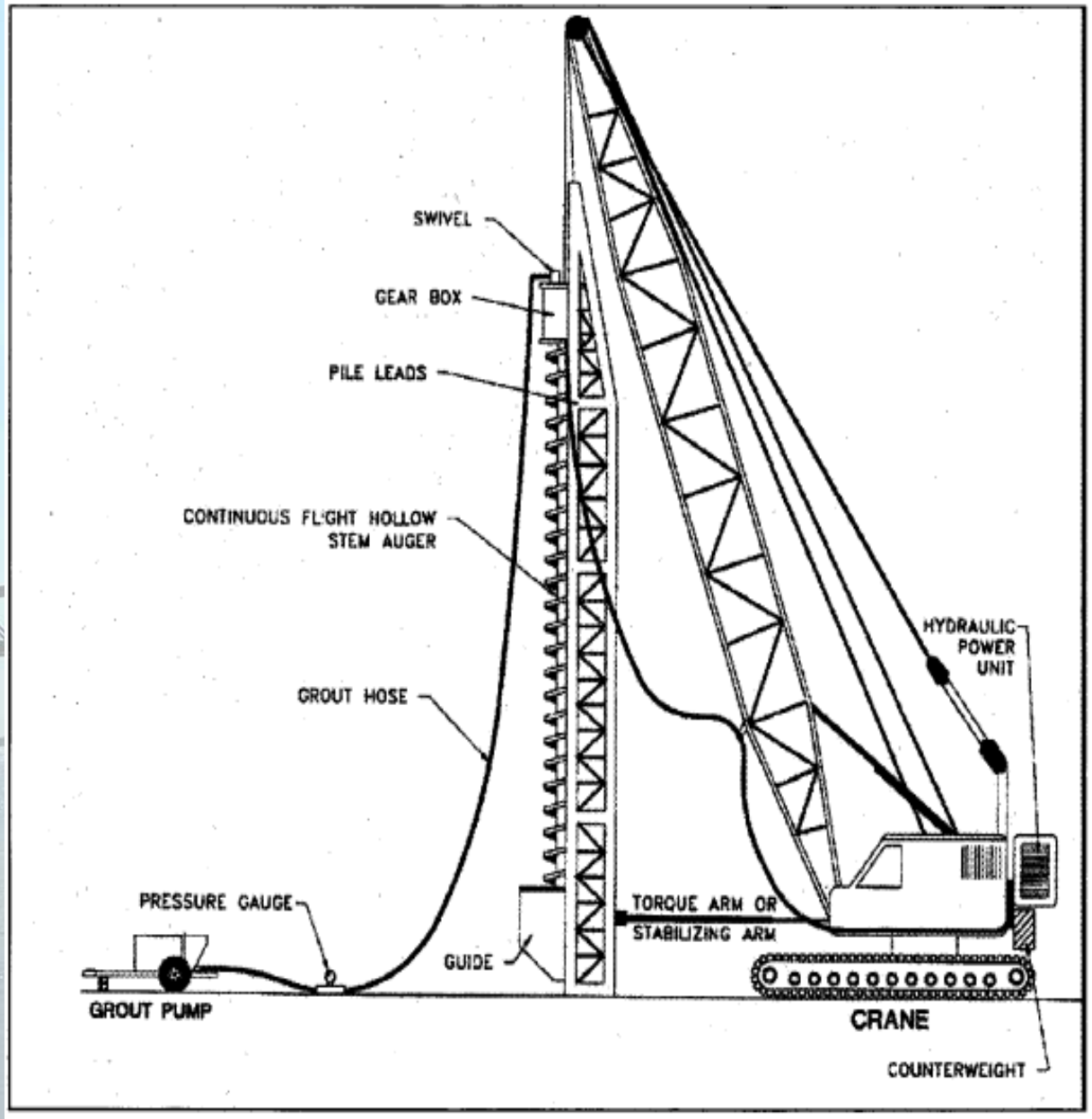
Typical CFA Pile Sizes are 12-24 inches.

Typical Depths are 20 to 50 feet deep.

Can drill as large as 40” and to depths of 100 feet.

Recommend installing a non production demonstration pile prior to starting construction.

Cost for private jobs typically 12 to 18 $/ft, limited DOT use but expect higher costs.



(Source: Deep Foundations Inst.)

Figure 4.1: Typical Crane Mounted CFA Rig.

Parker's Millhouse Just Upstream from Bridge B-4164

Photo 15 – Downstream view of Millhouse looking north

Project Commitment to SHPO – "No Adverse Effect"

GEU hired consultant to do a preconstruction condition survey of millhouse

GEU provided BMU two foundation alternates for this bridge

1. Driven H-Piles with Contractor responsible for monitoring vibrations
2. CFA Piles without Vibration Monitoring

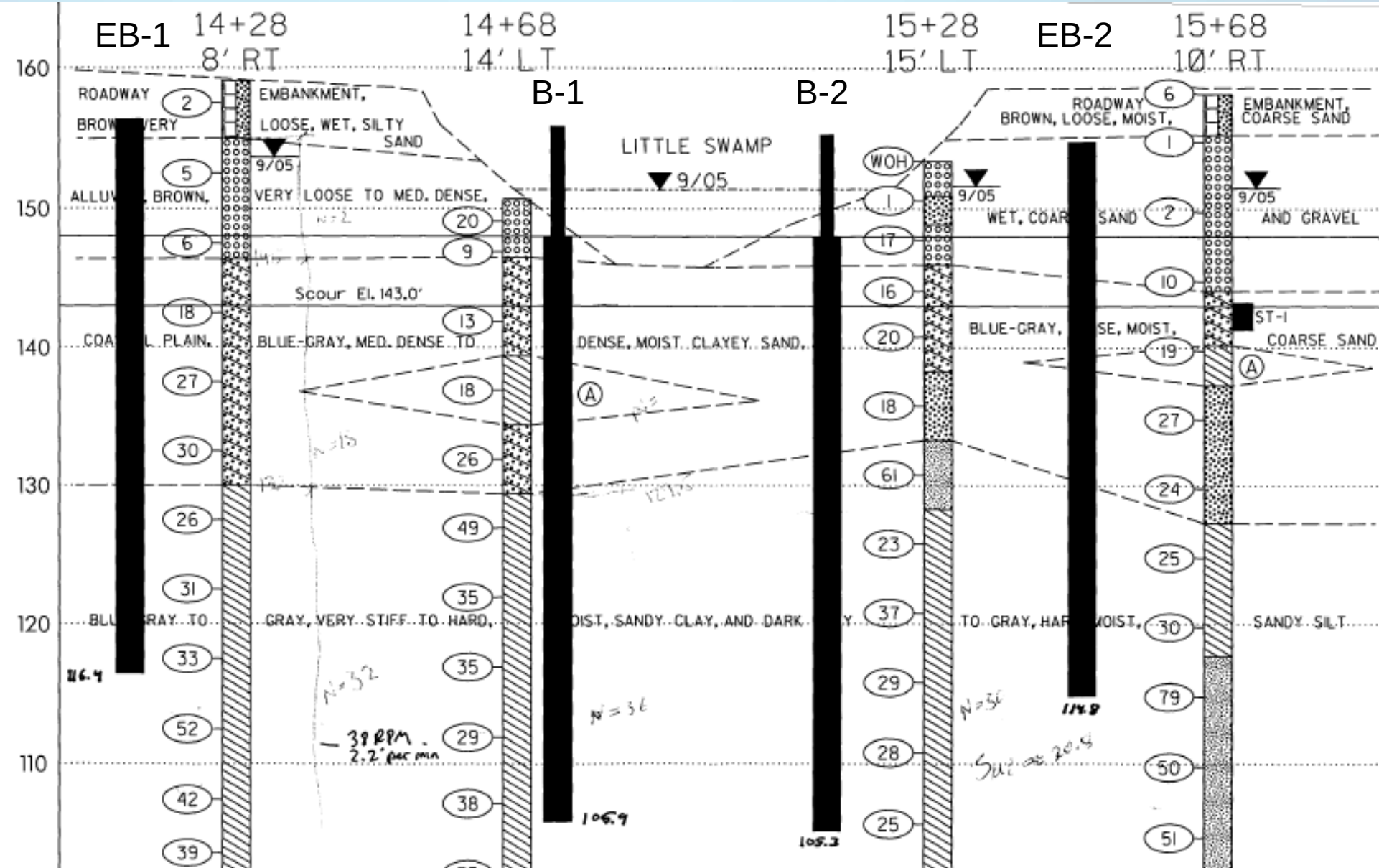
BMU chose alternate 2

Ignore the sheet piling installed here to provide dry level area at bent 1 to install CFA piles.

CFA Costs for B-4164 and B-4128

- B-4164
  - Demo pile @ $5,000
  - 24” CFA pile @ $75/lf
  - HP 12x53 @ $50/lf
- B-4128
  - Demo pile @ $38,000
  - 18” CFA pile @ $165/lf
  - HP 10x42 @ $46/lf

B-4164 Soil Profile w/ CFA Piles Shown



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01/15/2008

31

31 12:40PM

18 5:04 PM

31 11:23 AM

CFA Pile QC

- Auger Rotation Speed
- Torque
- Crowd
- Min. and Max Grout Pressure
- Grout Volume
- Grout Factor

Each of these values must be reported for each 2’ interval.

Computer controlled monitoring and recording equipment used.

Use of PIR-A computer to monitor CFA installation

Magnetic Flow Meter – new way of measuring grout volume

Old way of estimating grout volume by counting strokes.

Pile Installation Recorded Data

>>>>> REVIEW PRINTOUT IMMEDIATELY <<<<<

- -

Pile Name: 8
Project Name: MVFD BRIDGE
Pile Vol: 188.16 ft3 (133%)
Date: 2008-01-18

Auger Data [start 15:10]

depth (ft)	time interval (sec)	torque pres-avg (PSI)	DR	rotate (RPM)
0.0				
2.0	22	2020	4.09	23.6
4.0	25	3415	11.60	27.3
6.0	51	3838	9.47	30.1
8.0	11	3422	3.60	50.3
10.0	18	3755	8.20	44.4
12.0	13	3818	6.11	43.8
14.0	18	3710	8.97	36.4
16.0	19	3778	7.75	39.2
18.0	19	3727	8.09	48.5
20.0	27	3705	8.33	43.8
22.0	21	3670	7.33	40.5
24.0	20	3982	11.01	26.0
26.0	52	3870	21.67	35.0
28.0	29	3630	11.67	40.9
30.0	41	3645	18.08	37.7
32.0	30	3855	9.19	36.5
34.0	35	3950	10.25	35.0
36.0	44	3945	17.68	29.9
38.0	49	3925	17.97	28.1
40.0	48	3913	14.73	33.2
42.0	41	3893	15.87	33.1
44.0	53	3893	22.92	32.0
45.1	29	3873	22.22	31.0

[stop 15:44 (00:12:26)]

DR:22.22%

Withdrawal Data [start 15:44]

depth (ft)	dT (sec)	pumped volume (ft3)	volume ratio (%)	AVG line Pressure (PSI)
45.1				(max depth)
45.1		9.39		(Stem+Head)
44.0	42	4.80	141	31
42.0	17	8.51	135	119
40.0	17	7.59	121	77
38.0	15	7.91	126	112
36.0	16	7.98	127	104
34.0	17	7.49	119	103
32.0	17	8.05	128	113
30.0	15	8.16	130	123
28.0	23	8.40	134	109
26.0	17	8.30	132	120
24.0	19	7.98	127	91
22.0	20	7.35	117	94
20.0	20	8.48	135	105
18.0	18	8.79	140	146
16.0	16	8.76	139	151
14.0	18	8.90	142	140
12.0	17	7.95	126	150
10.0	17	8.55	136	150
9.2	<-- return depth (5.0)			
8.0	17	7.80	124	144
6.0	17	8.83	140	165
4.0	16	8.30	132	165
2.0	19	9.36	149	162
0.0	20	9.92	158	129
		0.00		(spill vol)

[stop 15:52 (00:07:25)]

Reaugered 27.9 to 28.5 (vol 3.11)

Volumes:	(ft3)	
Nominal Inc:	6.29	(2.0 ft)
Target Inc:	7.24	(2.0 ft)
Nominal:	141.65	(24.0 in dia)
Min Target:	162.90	(115%)
Shaft:	188.16	(133%)
Stem:	3.11	
Head:	6.29	(2.0 ft)
Pile:	197.55	(139%)
Spill:	0.00	
Reaugered:	3.11	
Total:	200.66	
Return:	148.01	(104%)

Pile = Shaft + Stem + Head
Total = Pile + Spill + Reauger

Legend for Increment Warnings.
* pumped volume < target volume
** pumped volume < nominal volume

>>>>>> INTERPRETATION QUESTIONS? <<<<<<
>> e-mail: pir@pile.com, or <<<<<<
>> call Pile Dynamics @ 216-831-6131 <<

Future Uses and Advice

- Some bridges when geology and site condition are favorable to CFA pile use, especially when noise and vibration from pile driving are a major concern.
- Noise wall foundations – could become a alternative to shafts for noise walls. (signal pole and light pole foundations to a lesser extent)
- Need a dry level area to drill.
- Use of PIR resulted in high confidence that foundations were build to spec.
- Try to increase pile spacing to 6D.
- Consider using reinforcing cage in end bent piles in lieu of H-pile.
- Some CFA piles had to be redrilled because H-Piles could not be inserted to the bottom.
- Consider adding mobilization pay item to decouple the cost from linear foot cost.

Retaining walls are structures!

Typical NCDOT MSE Retaining Walls

Are these MSE Walls?

What is an MSE retaining wall?

- MSE stands for “Mechanically Stabilized Earth”
- Defined as a soil-retaining system consisting of:
  - Facing Elements (segmental retaining wall (SRW) units, i.e., “blocks”, pre-cast concrete panels, fabric with wire mesh forms)
  - Reinforcement (steel, geogrid, fabric)
  - Backfill (stone, select materials)
- Coping (cap blocks, pre-cast or cast-in-place concrete)
- Temporary fabric walls and segmental retaining walls are different types of MSE walls

Facing Elements

Reinforcement

Why was a new MSE wall policy and provision needed?

- Department did not have an “official” policy
- Some things were undefined or unclear
- Current provision was too restrictive
- Technology in industry has changed significantly - quality has improved
- Consultants are using MSE walls more (e.g., design build, developer projects)

What does the new policy say?

- Defines “critical walls” as higher than 35 ft or walls supporting or adjacent to railroads, interstate highways and bridges
- MSE walls with SRW units are not allowed for critical walls
- GEU approves MSE wall systems (list on GEU web page)
- States procedure for how MSE wall systems get approved

Where is the new policy?

Address http://www.ncdot.org/doh/preconstruct/highway/geotech/

North Carolina Department of Transportation
GEOTECHNICAL ENGINEERING

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  - MSE Retaining Walls
  - Prequalification Requirements

HOME

The Geotechnical Engineering Unit provides the expertise required by NCDOT in the geologic and geotechnical engineering aspects of planning, design, construction and maintenance of North Carolina highways. The Unit plays a key role in the development and evaluation of new products and techniques involving use of earthen materials for construction and maintenance.

The Geotechnical Engineering Unit is staffed by geotechnical engineers, engineering geologists, technicians and other support staff. The Unit collects and analyzes subsurface information, and plans, designs and assists in the construction and maintenance of roadways and structures.

The Unit operates statewide with a Central Operations office located in the Century Center Complex in Raleigh, two Regional Headquarters in Raleigh and Charlotte, and two Area Field Offices in Greenville and Asheville.

The North Carolina Department of Transportation

What does the new provision say?

- Survey existing ground elevations and submit a revised wall envelope
- Use an approved MSE wall system
- Includes panels and blocks for facing elements
- Includes steel and geogrid for reinforcement
- Cast-in-place coping is required for MSE walls with blocks

Cap Block?

What does the new provision say?

- Freeze-thaw durable blocks are required to meet the following:
  - 5500 psi compressive strength (vs. 4000 psi)
  - weight loss of each of 4 of the 5 specimens after 150 cycles does not exceed 1% of its initial weight
- Allows 2S and 2MS sand in addition to stone for wall backfill in some situations
- Requires electrochemical testing when using 2S and 2MS with steel reinforcement

What does the new provision say?

- Corrosion monitoring is required for MSE walls with steel reinforcement - kit and assistance with installation provided by M&T
- Concrete barrier rail with moment slab is designed by Department and incidental
- Payment is per sq ft of exposed face area
  - top of wall is top of coping or concrete barrier rail coping
  - bottom of wall where finished grade intersects front face

Concrete Barrier Rail with Moment Slab

What else is new with walls?

“Big Block” Walls

recon Retaining Wall Systems

ReConline

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- Critical, substantial retaining walls must **perform** to high standards and the demands of difficult terrain.

- A retaining wall system needs to be **versatile** and **flexible** in order to accommodate the unique needs of each particular project site.

- Retaining walls should enhance the **aesthetics** of the natural surroundings and add **value** to a property.

*Check out our website! Learn more about how **ReCon Retaining Walls** and our licensed retaining wall producers can assist in solving difficult site-grading challenges.*

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Bronco

When you've got a landscaping job that requires a colossal-size segmental retaining wall (SRW), call for Bronco. Weighing in at 4,500 pounds and displaying 14 square feet of face area, Bronco has the heft and coverage to tackle any job you can throw at it. The heavyweight system builds walls up to 10 feet tall without soil reinforcement, making it ideal for projects with excavation constraints. And with a unique four-panel, natural-stone appearance, Bronco is the most attractive random-pattern large-block SRW system available. For full product data click here.

Brute Unit Measurements:	
Height:	30"
Width (face):	67.5"
Width (rear):	52.5"
Depth:	45"
Face area:	14 sq. ft.
Weight:	4500 lbs. *(approximate)*
Weight/Face Area:	325 lbs./sq. ft.

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Middle Block: Limestone Face

Face: 46" long x 18" high
5.75 sq. ft. of face

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Redi-Rock Retaining Walls

Redi-Rock International is leading the big block retaining wall market in North America. With over 115 dealers in 45+ states and several Canadian locations, there is a Redi-Rock dealer within reach of nearly every major market in North America.

All Redi-Rock products capture the "*Essence of Natural Rock*". Redi-Rock has developed its product line with attention to natural hardscapes and has thus developed a system that looks so natural that many mistake it for quarried stone.

Redi-Rock's retaining walls utilize blocks weighing over 1 ton each. The massive scale of the system allows walls to be built much higher than other wall systems without using geogrid or tie-backs. Also, taller reinforced retaining walls can be designed with our geo-connector.

Redi-Rock's diverse hardscape product line consists of retaining walls, free-standing walls, architectural columns, and massive pavers.

FREE PRODUCT

Dealer Locations

Trade Show Schedule:

International Homebuilders Show

World of Concrete

MCPX

with more info to come

“Big Block” Walls

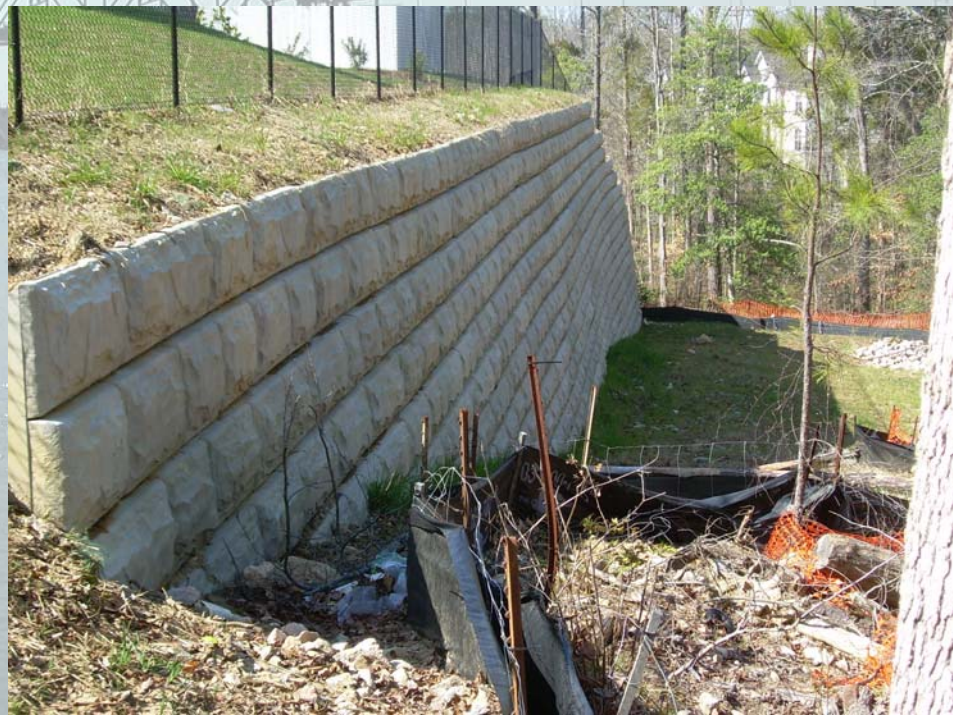
- Big and heavy blocks (Stone Strong block is 8 ft wide and 6000 lbs.)
- Some blocks have core spaces (stone fill)
- In general, no reinforcing in blocks
- Blocks require some batter (varies)
- Quick installation (1 Stone Strong block = 24 sf = 24 SRW units), no forms or curing, does require equipment
- Can be significantly cheaper than short MSE walls or cast-in-place gravity walls

“Big Block” Walls

- Unreinforced up to about 10 ft
- Reinforced with geogrid for taller walls, MSE wall! (economical?)
- No MSE wall systems with big blocks currently approved
- Less right-of-way in some cases (batter, reinforcement, shoring)
- Currently working on a special provision for big block walls (unreinforced) and standard big block wall designs (alternates to standard gravity walls)

Stone Strong by Stay-Right Precast

Stone Strong



Redi-Rock

Questions?