Case History

NYC MTA SUBWAY STATION

CINTEC™ REINFORCEMENT SYSTEMS

CINTEC America provides anchoring systems for NYC MTA subway station retrofit project

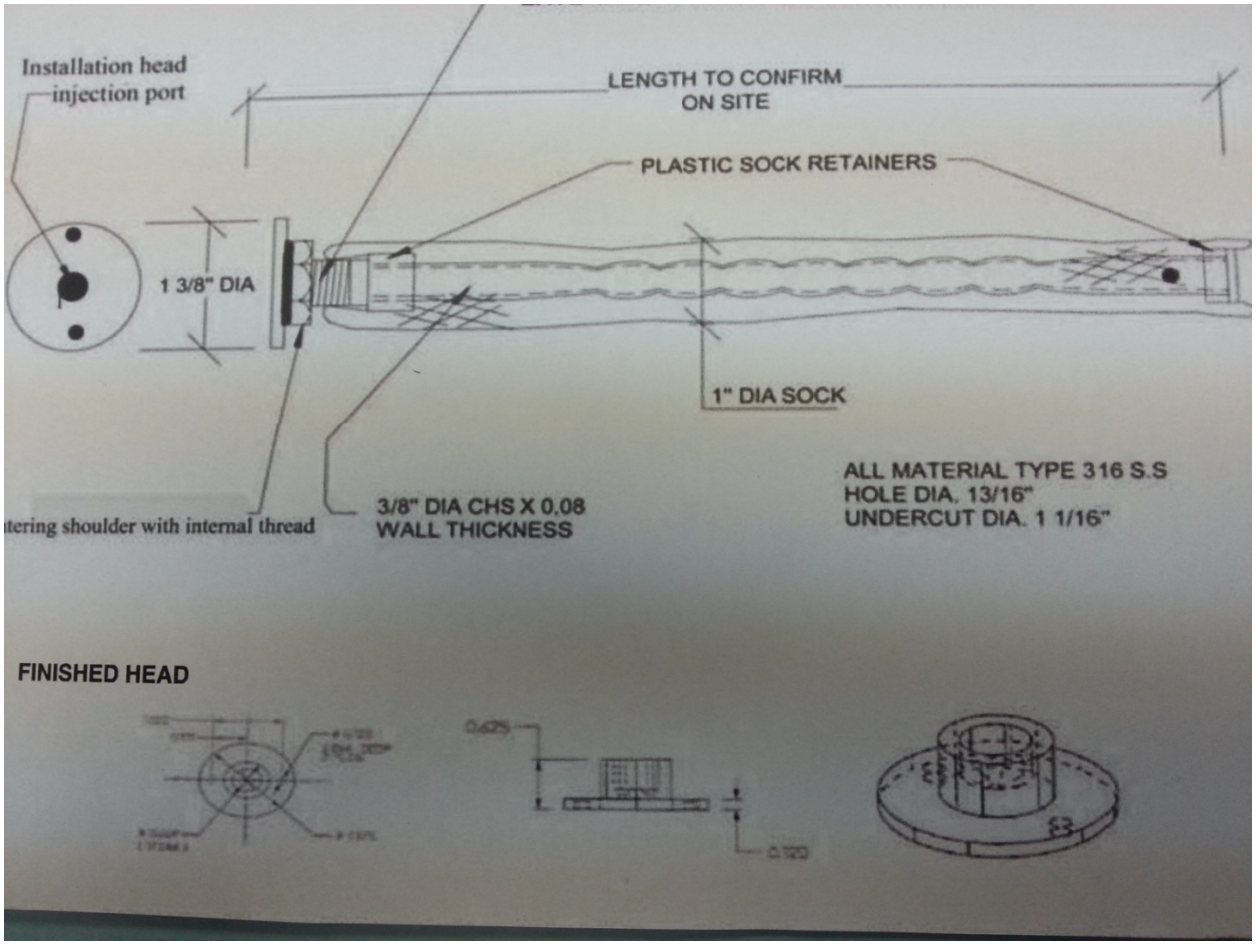
CINTEC America, a world leader in the field of structural masonry retrofit strengthening, repair, and preservation, has announced that after extensive site testing and evaluation it will supply a new anchoring system for the overhead glass fiber reinforced concrete (GFRC) panels for the NYC MTA subway station retrofit project for station platforms at 168th station and 181st station. The NYC MTA. subway station retrofit project is aimed at providing overhead support for the GRFC panels used for the underground suspended dome ceiling. Live onsite testing validated the strength and effectiveness of the anchors, which now support the over 2,000 pound ceiling panels firmly in place. For more information, call 1-800-363- 6066 or visit www.cintec.com .

Cintec Anchor Testing for the New York City Transit Authority Contract A36193 168 & 181 Station –Broadway/7th Ave. Line Repair of Brick Arch

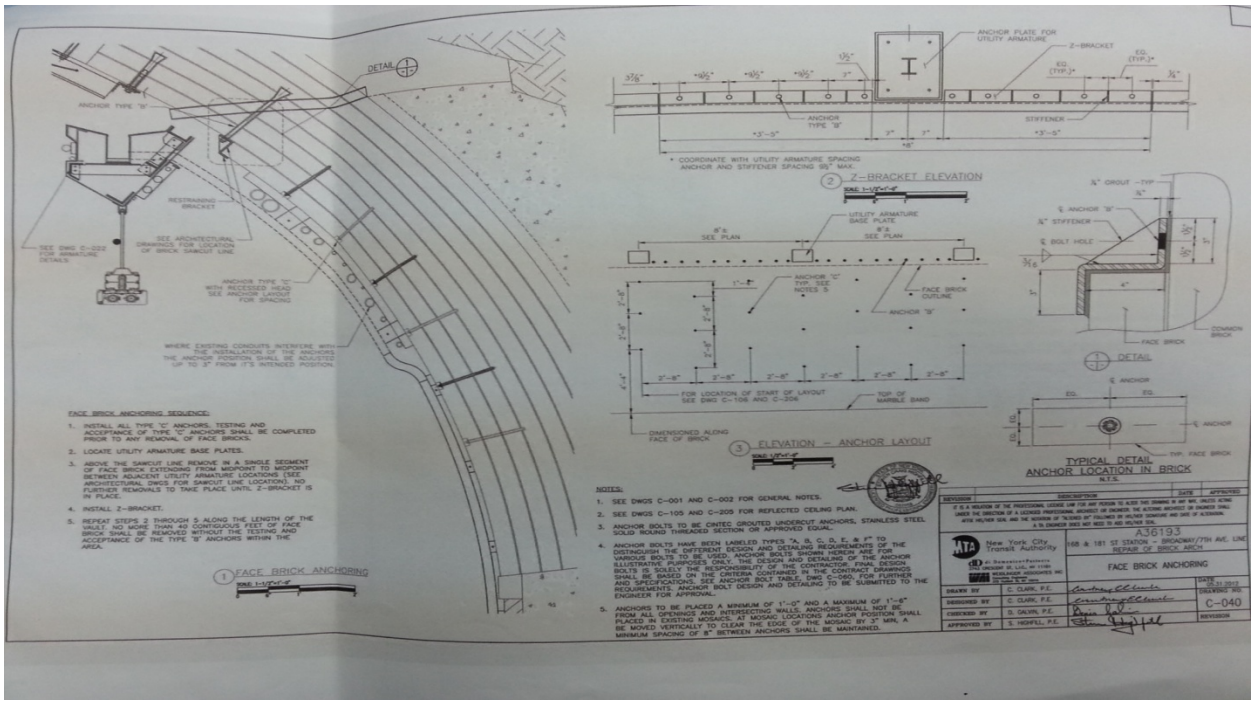
Overview

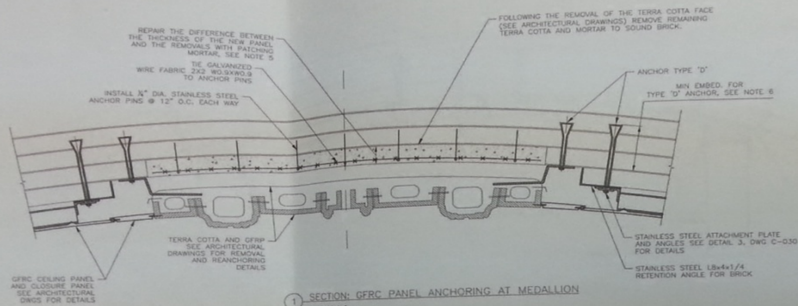
NYC Transit managers had learned in 1999 that a portion of the ceiling at 181st Street was at risk of collapse. However, it did not begin a comprehensive assessment of the ceiling's condition until June 2009. On August 16, 2009, at 10:18 p.m., a large section of the arched brick ceiling at the 181st Street Station on the IRT Line fell onto the platforms and tracks. Fortunately, no one was injured by the falling bricks and subway service to the station was immediately suspended.

In May 2010 Robert Silman & Associates contacted Cintec requesting that we assist them in a designing a wall strengthening anchor system that could be used to hold the face brick to the backup brick. The general scope was to design anchors with an 18" embed into the ceiling masonry that would consolidate and strengthen the wall with a removable head to allow for current and future anchor testing to validate the anchor performance. The final copyrighted design is shown below:

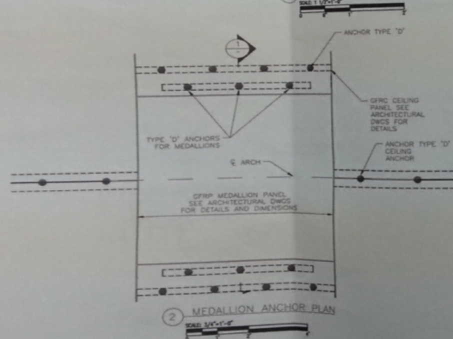


The NYC Transit changed directions and in 2011and Cintec was approached by Weidlinger Associates, Inc/Thornton Tomasetti NYC to assist in a new anchor design for a suspended ceiling application using GFRC Panels. The final anchor design for the panels included lateral, vertical and horizontal attachments. Final drawings with anchor locations for subway stop 168th and 181st street:





(1) SECTION: GFRC PANEL ANCHORING AT MEDALLION



(2) MEDALLION ANCHOR PLAN

NOTES:

1. SEE DWGS C-001 AND C-002 FOR GENERAL NOTES.
2. SEE DWGS C-105 AND C-205 FOR REFLECTED CEILING PLAN.
3. ANCHOR BOLTS TO BE CINTEC GROUTED UNDERCUT ANCHORS, STAINLESS STEEL OR APPROVED EQUAL UNLESS OTHERWISE NOTED.
4. ANCHOR BOLTS HAVE BEEN LABELED TYPES "A, B, C, D, E, & F" TO DISTINGUISH THE DIFFERENT DESIGN AND DETAILING REQUIREMENTS OF THE VARIOUS BOLTS TO BE USED. ANCHOR BOLTS SHOWN HEREIN ARE FOR ILLUSTRATIVE PURPOSES ONLY. THE DESIGN AND DETAILING OF THE ANCHOR BOLTS IS SOLELY THE RESPONSIBILITY OF THE CONTRACTOR. FINAL DESIGN SHALL BE BASED ON THE CRITERIA CONTAINED IN THE CONTRACT DRAWINGS AND SPECIFICATIONS. SEE ANCHOR BOLT TABLE, DWG C-060, FOR FURTHER REQUIREMENTS. ANCHOR BOLT DESIGN AND DETAILING TO BE SUBMITTED TO THE ENGINEER FOR APPROVAL.
5. APPLY REPAIRING MORTAR SIKATOP 123-PLUS (OR APPROVED EQUAL) IN ½" MAXIMUM LIFTS. MORTAR MUST BE SCRUBBED INTO SUBSTRATE.
6. DUE TO PROXIMITY TO BRICK/SUBSTRATE REMOVAL AT MEDALLION, THE FIRST LAYER OF COMMON BRICK SHALL BE DISCOUNTED IN THE INSTALLATION OF TYPE 'D' ANCHORS SUPPORTING PANELS AT MEDALLIONS. ANCHORS SHALL BE INSTALLED TO THEIR DESIGN LENGTH PLUS 4 IN.

REVISION	DESCRIPTION	DATE	APPROVED

IT IS A VIOLATION OF THE PROFESSIONAL LICENSE LAW FOR ANY PERSON TO ALTER THIS DRAWING IN ANY WAY, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ARCHITECT OR ENGINEER. THE ALTERING ARCHITECT OR ENGINEER SHALL AFFIX HIS/HER SEAL AND THE NOTATION OF "ALTERED BY" FOLLOWED BY HIS/HER SIGNATURE AND DATE OF ALTERATION. A TA ENGINEER DOES NOT NEED TO ADD HIS/HER SEAL.

MTA New York City Transit Authority

dP di Domenico+Partners

WEIDLINGER ASSOCIATES INC

A36193

168 & 181 ST STATION – BROADWAY/7TH AVE. LINE
REPAIR OF BRICK ARCH

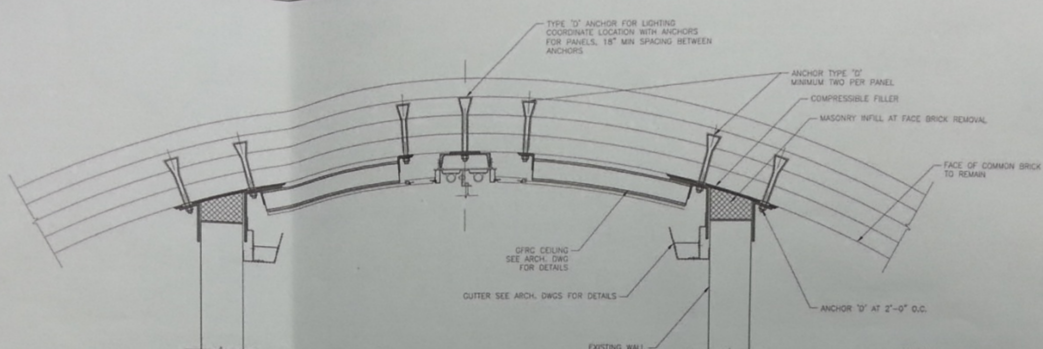
MEDALLION ANCHORING

DRAWN BY	C. CLARK, P.E.	
DESIGNED BY	C. CLARK, P.E.	
CHECKED BY	D. GALVIN, P.E.	
APPROVED BY	S. HIGHFILL, P.E.	

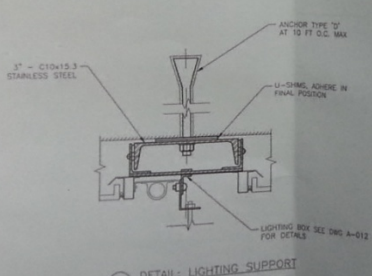
DATE 05.31.2012

DRAWING NO. C-031

REVISION



(1) SECTION: CROSS VAULT CEILING ANCHORS



(2) DETAIL: LIGHTING SUPPORT

NOTES:

1. SEE DWGS C-001 AND C-002 FOR GENERAL NOTES.
2. SEE DWGS C-105 AND C-205 FOR REFLECTED CEILING PLAN.
3. ANCHOR BOLTS TO BE CINTEC GROUTED UNDERCUT ANCHORS, STAINLESS STEEL OR APPROVED EQUAL UNLESS OTHERWISE NOTED.
4. ANCHOR BOLTS HAVE BEEN LABELED TYPES "A, B, C, D, E, & F" TO DISTINGUISH THE DIFFERENT DESIGN AND DETAILING REQUIREMENTS OF THE VARIOUS BOLTS TO BE USED. ANCHOR BOLTS SHOWN HEREIN ARE FOR ILLUSTRATIVE PURPOSES ONLY. THE DESIGN AND DETAILING OF THE ANCHOR BOLTS IS SOLELY THE RESPONSIBILITY OF THE CONTRACTOR. FINAL DESIGN SHALL BE BASED ON THE CRITERIA CONTAINED IN THE CONTRACT DRAWINGS AND SPECIFICATIONS. SEE ANCHOR BOLT TABLE, DWG C-060, FOR FURTHER REQUIREMENTS. ANCHOR BOLT DESIGN AND DETAILING TO BE SUBMITTED TO THE ENGINEER FOR APPROVAL.
5. APPLY REPAIRING MORTAR SIKATOP 123-PLUS (OR APPROVED EQUAL) IN ½" MAXIMUM LIFTS. MORTAR MUST BE SCRUBBED INTO SUBSTRATE.
6. LOCATIONS OF ANCHORS FOR LIGHTING TRAYS AND CEILING PANELS IN THE CROSS VAULTS AND THE GROIN VAULT AREAS SHALL BE COORDINATED TO AVOID INTERFERENCES. THE MINIMUM SPACING BETWEEN ANCHORS SHALL BE 18". PANELS IN THE CROSS VAULT SHALL BE SUPPORTED BY A MINIMUM OF FOUR ANCHORS (TWO AT TOP AND TWO AT BOTTOM OF EACH PANEL). PANELS AT THE GROIN VAULT INTERSECTION SHALL BE SUPPORTED BY A MINIMUM OF SIX ANCHORS (THREE AT TOP AND THREE AT BOTTOM OF EACH PANEL).

REVISION	DESCRIPTION	DATE	APPROVED

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MTA New York City Transit Authority

dP di Domenico+Partners

WEIDLINGER ASSOCIATES INC

A36193

168 & 181 ST STATION – BROADWAY/7TH AVE. LINE
REPAIR OF BRICK ARCH

MISCELLANEOUS CEILING ANCHORS

DRAWN BY	C. CLARK, P.E.	
DESIGNED BY	C. CLARK, P.E.	
CHECKED BY	D. GALVIN, P.E.	
APPROVED BY	S. HIGHFILL, P.E.	

DATE 05.31.2012

DRAWING NO. C-032

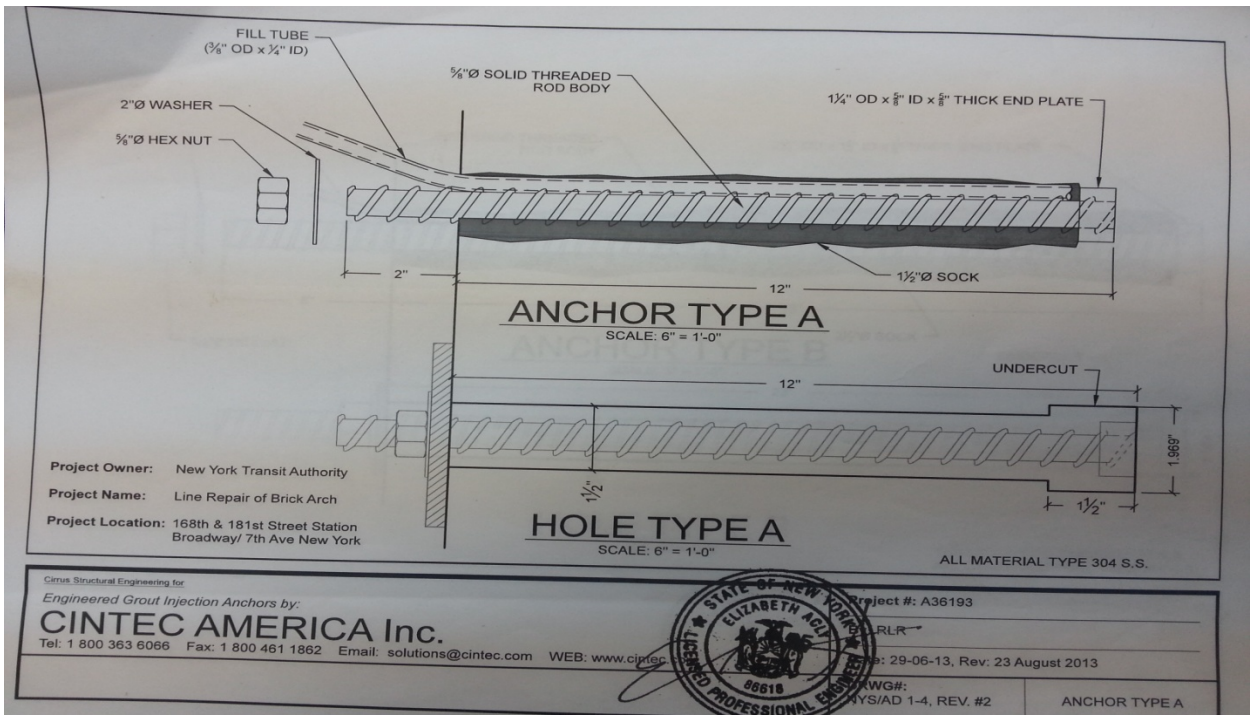
REVISION

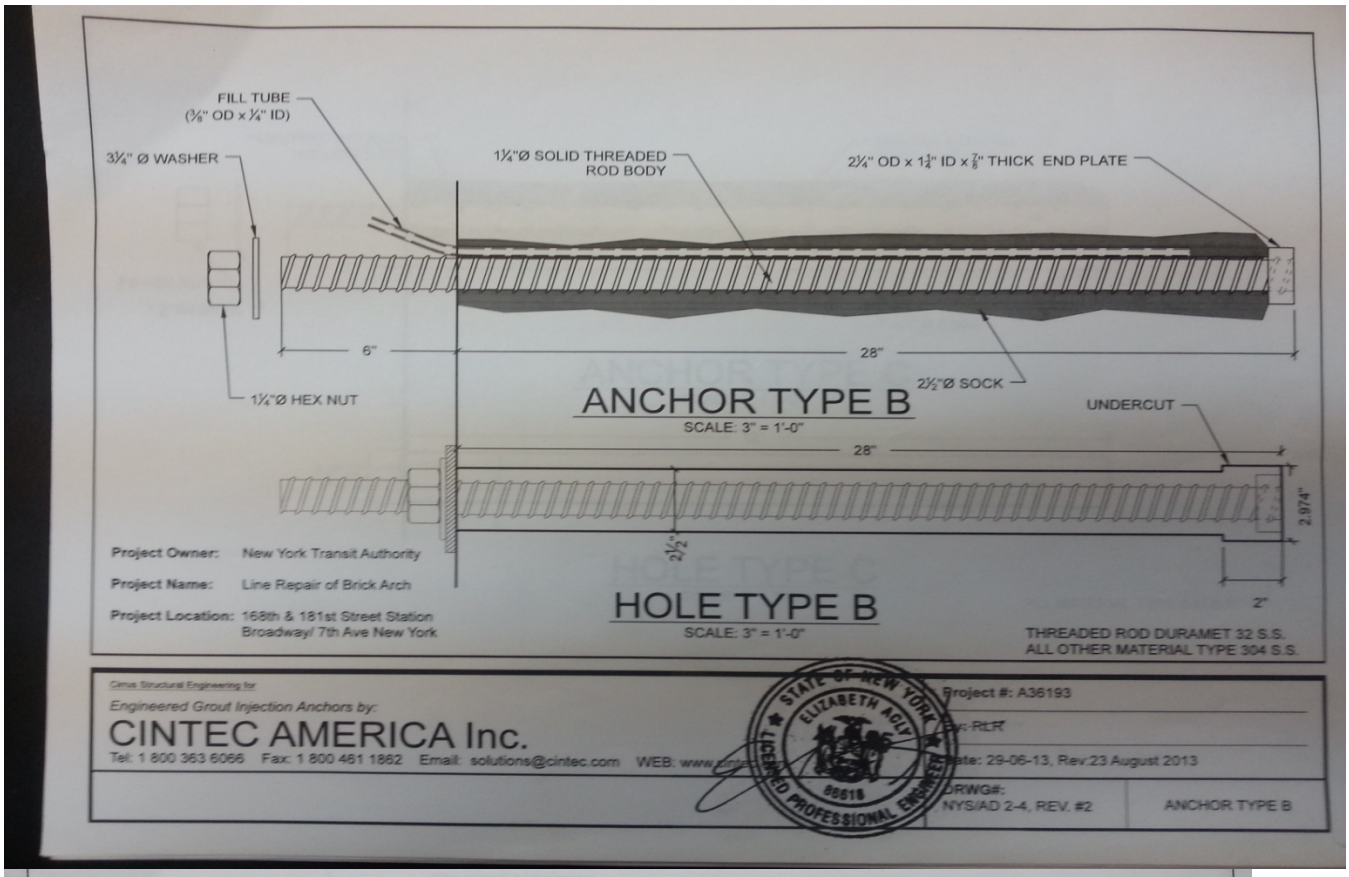
One of the challenges set worth was to design a positive lock system at the back end of the anchor drilled hole. To accomplish this Cintec developed and patented an undercut cutting head that developed a square cut not a taper cut within the drilled hole. This approach to augment hole drilling gives the anchor the ability to handle higher loads in tension.

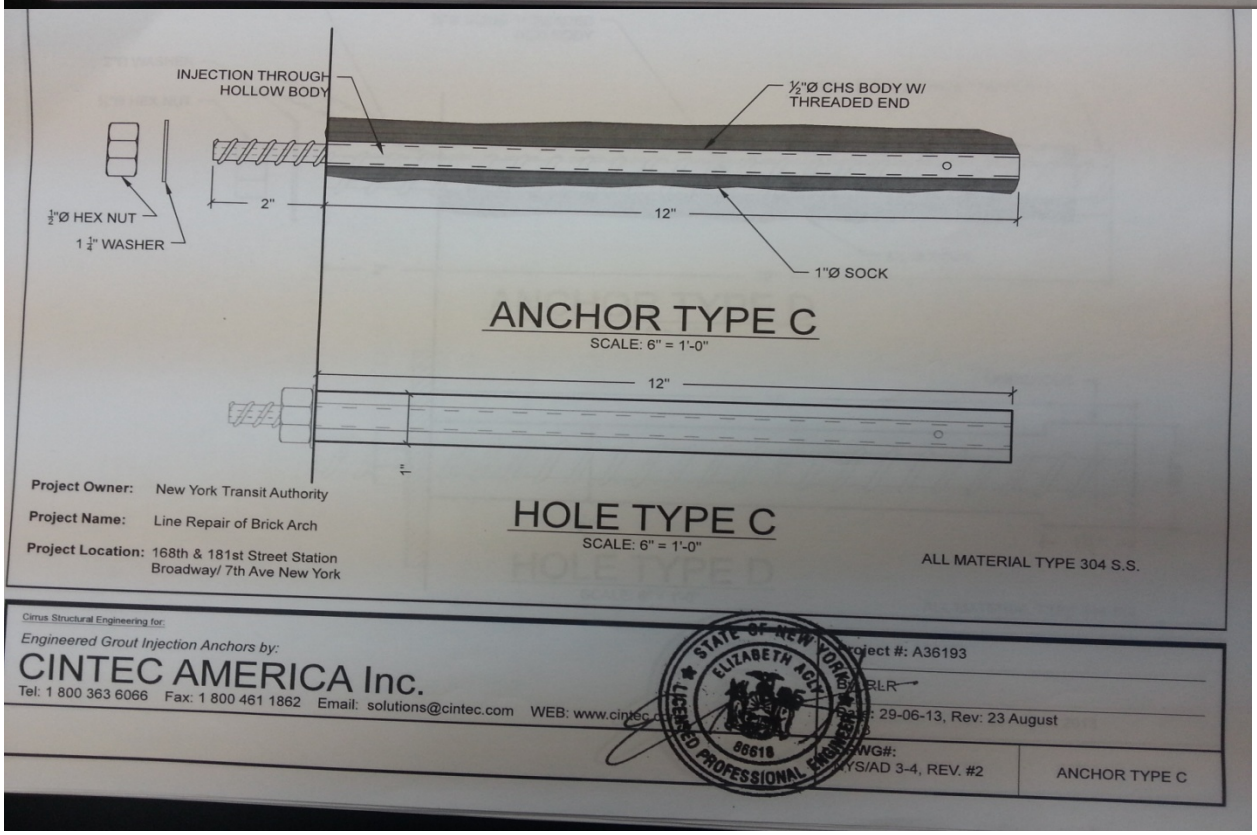
To validate the design, Cintec hired Elizabeth Acly. PE at Cirrus Structural Engineering, Hartford, CT to validate the all anchor types based on the following:

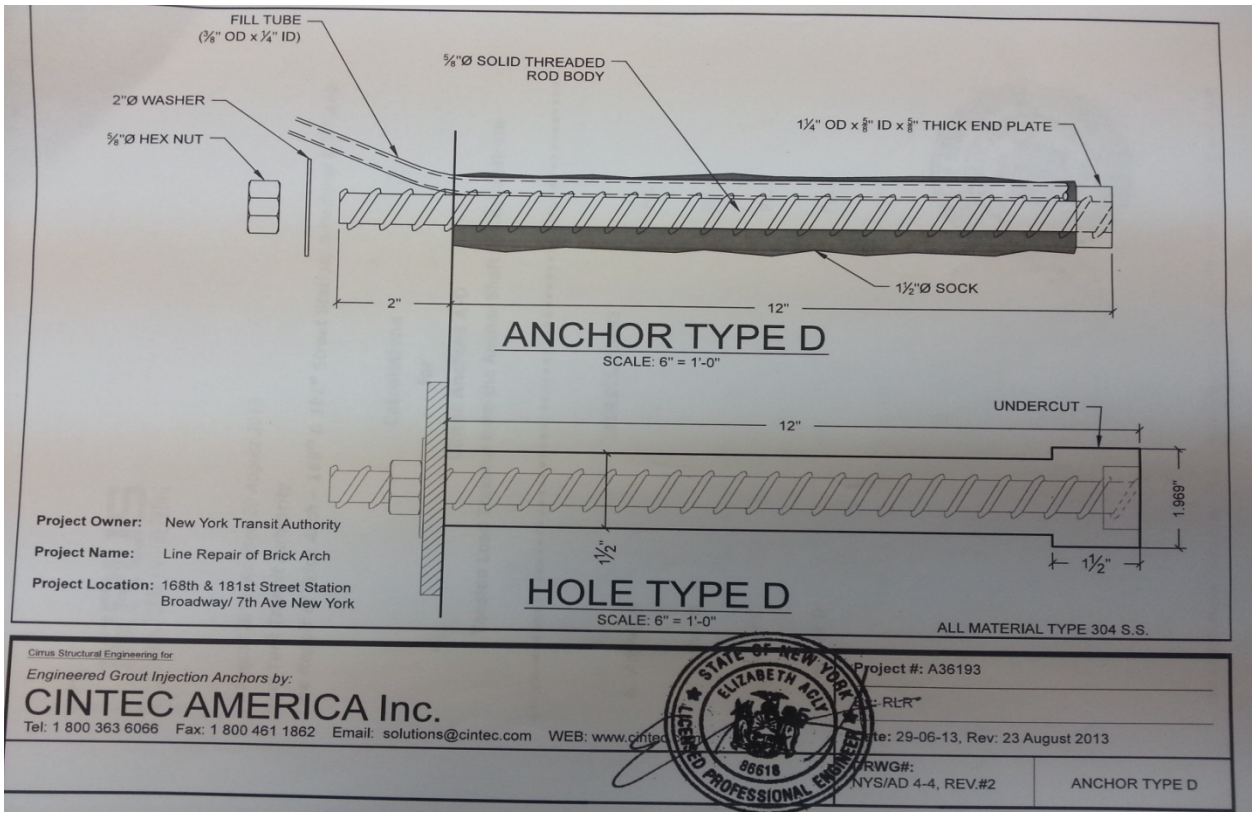
- Embed depth
- Tension load transfer from the anchor shaft to the substrate,
- Bond pull-out analysis
- Transfer of load from end plate to grout
- Transfer of load from grout bulb to substrate
- Contribution of Undercut
- Cone break-out analysis
- Steel yielding analysis
- Transfer of shear load to substrate via bearing

Copyrighted anchor drawings based on calculations:

- 


FILL TUBE
(⅜" OD x ¼" ID)
¾" Ø WASHER
1¼"Ø SOLID THREADED ROD BODY
2¼" OD x 1¾" ID x ⅞" THICK END PLATE
6"
28"
1¼"Ø HEX NUT
2½"Ø SOCK
ANCHOR TYPE B
SCALE: 3" = 1'-0"
UNDERCUT
28"
2.974"
2½"
2"
HOLE TYPE B
SCALE: 3" = 1'-0"
Project Owner: New York Transit Authority
Project Name: Line Repair of Brick Arch
Project Location: 168th & 181st Street Station
Broadway/ 7th Ave New York
THREADED ROD DURAMET 32 S.S.
ALL OTHER MATERIAL TYPE 304 S.S.
Cirrus Structural Engineering for:
Engineered Grout Injection Anchors by:
CINTEC AMERICA Inc.
Tel: 1 800 363 6066 Fax: 1 800 461 1862 Email: solutions@cintec.com WEB: www.
STATE OF NEW YORK ELIZABETH ACLY 86618 LICENSED PROFESSIONAL ENGINEER
Project #: A36193
By: RLR
Date: 29-06-13, Rev:23 August 2013
DRWG#: NYS/AD 2-4, REV. #2
ANCHOR TYPE B


INJECTION THROUGH HOLLOW BODY
½"Ø CHS BODY W/ THREADED END
½"Ø HEX NUT
1 ¼" WASHER
2"
12"
1"Ø SOCK
ANCHOR TYPE C
SCALE: 6" = 1'-0"
12"
1"
Project Owner: New York Transit Authority
Project Name: Line Repair of Brick Arch
Project Location: 168th & 181st Street Station
Broadway/ 7th Ave New York
HOLE TYPE C
SCALE: 6" = 1'-0"
ALL MATERIAL TYPE 304 S.S.
Cirrus Structural Engineering for:
Engineered Grout Injection Anchors by:
CINTEC AMERICA Inc.
Tel: 1 800 363 6066 Fax: 1 800 461 1862 Email: solutions@cintec.com WEB: www.cintec.
STATE OF NEW YORK ELIZABETH ACLY 86618 LICENSED PROFESSIONAL ENGINEER
Project #: A36193
By: RLR
Date: 29-06-13, Rev: 23 August
DRWG#: NYS/AD 3-4, REV. #2
ANCHOR TYPE C

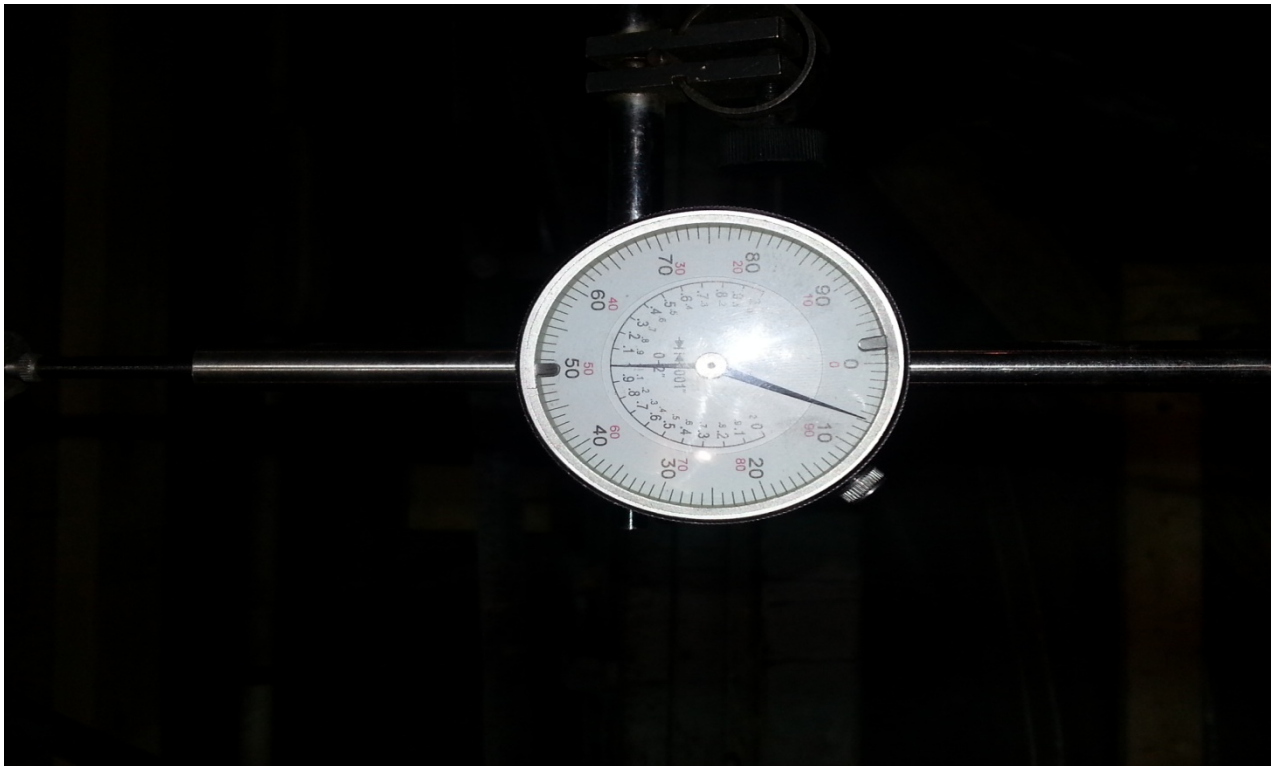


To validate the required proof load tension and shear values, NYC Transit under contract A36193 hired Future Testing Corporation to conduct on site field testing at both subway stations. All specifications for testing were designed by Weidlinger Associates, Inc. A total of 22 anchors at 168th and 22 anchors at 181st subway stops. Photo below is the A anchor being tension tested.

Type A Anchors test results

- 5/8” threaded rod, 12” embed, installed in 1.5” hole and 1.5” sock
- Proof load 4800 tension max displacement .125 inches
- Grouping of 4 = 19,200 combined tension load
- Subway station 181 Anchor A1, A2, A3, A4
- Tested to 19,200
- Result 19,200 Passed in Tension max movement .018

Dial Gauge actual reading after 10 minutes at rest. .018, max movement per scope was .220.



Type A Overhead Anchor

Type A Anchors

- **Overhead application**
- 5/8” threaded rod, 12” embed, installed in 1.5” hole and 1.5” sock
- Proof load 5,600 tension max displacement .125 inches
- Subway station 181 Anchor D1
- Tested to 5,600
- Result 5,600 Passed in Tension max movement .019

Dial Gauge actual reading after 10 minutes at rest. .019

Type B Anchors side wall brick retention:

Type B Anchors

- 1 ¼”” threaded rod, 22” embed, installed in 2.5” hole and 2.5” sock
- Proof load 6,400 shear max displacement .125 inches
- Subway station 181 Anchor B2
- Tested to 6,400
- Result 6,400 Passed in Shear max movement .018

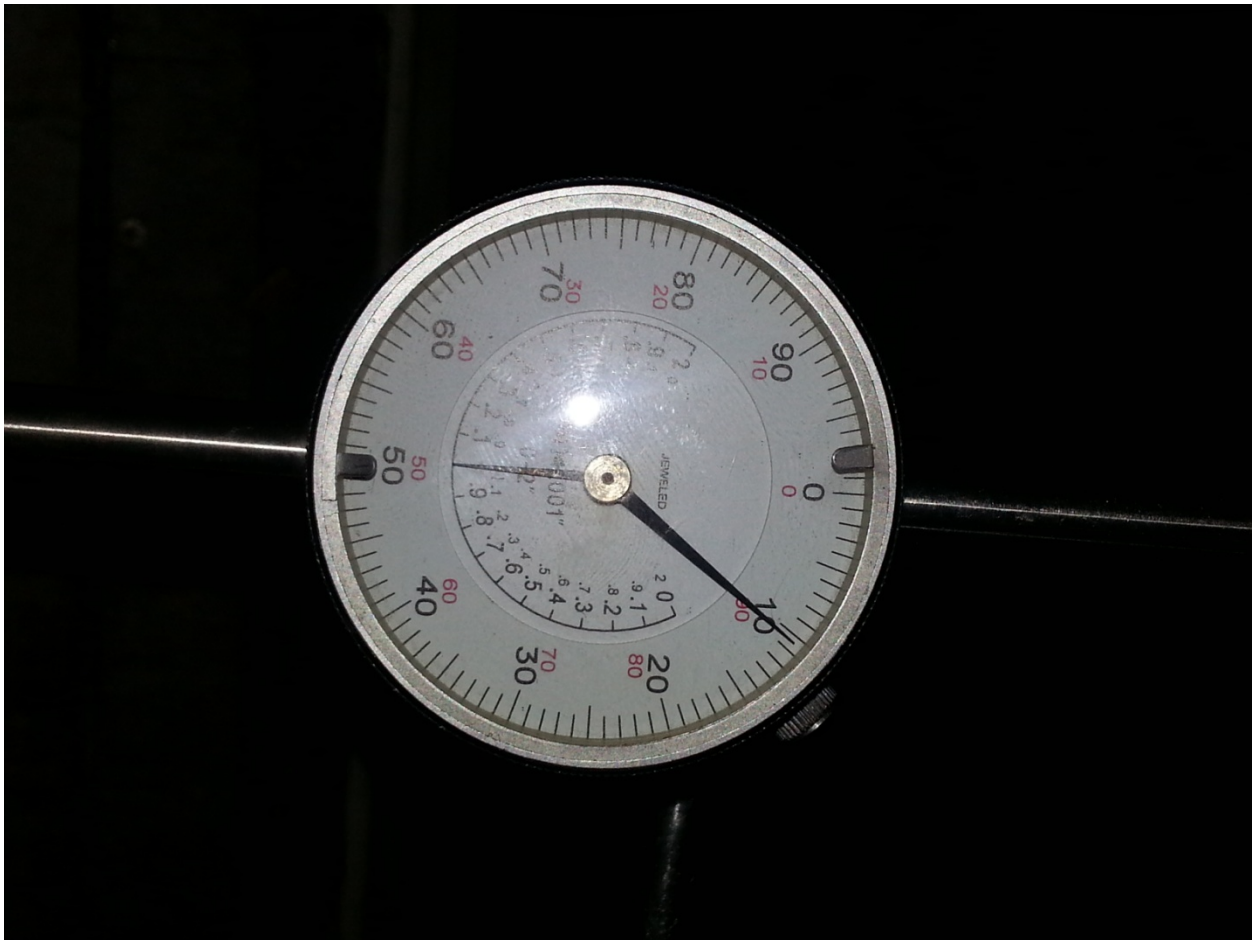
Dial Gauge actual reading after 10 minutes at rest. .049

To attach the finished GFRP panels they were delivered by a work train during the evening. The working platform that was erected over the track had an access panel in the floor which allowed the finished panel to be hoisted up to the work area. The picture below is an example of the stored finished panel prior to being attached to the wall.

Type C Anchors

- 3/8” circular hollow section, 12” embed, installed in 1.0” hole and 1.0” sock
- Proof load 1200 tension max displacement .125 inches
- Subway station 181 Anchor C3
- Tested to 1,200
- Result 1,200 Passed in Tension max movement .009

Dial Gauge actual reading after 10 minutes at rest. .009



The panel were lifted to the ceiling on a custom designed lifting rig which allowed the finished panel to be aligned with the guide panel installed in the ceiling and side wall. This pictures show the ceiling guide panels.

The yellow and gray lift in foreground is used to lift the panels in place.

The panels are attached to the center guide panel and to a safety anchor which can be seen in the far right of the picture with a cable strap. The opening in the picture is for original terra cotta medallion reinstallation location.

Type C Anchor Test Rig

The finished panels over 168th.