Rev 6 October 2022

CINTEC
NORTH AMERICA

CINTEC

Designed Anchor Systems

Introduction to the Cintec Anchoring & Reinforcement System
Non Destructive Test Procedure.
Client Reports from International Testing Establishments
with relevent standards.

TEST DATA
FOR CINTEC ANCHORS

BUILDING RESEARCH ESTABLISHMENT U.K. ACCELERATED 40 YEAR LIFE CYCLE-FIRE-TESTING -- FREEZE THAW TESTING
ARCON, TORONTO CANADA-UNIVERSITY OF NEWCASTLE AUSTRALIA WALL TIES. ISIS CANADA (university of Manitoba) [BEHAVIOUR OF CINTEC ANCHORS subjected to ULTIMATE LOAD TEST AND FREEZE THAW FOR THE CANADIAN PARLIAMENT] On behlf of the Canadian Government.. NYC. MTA. Subway ARCH REPAIRS [W168th street & W181st street] ANCHOR TESTING
Empire State Building, New York. Union Court House NewJersey. Testwell Labtatories & Simpson Gumbertz& Heger (SGH). Mission San Jaun Capistrano, (Sanctuary walls). The Roselund Engineering Company & Twining Laboratories, CA. New York Schools Construction Authority PS230K & PS238K Versitile Consulting & Testing, New York. Nuclear Power Station Wylfa testing of wall anchors, Celtest Ltd, Wales, UK

SECURING THE PAST FOR THE FUTURE

CINTEC'S ANCHORING SYSTEM

WE DESIGN AND MANUFACTURE THE WORLD'S MOST INNOVATIVE STRUCTURAL ANCHOR SYSTEM

As the designer and manufacturer of the pre-eminent anchoring systems for masonry structures, anchoring systems for masonry structures, Cintec® has cemented its reputation internationally

For over a quarter of a century, Cintec™ has secured historic and historical buildings, masonry bridges, monuments, railway structures, retaining walls and harbour walls using Cintec's anchor systems.

The patented Cintec® reinforcement system and anchor system is straightforward: injecting a proprietary,Presstec® ,cementitious fluid grout into an anchor surrounded by a fabric sock, which has already been placed in an oversized drilled hole. The anchor system's ingenuity lies in its versatility. Drawing on decades of experience and testing, our designers can customize it to any specification.

Our engineered solution reinforces/anchors an array of materials—stone, concrete, clay, terra cotta, adobe, and even timber. It can be used under water and in weak substrates. Even as it restores, stabilizes, strengthens, and repairs, the system does not compromise the parent material. And because the reinforcement system and anchor system becomes part of the structure, it does not visibly alter a structure's appearance. From intricate wall ties to solid bar anchors over 30 metres (100 feet) long, Cintec® will develop the reinforcement system and anchor system solution that will fit your project.

The Cintec® anchor system offers a remarkably versatile, proven approach to internally strengthen masonry buildings and structures.

The system works by pre-drilling an oversized hole in the structure and inserting an anchor body surrounded by a fabric sock. Presstec® ,a cementitious grout is injected through the middle of the anchor under low pressure. It passes through a series of grout flood holes into the fabric sock, inflating the entire assembly like a balloon.

THE ANCHOR

The fire-resistant structural anchor is designed specifically for the loads and configuration of each application. Cintec®designs generally use anchors that are non-corrosive metal, typically stainless steel in various grades. **Exceeds ASTM E119**

THE GROUT **Tested to ASTM C 1019-18. Freeze thaw Tested ASTM C492**

Cintec™'s Presstec® grout is a proprietary pure mineral grout tested in accordance with the strict German DIN standards and does not contain any resin binders. The grout is specially formulated to have a very high viscosity prior to setting. Its non-absorptive properties provide durability and freeze-thaw resistance.

THE SOCK

The sock is a specially woven polyester-based fabric sleeve with expansion properties to suit the diameter of the bore hole and particular substrate. It retains the grout in such a way that the cured grout bulb conforms to the cavities in the substrate, providing a strong mechanical lock to the connected elements. The grout milk that seeps through the sock also forms a cementitious bond with the parent material.

PERPENDICULAR OR IN-PLANE STRENGTHENING

Internal strengthening can be perpendicular to or in the plane of the face of the masonry units, components or systems. Perpendicular strengthening involves tying together the deteriorated masonry or tying the wythes of composite or cavity systems. In-plane internal reinforcement can be in any direction in the plane of the wall. In-plane reinforcement can increase in-plane compressive, shear and tensile strength and out-of-plane shear and bending strength.

STRENGTHENING OF THE INTERCONNECTION OF DIFFERENT STRUCTURAL MATERIALS

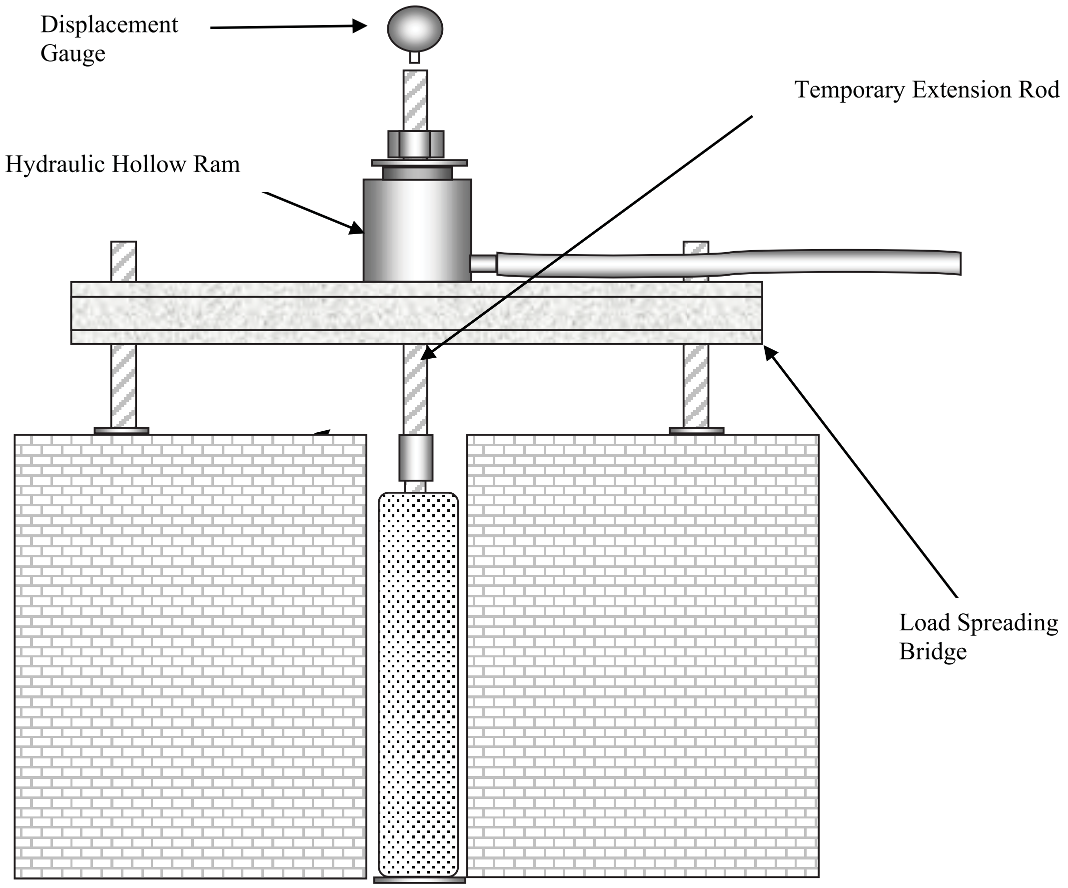
Cintec® anchor systems can be very effective and often are the only means available to Tye the vertical and horizontal elements of a building.
Typical examples would be the tying of poured gypsum, cast-in-place concrete or hollow core precast roof and floor diaphragms to masonry walls. This method of tying is especially effective in reducing earthquake risks in unenforced masonry structures

POST-TENSIONED STRENGTHENING

Internal and interconnection anchoring can be post-tensioned. Post-tensioning is advantageous as a strengthening method as it induces compressive stresses in the masonry. This reduces the risk of tensile stresses developing in the structure, which results in cracking.

CINTEC NORTH AMERICA

Non Destructive Test Procedure



Install Cintec anchor and allow to cure for seven days, attach test rig as shown above and apply a 20kn load to settle the rig.

Zero the displacement gauge.

Apply the loads in 20kn increments, leave the applied load for 2 minutes and log the movement and load at the beginning of the 2 minutes and at the end of the 2 minutes.

Log all readings on the Cintec test data sheet.

Continue applying the load until the required load is achieved or the displacement gauge shows significant creep in the anchor, this will be noticed with a drop in the hydraulic pressure gauge reading and an increase in the displacement reading.

All measurements can then be logged and a load curve obtained

Client Reports from International Testing Establishments

- BUILDING RESEARCH ESTABLISHMENT (UK) STRUCTURAL INTEGRATY DIVISION.

  Moisture / Temperature Cycling Test on Cintec wall ties.
  "40 year Accelerated Life Cycle Testing"

  2 Hour Fire Testing. **EXCEEDS ASTM E119**

- CELTEST LTD BANGOR, GWYNEDD NORTH WALES, UK.
  British Nuclear Fuels, Magnox Generation Wylfa Power Station, UK.
  Testing of Cintec wall anchors (to resist a Systemic Event).
  1351881: part 116:1983

- ARCON TEST, INCORPORATED, CANADA.
  Freeze thaw testing unidirectional freeze thaw performance of Cintec Masonry Anchors (BS EN 772 part 2 **ASTM C942)**

- UNIVERSITY OF NEW CASTLE RESEARCH ASSOCIATION AUSTRALIA.
  Wall tie test to Dr 97300-97302 (revision of AS 2699-1984) – Appendix A and amendment No 1 to
  AS 3700-1998

- ISIS CANADA On behalf of the Canadian Government
  Environmental Investigation on the behavior of Cintec Anchors subjected to ultimate load test. (Ottawa Canadian Parliament West Block Rehabilitation Project) **ASTM E1512 ASTM C666/C661M**

- FUTURE TEC CONSULTANTS OF NEW YORK INC, USA.
  Anchor testing program MTA Arch repairs at W168 Street - W181 Street Stations New York Subway. New York, USA
  ASTM E488-9696

- VERSATILE CONSULTING & TESTING SERVICES INC, DOUGLASTON, NY
  Anchor testing for parapet walls.
  New York Schools Construction authority. PS 230K Brooklyn, NY & PS 238K Brooklyn, NY.
  ASTM E1512. NYC.DDC as per item 04525 – Terra Cotta restoration & repair anchors Paragraph 2.2

- TESTWELL LABORATORIES OSSINING, NY and SIMPSON GUMPERTZ and HEGER. Shear load test for masonry and Terra Cotta. Union County Court House Elizabeth New Jersey, USA.

- TWINING LABORATORIES OF SOUTHERN CALIFORNIA, USA.
  Mission San Juan Capistrano C.A.
  Tension tests on Cintec wall anchors.
  “stabilization of stone wall” **ASTM E1512**

Cintec Testing is carried out to the following International standards.

BS EN 846-2	2000	Methods of testing for ancillary components for masonry – Part 2 Determination of bond strength of prefabricated bed joint reinforcement in mortar joints.
BS EN 772-1	2011	Methods of test for masonry units Part 1 : Determination of compressive strength.
BS EN 1015	1999	Methods of test for mortar for masonry. Determination of flexural and compressive strength.
ASTM E1512	1993	Standard test methods for strength of anchors in concrete and masonry elements. These test methods cover procedures for determining the static, seismic, fatigue and chock, tensile and shear strengths of post-installed and cast-in-place anchorage systems in structural members.
ASTM C666/ C666M-03	2008	Standard test method for resistance of concrete to rapid freezing.
ASTM E1512-01	2007	Standard test methods for testing bond performance of bonded anchors.
BS 5080-1	1993	Structural fixings in concrete and masonry- Part 1: method of test for tensile loading.
BS 5080-2	1993	Part 2: method for determination of resistance to loading in shear.

DIN EN 772-22	2019	Methods of test for masonry units – Part 22: Determination of freeze/thaw resistance of clay masonry units; German version EN 772-22-2018
ASTM C942	2008	Standard test method for compressive strength grouts.
ASTM C42 / C1019		Standard test method for sampling and testing grout.

STANDARDS OF PRESSTEC GROUT .

Standard	Date	Title and definition
		COMPONENTS, DEFINITIONS, SPECIFICATIONS AND CONFORMITY CRITERIA
DIN EN 197-1	2011	Cement Composition, Requirements and conformity of standard Cement
DTN 1164-10	2013	Cement with special properties
DIN EN 196	2011	Cement, Testing methods
DIN EN 459-1	2010	Building lime
DIN 51043	1979	Trass, Pozzolanic material, Requirements, testing
DIN EN 934-2	2012	Additives for concrete, mortar and injection grouts
DIN EN 13139	2002	Mineral aggregates, fractions for mortar
DIN EN 932	2002	Determination of general properties of mineral aggregates
		TESTING OF MORTARS CONTAINING MINERAL BINDERS
DIN 18555-3	1982	Determination of strengths
-6	1987	Determination of adhesive tensile strength
DIN EN 1015-1	2007	Determination of stone fractions
-2	2007	Sampling and Preparation of mortars for testing
-3	2007	Determination of consistence of fresh mortar
-6	2007	Determination of bulk density of fresh mortar
-7	1998	Determination of air content of fresh mortar
-9	2007	Determination of workability time
-10	2007	Determination of bulk density of dry mass
-11	2007	Determination of compressive strength and flexural strength
-12	2000	Determination of bond shear strength

DIN EN 1052-3	2002	Determination of shear strength
DIN 4272-5	1994	Determination of swell behavior
		QUALITY CONTROL
DIN 18200	2000	Inspection, Internal control, Third party inspection
DIN 18557	1982	Factory mortar, production, control and delivery

07.10.2019

GROUT STANDARDS

LISTED CRITERIA

STANDARDS

You will find two cited kinds of Standard: -

DIN, i.e. German National Standard DIN EN, European Standard with German Provenience

EXPLANATION

The Numbers of Standards and dates depend from their first emission, respectively are from their update caused for the extended use in the European area.

Examples:

The main listed Standard for testing DIN EN 1015 of 2007 is based on the former DIN 18 555 of 1982.
The aggregates for mineral grouts DIN EN 13139 have better definitions as the former DIN 1045 for concrete.

The mentioned Standards on the list of today are reported in 3 groups: Components, Testing and Quality control.

COMPONENTS

The cited components refer to CINTEC'S **PRESSTEC®** grout

TESTING OF MORTARS AND QUALITY CONTROL

The mentioned testing standards are destined for mortars for masonry. CINTEC grout as mineral injection grout can only be defined and tested by the use of these Standards for mortars.

BRE Technical Consultancy

Structural Integrity Division

CLIENT REPORT:

Moisture/Temperature cycling tests on the Cintec remedial wall tie

For: Cintec Ltd.,

Factory Road, Newport, S. Wales Np20 5FA

[Now known as Cintec International Ltd]

By S K Arora

November 1990

Enquiry Number 02831

Building Research Establishment
Garston, Watfoed, Herts. WD2 7JR
Telephone: 0923 894040
Fax: 0923 664096

INTRODUCTION

This report gives results of pull-out tests on Cintec Harke [Cintec] remedial tie embedded in a clay brick, having been subjected to accelerated moisture/temperature cycling over a period of three months. The object of the exercise was to test the long-term performance of the tie anchors under conditions of wetting by rain of the external walls of a structure into which they would be incorporated followed by drying.

THE ANCHOR SYSTEM

The literature supplied by the manufacturers of the system, Messrs CavityLock Systems Ltd. Now known as Cintec International Ltd of Newport, Gwent, describes Cintec-Harke [Cintec] replacement wall tie as a cementitious anchor. The standard design is a long stainless steel hollow tube of 8mm O.D.[1] x 1mm thickness provided with a mesh polyester fabric sleeve or a 'sock' of required diameter at each end. A specifically designed cementitious grout is injection into the socks through the tie under pressure in pre-drilled position(s) in the cavity wall requiring replacement tie(s). The pressure is maintained until the inflated socks are hard and the grout milk with bonding agents are driven out to give good bond between the inflated sock and the background material. The grout is a presstec or S.T.M.A. grout[1].

EXPERIMENTAL DETAILS

The anchor used in the pull-out tests was a special design of 165-175mm long 8mm O.D. x 1mm stainless steel hollow tube, with an 85mm long sock provided at one end only which would inflate to a diameter of approximately 22mm. The background material chosen for the test specimens was a flat faced solid wire-cut facing clay brick of 212mm x 100mm x 65mm size. The anchor sock was embedded through one of the 212mm x 65mm faces to its full depth, with the steel tube coming out through the other face. Three spare specimens were also prepared with the anchor sock embedded to a lesser depth of around 60mm, with the remaining part providing a bulge of anchor material into a reamed-out hole of 40mm diameter. This was done to test a situation where a positive re-entrant tension fixing is to be provided in a wall, in case the grout to brick bond fails.

The specimens made with the said brick supplied by BRE were prepared by the manufacturers at their own premises and delivered to BRE three days later.

The test programme assumed that a masonry wall in reality would be exposed to rain such as to saturate it fully with water at least once a year. Trials were made to ensure wetting of the brick in a water tank to saturation followed by drying in an electric oven heated to 40° C (±2°C) temperature, to a constant weight. A half hour soak in a water tank followed by a minimum of two days of drying was found sufficient to meet the requirements.

The BRE contract stipulated 20 pull-out tests on brick/anchor specimens, five each to be tested at: seven days cure after construction of the specimens, then after 10, 20, and 40 cycles of wetting/drying of the specimens. A further three specimens of 60 mm embedment length referred above.

were also tested after 40 wetting/drying cycles

The pull-out testing was carried out on a standard Universal Testing machine with a maximum load capacity of 20 Tonnes, calibrated to BS 1610: 1985 Grade 2. The test brick was placed in a small restraining rid made out of a rectangular hollow steel section designed to hold the brick firmly along its 'anchored' face. A side load of about 3.5 N/mm² pressure was applied on the bed faces to simulate condition of confinement of the brick in a real wall. Vertical restraint was provided by small vedge strips keeping the top surface of the brick tightly parallel against the upper part of the frame.

TEST RESULTS

Clay Brick

For the clay brick used, trial tests indicated a water absorption after a ½ hour soak of 15.0% which approximates the full saturation value after a 24-hour soak of 17.5% for the same brick. Its compressive strength was indicated to be 43.3 N/mm².

Brick/Anchor specimens

The pull-out values obtained in the 20 standard and three extra tests carried out are tabulated below.

Tie Pull-out Values in KN

Specimen No.	After 7 Days cure	Number of wetting/Drying Cycles.		
		10	20	40
1	10.45	7.56	10.45	9.10 (9.79)
2	12.23	10.23	10.23	11.00 (6.23)
3	10.68	8.45	10.23	10.00 (8.01)
4	10.45	10.68	10.90	12.90
5	10.90	10.68	8.45	9.79
Mean	10.94	9.52	10.10	10.56 (8.01)
C.O.V. %	7.00	15.00	9.00	14.00 (22.00)

Note: - The bracketed values are for the three extra tests involving anchors of the limited embedment length of 60 mm.

A one-way analysis of variance of the tabulated values for the 20 standard tests has shown that the wetting/drying treatment given did not affect the pull-out performance of the tie in the background material tested in any significant way. Mean pull-out value for these specimens was 10.28 KN. Regression analysis of the data (for a linear as well as polynomial fits) further confirmed a lack of a significant correlation between the pull-out performance and the wetting/drying treatment given.

The failure of the system tested was typically by a pull-out of the steel tube from the anchor grout (Figure 1), sometimes accompanied by splitting of the brick in the plane of the anchor.

As to the three extra specimens, the mean pull-out value of 8.01 KN, when compared with the corresponding value given for the standard specimens, suggests that the apparent deterioration in performance was only due to the reduced length of embedment of the anchor. The failure here was typically by a rupture of the anchor grout at the interface between the embedded part to the bulging part, accompanied by a pull-out of the steel tube again (Figure 2).

Conclusions

1. The experiments show that the pull-out performance of the test anchor/clay brick combination tested would not be affected adversely in any significant way in the conditions of exposure to rain simulated in the manner described.

2. The failure of the standard specimens was typically by pull-out of the steel tube from the anchor grout.

3. The pull-out performance of the anchor/brick system tested appears to be directly proportional to the length of embedment of the anchored sock.

REFERENCE

Private communication, Mr. Owen / Mr. Peter James, Messrs Cavity Lock Systems. [Cintec international Ltd] Factory Road, Newport, Gwent, Wales

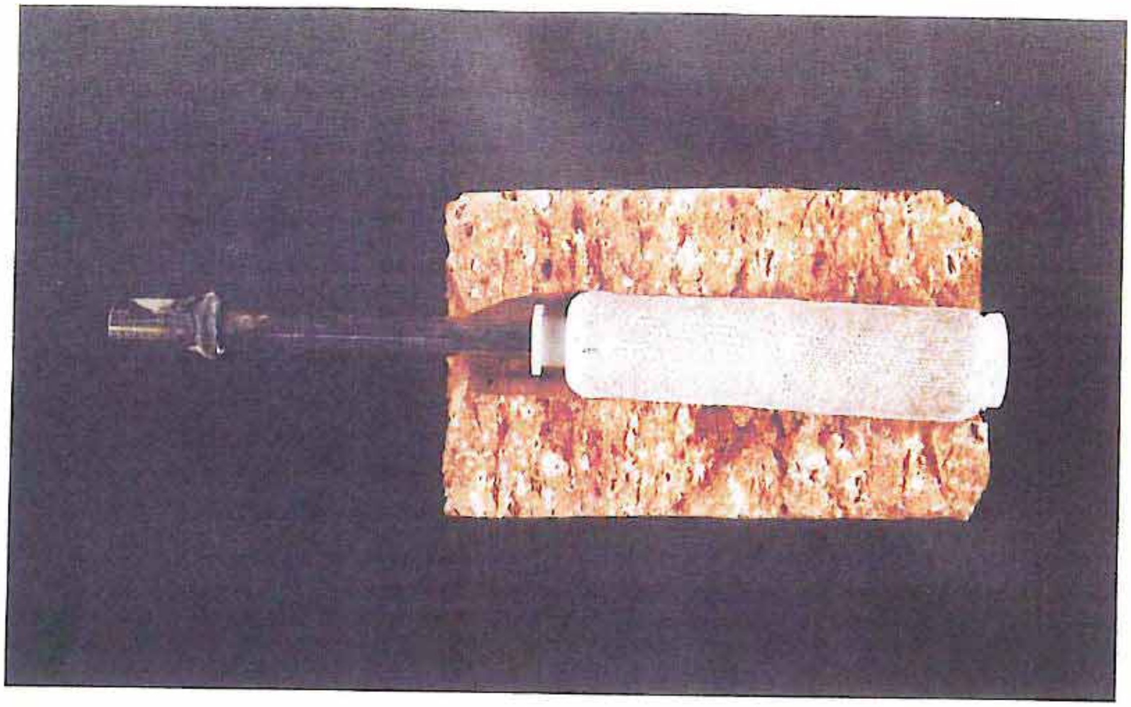


FIGURE 1 TYPICAL FAILURE MODE FOR THE STANDARD SPECIMEN

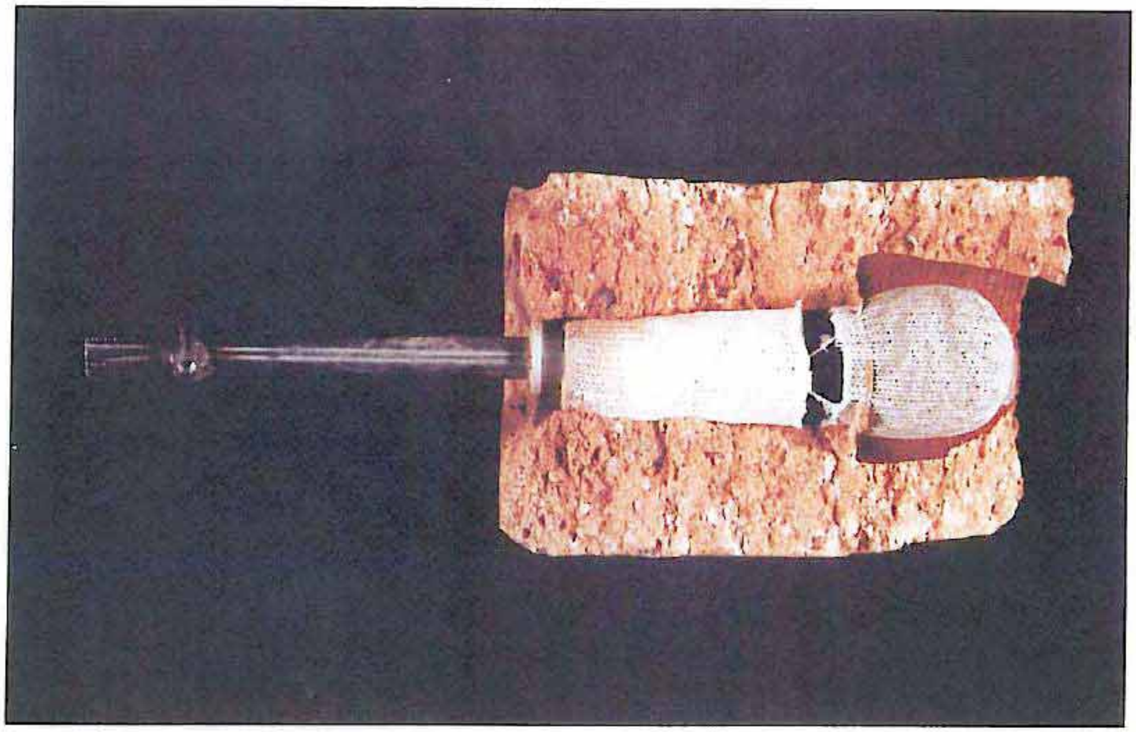
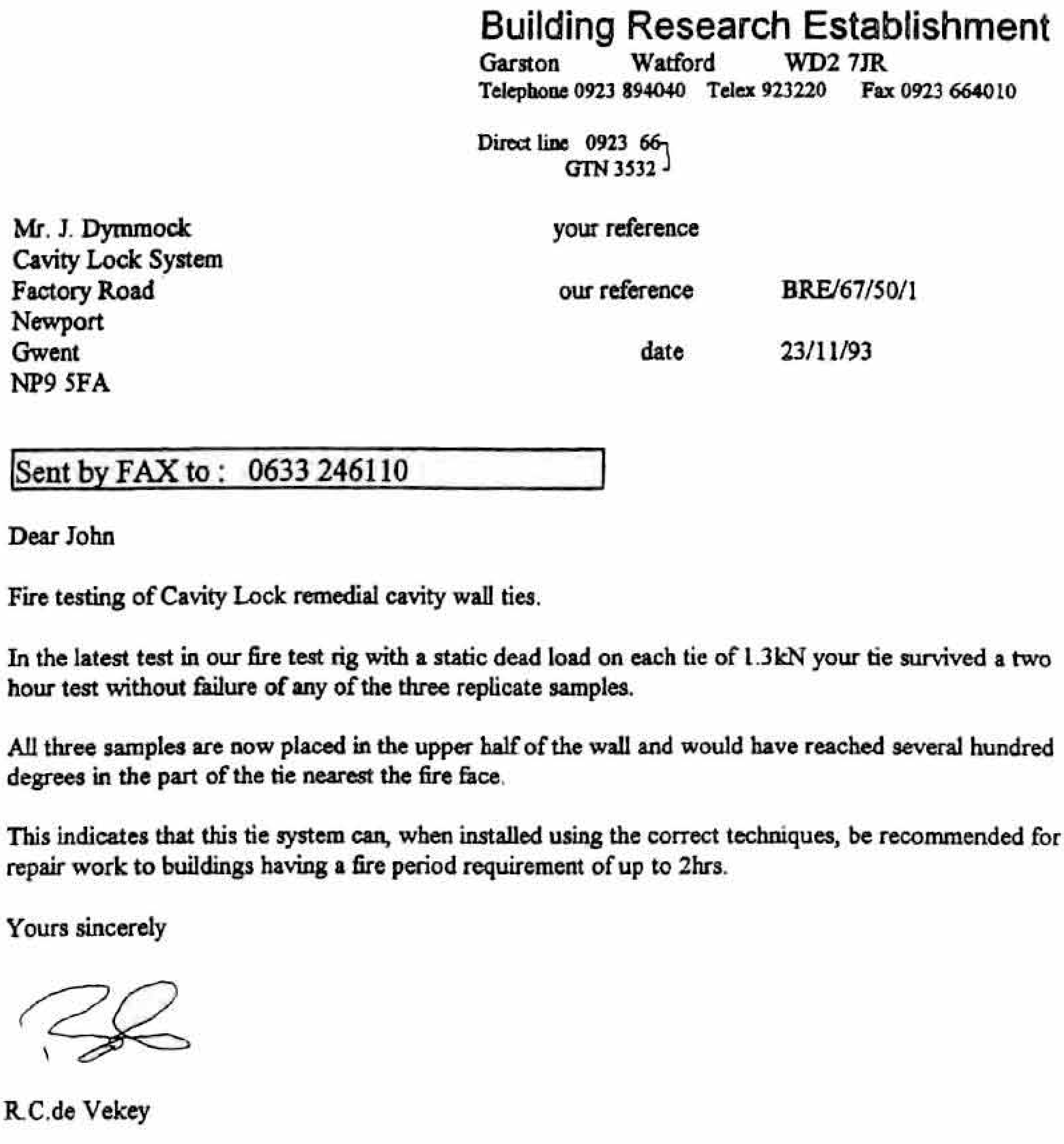


FIGURE 2 TYPICAL FAILURE MODE FOR THE EXTRA SPECIMEN



Building Research Establishment
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Direct line 0923 66
GTN 3532

Mr. J. Dymmock
Cavity Lock System
Factory Road
Newport
Gwent
NP9 5FA

your reference

our reference BRE/67/50/1

date 23/11/93

Sent by FAX to : 0633 246110

Dear John

Fire testing of Cavity Lock remedial cavity wall ties.

In the latest test in our fire test rig with a static dead load on each tie of 1.3kN your tie survived a two hour test without failure of any of the three replicate samples.

All three samples are now placed in the upper half of the wall and would have reached several hundred degrees in the part of the tie nearest the fire face.

This indicates that this tie system can, when installed using the correct techniques, be recommended for repair work to buildings having a fire period requirement of up to 2hrs.

Yours sincerely

R.C.de Vekey

Head of Masonry Structures Section, Structural Design Division, Geotachnics and Structures Group

CAVITY LOCK SYSTEMS IS NOW KNOWN AS CINTEC INTERNATIONAL LTD

Building Research Establishment PD 357/93

A FIRE TEST FOR WALL TIES

D Chehal and Dr. R C deVekey

SUMMARY

A diverse range of connectors, termed wall ties, restraint ties or cavity connectors, are used in industry to link cladding masonry to either inner leaves of load bearing masonry or to frames of timber, concrete or steel. Their function is to support the cladding and transfer loads arising from wind, impacts, seismic events etc. to the main structure of the building. Many of these connectors have fixing mechanisms or structural components that are made from heat sensitive materials such as resins, plastics and low-melting alloys. Other products use mechanical devices that might be affected by thermal expansion of the components. However, until now, no widely publicised tests have been carried out on the performance of masonry cavity connectors exposed to fire conditions. Under the terms of the EC Construction Products Directive, CEN standards are being drafted for the specification of cavity connectors and resistance to fire is one of the essential requirements for which performance tests are required. Eventually fire performance data will be necessary in order to design in accordance with the forthcoming CEN Code of Practice. The successful application of performance evaluated products will reduce the risks to the public attempting to escape from burning buildings, and to the fire fighting services dealing with the fires. Therefore, BRE has initiated such tests to assess the behaviour of cavity connectors under the effects of fire. In the future it is hoped that the test methodology described in this paper can be extended to other products such as general fixings, support angles, and hangers and straps.

To be presented at the Autumn 1993 meeting of the British Masonry Society, at British Ceramic Research Ltd. Stoke on Trent, 9th - 10th November 1993

Date Oct 1993
Project No. GD0457
WIF Ref. CDS03/07
File No. BRE 74/1/6

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Report on the Uni-directional Freeze-thaw Performance of Cintec Masonry Anchors

Prepaired for CINTEC NORTH AMERICA

Test BRE EN 772 ASTM C942

Introduction

ArconTEST Incorporated was retained by Cintec International Limited to assess the unidirectional freeze-thaw resistance of Cintec grouted masonry anchors. Examples of the proprietary anchor and grout system were installed within a purpose-built brickwork wallette using standard procedures, which after a curing period of 30 days was subjected to a standard 100 cycle unidirectional freeze-thaw testing procedure.

Samples of the proprietory Presstec grout were cast in four-inch and two-inch square standard molds to allow compressive strength testing of the two-inch cubes, and freeze-thaw testing of the four-inch cubes within the test chamber alongside the test wallette.

Uni-directional Freeze-thaw Test

Background

Materials being used in outdoor conditions are subject to extreme variations in weather conditions. A typical Ottawa winter season characteristically goes through 100 freeze-thaw cycles. Although many products are fully frost-resistant after curing, it is often beneficial to determine at what point in time adequate frost resistance occurs. Premature exposure to frost cycling in many cases leads to material failure and costly replacement.

The purpose of freeze-thaw testing is to provide a standard relative determination of the resistance of building materials to harsh climatic fluctuations such as are found in Canada.

The uni-directional freeze-thaw testing chamber was constructed to conform to European Standard EN 772 - Part 22 (Methods of Test for Masonry Units - Part 22: Determination of freeze-thaw resistance of Clay Masonry Units). Its primary purpose is to test the durability of clay masonry units, either with mortar joints or without (using suitable spacers or sealant). This standard is a combination of the German and British test standards that have been used for several years, and now supersedes the previously-used Dutch standard. This methodology has been found to more closely match the field conditions experienced on buildings than can be achieved by using the omni-directional ASTM C-666-92 rapid freeze-thaw testing methodology.

While this standard test is not specifically designed to test mortar (or grout) durability, it is being used by mortar and grout research groups as a relative performance indicator of masonry assemblies containing mortar, grout and unit masonry.

Materials to be tested are fitted into a thermally-insulated stainless steel frame which is mounted into the front of the testing chamber so that one face of the test panel is exposed to freeze-thaw cycling. The number of cycles and test parameters may be custom programmed to suit the purpose of the test and the characteristics of the material(s) being tested.

Apparatus

Since January 1999 ArconTEST's laboratory has been equipped with a fully-automated uni-directional environmental chamber for testing the freeze-thaw resistance of material assemblies up to 580 x 630mm in face area and up to 280mm in thickness. This unidirectional freeze-thaw testing apparatus was developed as a part of our research to aid in determining the durability and frost resistance of mortars.

The uni-directional freeze-thaw apparatus is capable of generating a cold stream of air within the chamber to lower the temperature of the face of the specimen to -15°C. This temperature is reached within one hour of the beginning of the test. The initial freeze cycle is six hours in duration to fully freeze the specimen. Thawing at the end of each cycle is achieved by blowing a stream of warm air against the face of the test panel for twenty minutes, followed by spraying a two minute flood-coat of 25°C water which re-saturates the face of the specimen and starts the next cycle. After the initial cycle each subsequent freeze period is 120 minutes in duration.

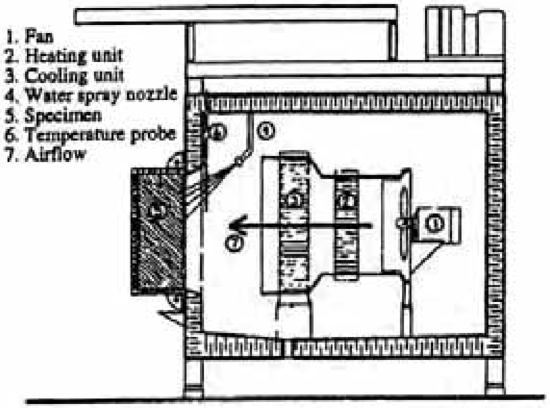


Figure 1 Schematic of Test Apparatus

Methodology

Freeze-thaw Wallette

The two-brick thick wallette, which was constructed before anchor installation, was built within an insulated stainless steel frame using a relatively high initial strength cement-gauged bedding mortar known to be durable under freeze-thaw testing. The bedding mortar was formulated using 1-part white Portland cement, 1-part dolomitic lime putty and 6-parts of concrete sand. The back of the wallette was encased in 50mm thick rigid insulation. The perimeter of the wallette was insulated from the frame with 25mm rigid insulation. The gap between the wallette and frame was sealed with a strip of adhesive membrane to prevent water entry during testing. The wallette was damp-cured for seven days then allowed to dry at room temperature for 21-days before drilling and installation of anchors.

Nine test anchors were installed in the fully-cured masonry in accordance with standard Cintec installation methodology. Three anchors were installed within holes drilled through the mid-section of the face and six holes drilled through the sides of the wallette. All anchors consisted of a stainless steel rod and expandible fabric socklet that contains the proprietary grout injected under low pressure through a plastic feeder tube along and to the back of the anchor.

Once all the anchors were installed, the completed unit was damp-cured for 7-days and then left aside at room temperature and approximately 50% RH for a total of 34 days to achieve the final test strength. The test wallette was then conditioned by water soaking for seven days before the commencement of the freeze-thaw test (total of 41 days).

The test consisted of 100-cycles of freezing and thawing of the exposed surface of the wallette within the test chamber. The chamber temperature cycled between -15 to +15C as required by the standard. The specimen was photographed before testing began and then periodically examined for damage during the course of the test, and after the selected number of cycles had been completed (five, 25, 50 and 100-cycles).

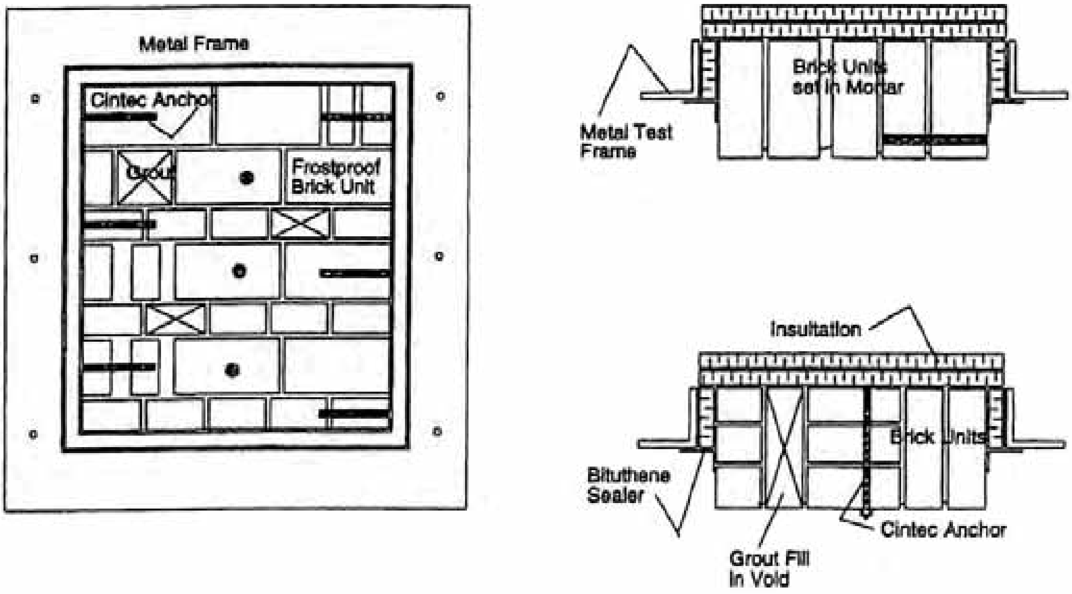


Figure 2 Schematic of Wallette with Cintec anchors

Freeze-thaw Testing of Grout Cubes

Three four-inch square standard cubes were cast for freeze-thaw testing within the chamber.

The cubes were cured after casting in a similar manner to the wallette, then dried and weighed before being immersed in water for 24 hours. The cubes were placed on the floor of the freeze-thaw cabinet and were exposed to the same cycling as the wallette.

Any changes in the weight of the cubes were recorded after 50 and 100 cycles.

Compressive Strength Testing of Grout

Nine two-inch standard cubes were cast of the grout in order to check their compressive strength at three, seven and 28-days after casting.

The cubes were wet cured after casting, then tested in accordance with the requirements of ASTM C-942 - Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.

Test Results

Table 1 Freeze-thaw Testing

Specimen Type	Observations, Comments				
	Before Testing	After 5 cycles	After 25-cycles	After 50-cycles	After 100-cycles
Wallette A	Intact	Intact	Intact	Intact	Intact

Table 2 Weight Change of Freeze-thaw Wallette

Specimen Type	Weight before testing		Weight after testing (100 cycles)	
	Dry	After 7 days of soaking	After 7 days of soaking	Dry
Wallette A	173.15 kg	174.50 kg	174.59 kg	173.06 kg

Table 3 Freeze-thaw Testing of 4-inch Grout Cubes

Specimen	Dry Weight (grams)	Weight after 24 hours of immersion (grams)	Weight after 50 Cycles of FreezeTthaw (grams)	Weight after 100 Cycles of Freeze/Thaw (grams)
Sample 1	1941.99	2043.65	2043.65	2045.13
Sample 2	1964.20	2002.37	2002.35	2003.19
Sample 3	1914.14	2054.41	2054.40	2054.56

Table 4 Compressive Strength Testing of 2-inch Grout Cubes

Wet Curing - Time Lapse		Sample 01	Sample 02	Sample 03	Average
3 days	MPa	30.39	27.05	30.91	29.45
	psi	4405	3920	4480	4268
7 days	MPa	36.29	37.23	37.40	36.97
	psi	5260	5395	5420	5358
28 Days	MPa	47.44	46.30	47.92	47.22
	psi	6875	6710	6945	6843

Discussion

No appreciable loss of grout or encasing brickwork was observed after the full 100-cycle test. No grout degradation or delamination of the grout from the brickwork was noted after the test.

The Presstec grout cubes which were placed on the floor of the freeze/thaw cabinet and subject to 100 freeze-thaw cycles displayed no evidence of damage or weight loss.

The average compressive strength of cast grout cubes, after 28 days of curing was found to be approximately 47 MPa.

Conclusions

The anchor grout and installed anchor system installed within a brick wallette performs satisfactorily when tested to the requirements of European Standard EN772 Part 22 (Methods of Test for Masonry Units - Part 22): Determination of freeze-thaw resistance of Clay Masonry Units).

ArconTEST Incorporated

per

Spencer Higgins M.Arch
Conservation Architect

Pawel Marek M.A.
Conservator

Photographic Documentation

Figure 3 Wallette A before testing

Photographic Documentation

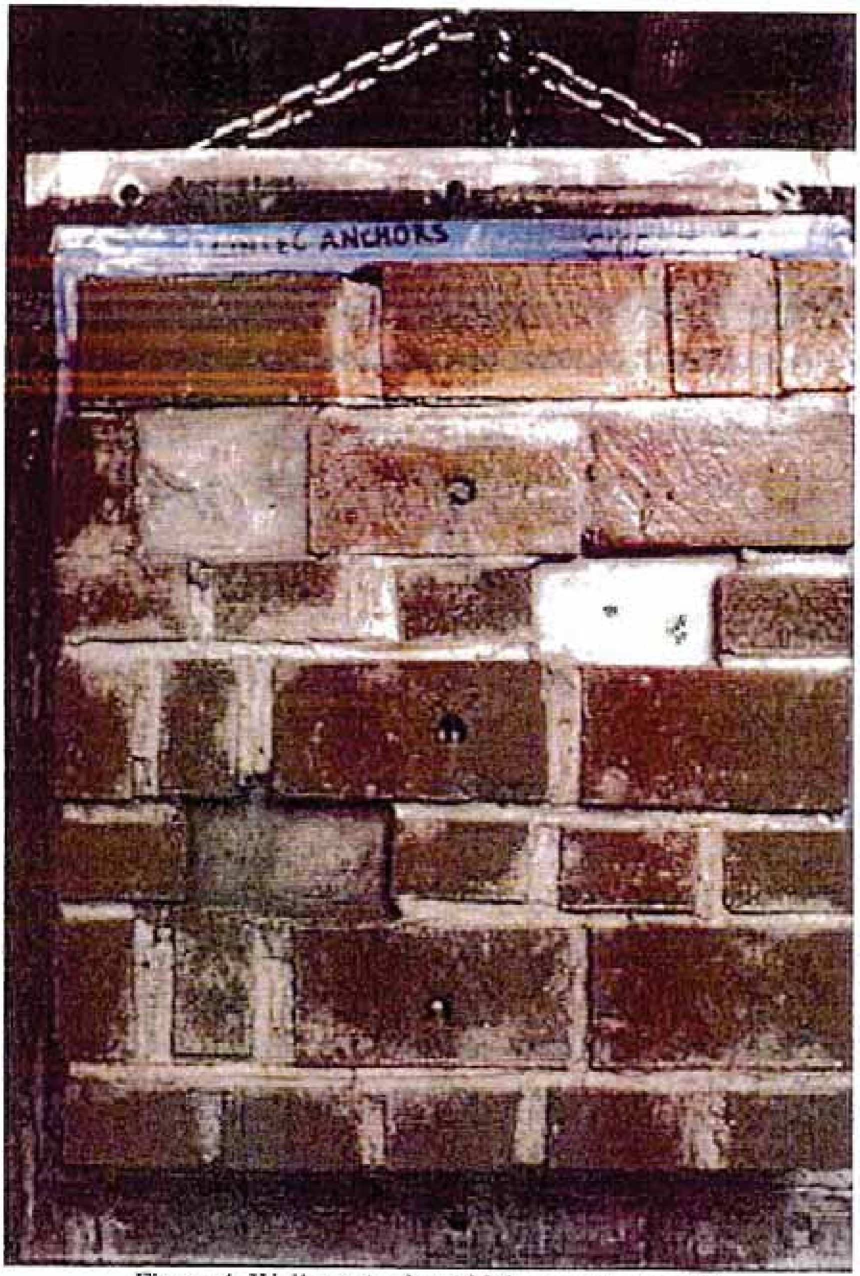


Figure 4 Wallette A after 100 freeze-thaw cycles

Photographic Documentation

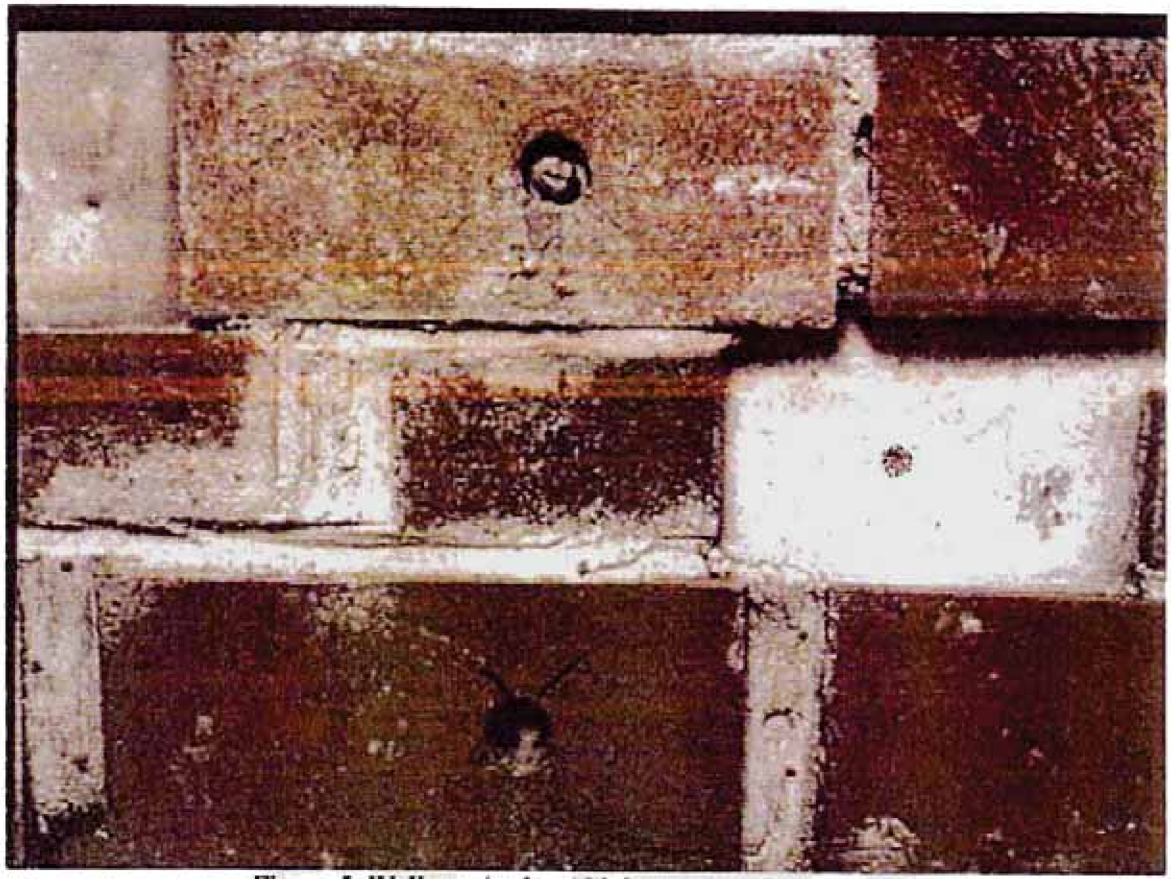


Figure 5 Wallette A after 100 freeze-thaw cycles, detail

Photographic Documentation

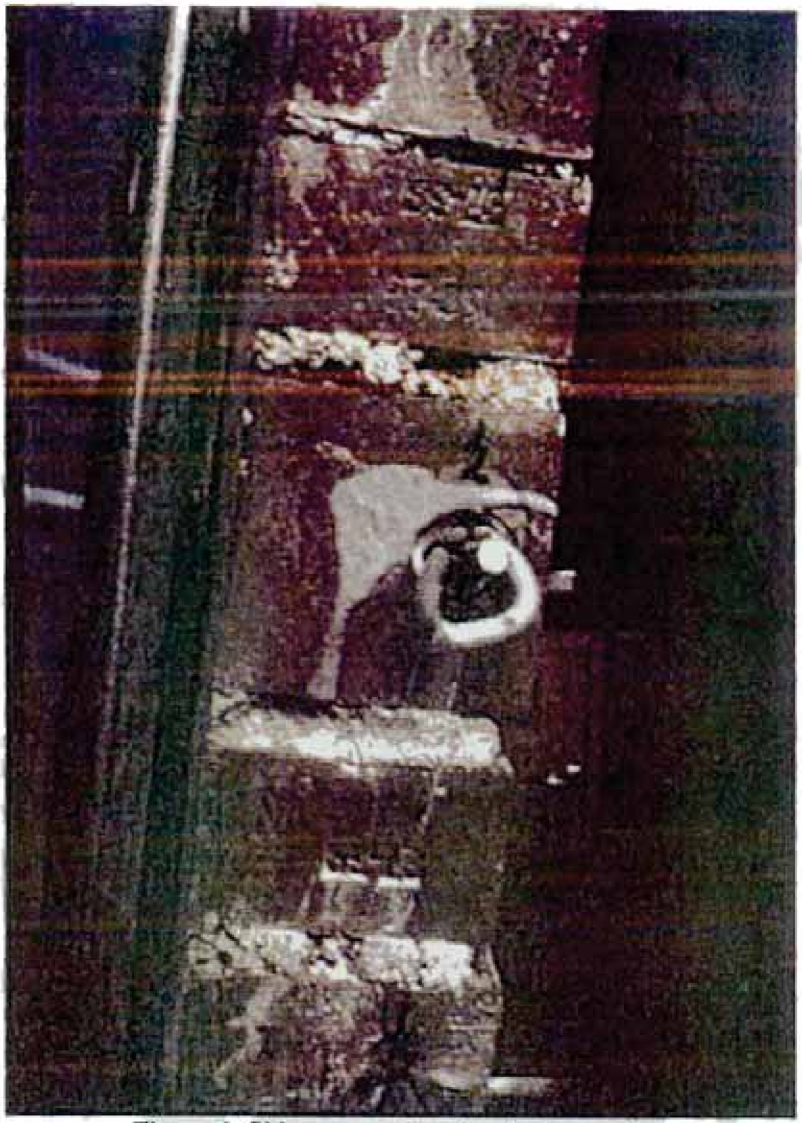


Figure 6 Side-mounted anchor before testing

Photographic Documentation

Figure 7 Side-mounted anchor after 100 freeze-thaw cycles

CINTEC REMEDIAL WALL TIE TEST (1)

TUNRA
RESEARCH
BUSINESS

THE UNIVERSITY OF NEWCASTLE RESEARCH ASSOCIATES LIMITED

CINTEC REMEDIAL WALL TIE TEST (1)

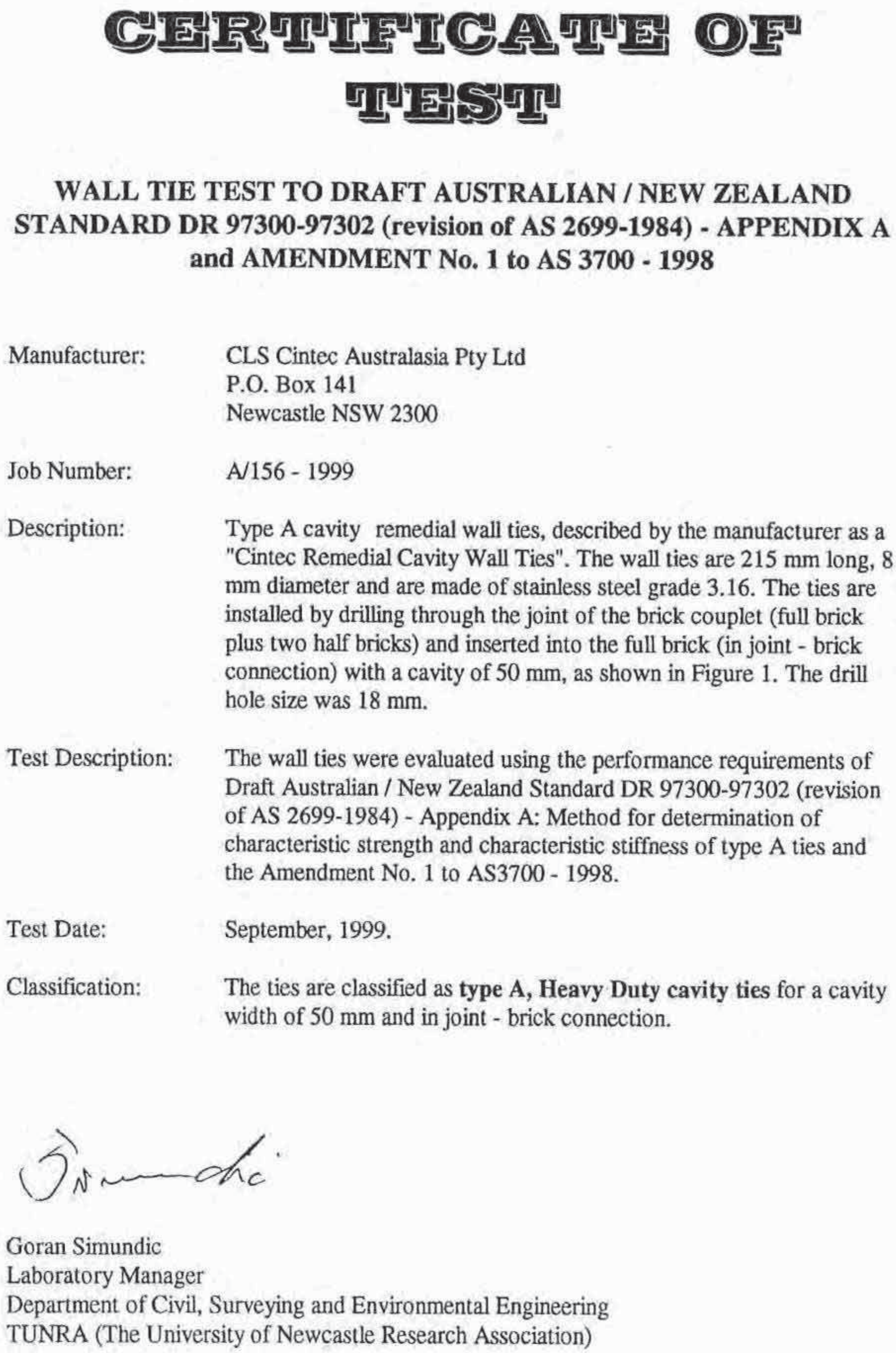
PROJECT NO. A / 156

By

GORAN SIMUNDIC, BE, ME, MIEAust., CP Eng
Laboratory Manager

Department of Civil, Surveying and Environmental Engineering
The University of Newcastle, NSW, 2308, Australia

CLIENT: CLS Cintec Australia Pty Ltd
P.O. Box 141
Newcastle NSW 2300



CERTIFICATE OF TEST

WALL TIE TEST TO DRAFT AUSTRALIAN / NEW ZEALAND STANDARD DR 97300-97302 (revision of AS 2699-1984) - APPENDIX A and AMENDMENT No. 1 to AS 3700 - 1998

Manufacturer:
CLS Cintec Australasia Pty Ltd
P.O. Box 141
Newcastle NSW 2300

Job Number: A/156 - 1999

Description: Type A cavity remedial wall ties, described by the manufacturer as a "Cintec Remedial Cavity Wall Ties". The wall ties are 215 mm long, 8 mm diameter and are made of stainless steel grade 3.16. The ties are installed by drilling through the joint of the brick couplet (full brick plus two half bricks) and inserted into the full brick (in joint - brick connection) with a cavity of 50 mm, as shown in Figure 1. The drill hole size was 18 mm.

Test Description: The wall ties were evaluated using the performance requirements of Draft Australian / New Zealand Standard DR 97300-97302 (revision of AS 2699-1984) - Appendix A: Method for determination of characteristic strength and characteristic stiffness of type A ties and the Amendment No. 1 to AS3700 - 1998.

Test Date: September, 1999.

Classification: The ties are classified as **type A, Heavy Duty cavity ties** for a cavity width of 50 mm and in joint - brick connection.

Goran Simundic
Laboratory Manager
Department of Civil, Surveying and Environmental Engineering
TUNRA (The University of Newcastle Research Association)

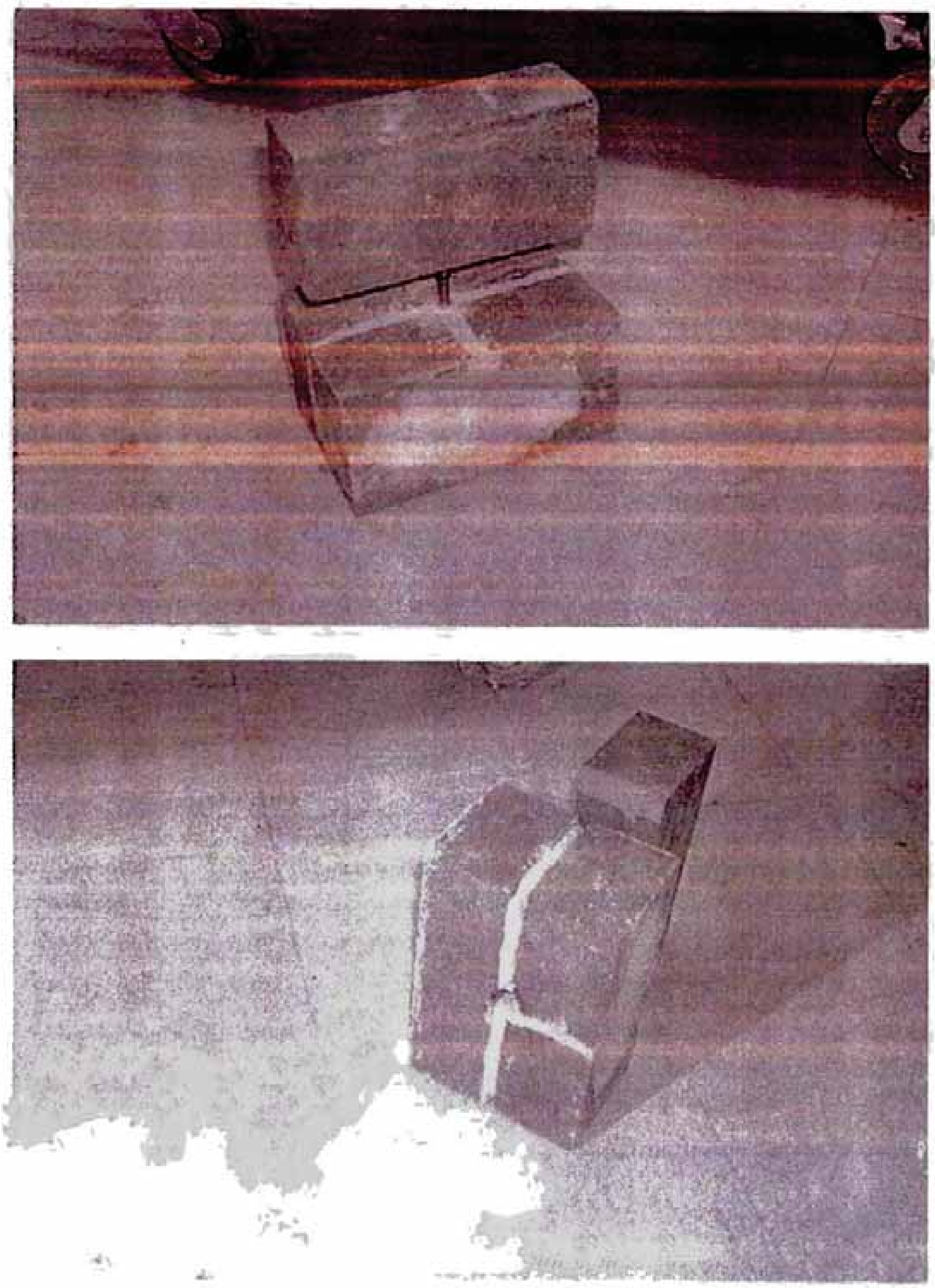


FIGURE 1. Test Specimen

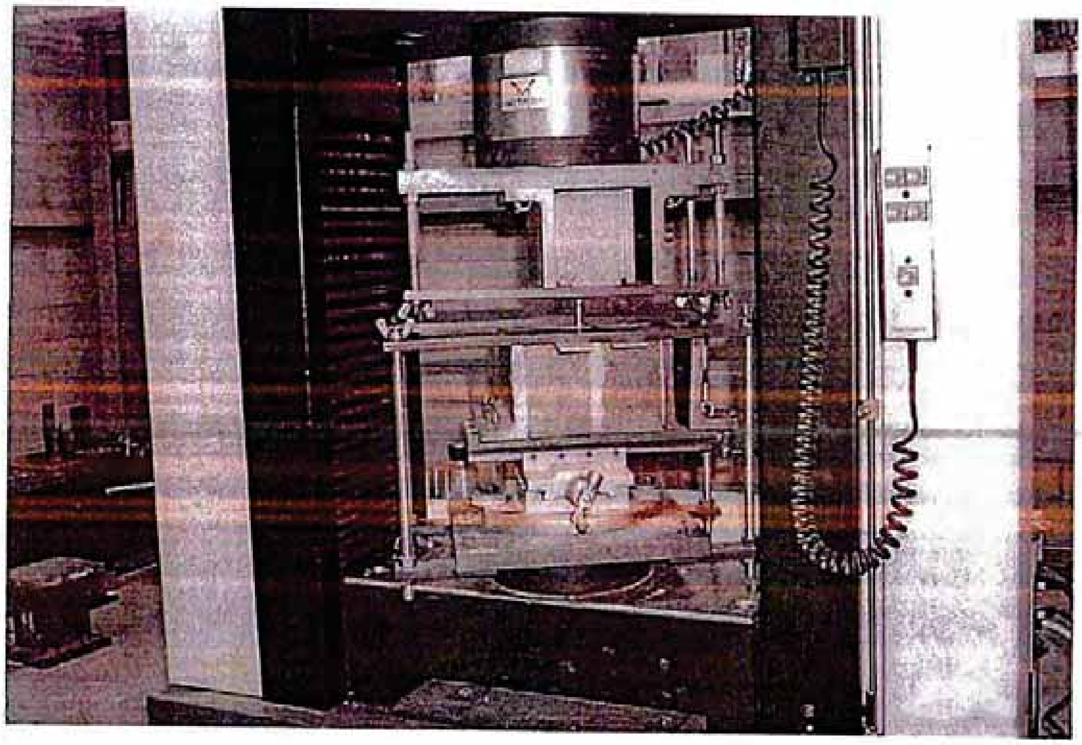


FIGURE 2. Testing Arrangement

Type A Cavity Tie (215 mm long, d=8 mm, 50 mm cavity)
Cintec Remedial Wall Tie (in joint - brick)

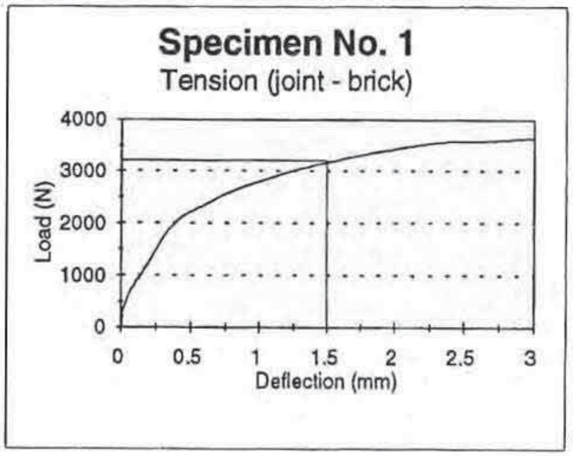
Specimen Number	Force required to induce 1.5 mm deflection or failure (N)	
	Tension	Compression
1	3172	3115
2	2991	2564
3	2915	3353
4	2754	3566
5	2712	5011
6	2243	3203

Mean:	2798	3469
Standard Deviation:	319	827
Characteristic Value:	1436	1641

Note:
-The specimens were made in accordance with the draft Australian/New Zealand Standard DR 97300 - 97302 (revision of AS 2699 - 1984) - Appendix A.
- The mortar at the time of testing was more than 28 days old.
- The grout at the time of testing was 20 days old.
- The ties were installed by driling through the joint of the brick couplet (full brick plus two half bricks) and inserted into the full brick (in joint - brick connection).
- The cavity between the brick couplet and the brick was 50 mm.
- The drill hole size was 18 mm.

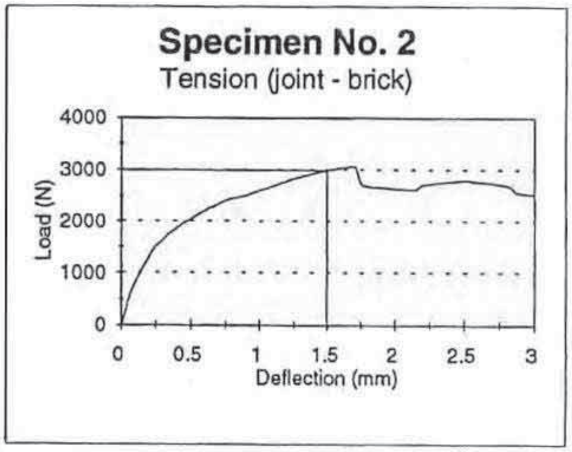
APPENDIX A

Load – Deflection Graphs



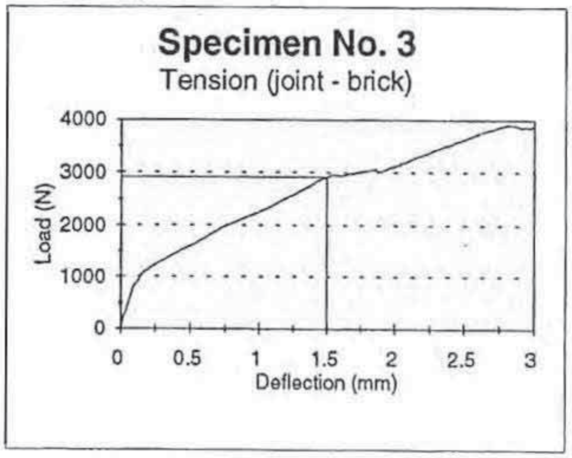
Specimen No. 1

Tension (joint - brick)



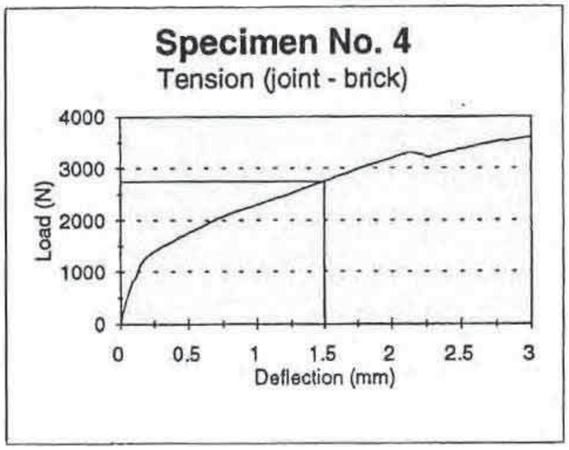
Specimen No. 2

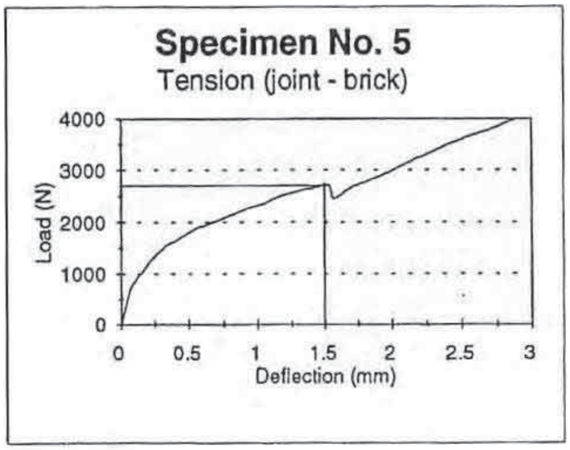
Tension (joint - brick)

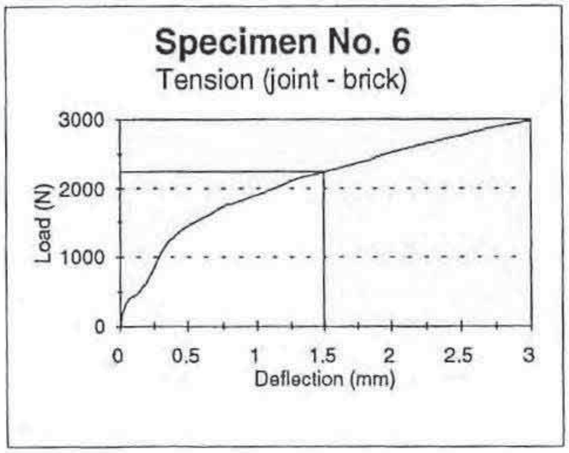


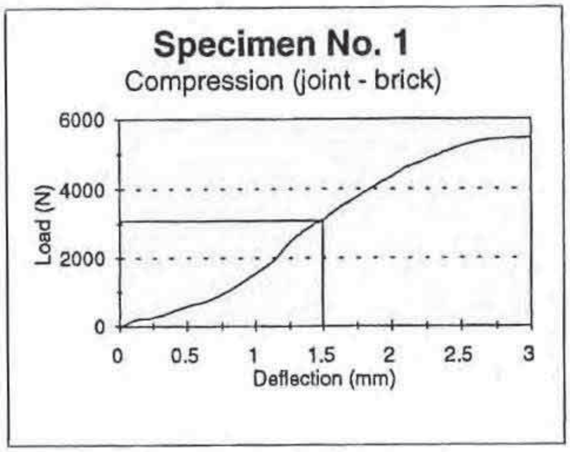
Specimen No. 3

Tension (joint - brick)


Specimen No. 4
Tension (joint - brick)
Load (N)
4000
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
Deflection (mm)

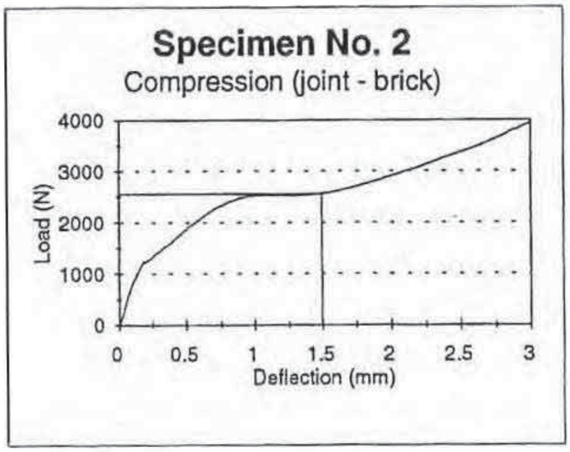

Specimen No. 5
Tension (joint - brick)
Load (N)
4000
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
Deflection (mm)


Specimen No. 6
Tension (joint - brick)
Load (N)
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
Deflection (mm)



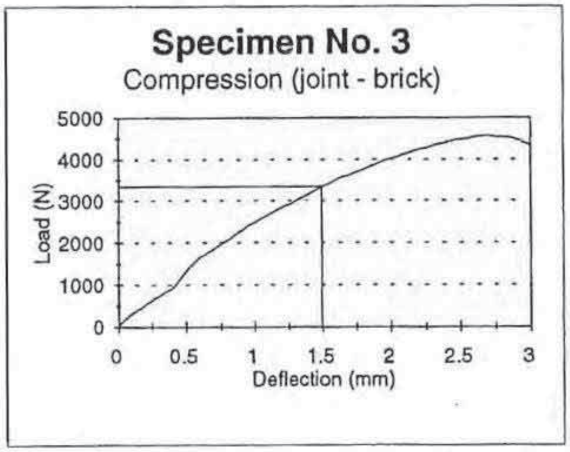
Specimen No. 1

Compression (joint - brick)



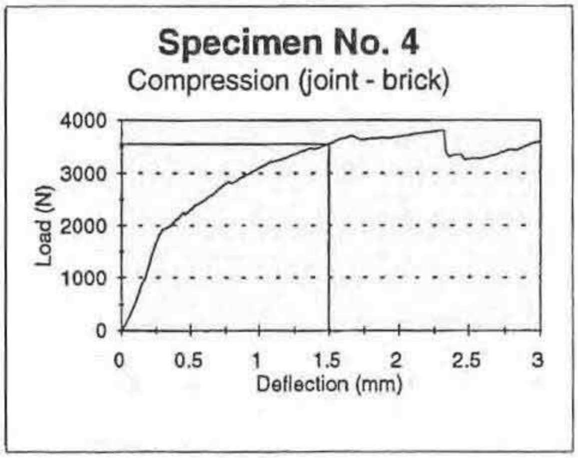
Specimen No. 2

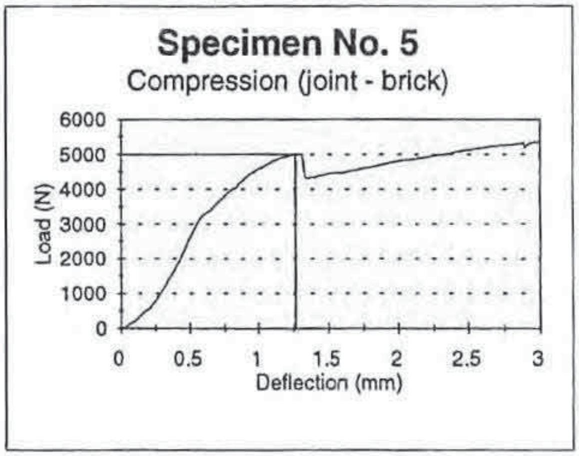
Compression (joint - brick)

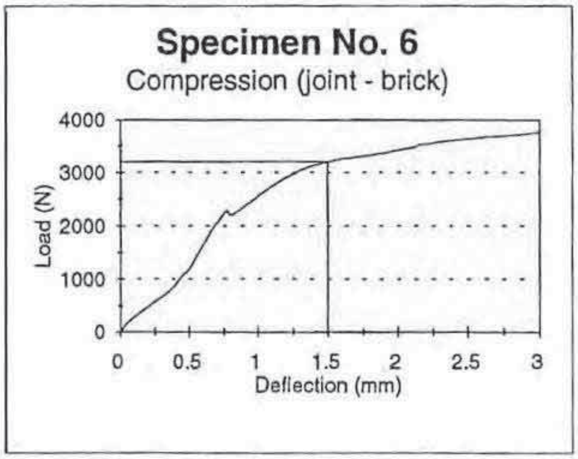


Specimen No. 3

Compression (joint - brick)


Specimen No. 4
Compression (joint - brick)
Load (N)
4000
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
Deflection (mm)


Specimen No. 5
Compression (joint - brick)
Load (N)
6000
5000
4000
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
Deflection (mm)


Specimen No. 6
Compression (joint - brick)
Load (N)
4000
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
Deflection (mm)

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ISIS CANADA
RESOURCE CENTRE

Environmental investigation on the Behaviour of Cintec Anchors subjected to Ultimate Load Test – Ottawa Parliament West Block Rehabilitation Project

Dr. Hugues M. Vogel, E.I.T.
Dr. Aftab Mufti, CM, P.Eng.

March 2012

Solutions for Civil and Heritage Infrastructure

Tested to ASTM E 1512 ASTM C666/C661M

ISIS CANADA
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Environmental investigation on the Behaviour of Cintec Anchors subjected to Ultimate Load Test - Ottawa Parliament West Block Rehabilitation Project

By

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Prepared for:
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Executive Summary

This document provides a report on the results obtained from pullout tests performed on Ohio sandstone masonry blocks instrumented with anchors provided by PWGSC and installed by Cintec Canada Ltd. The masonry blocks were provided by Public Works and Government Services Canada (PWGSC) to represent material that needs to be repaired in the West Block structure found on Parliament Hill in Ottawa.

The performance of 10 samples kept under ambient conditions was compared to that obtained from 25 samples subjected to weathering conditions typically found in the Canadian climate. Out of these 25 samples, a total of 10 were subjected to 150 dry freeze-thaw cycles and a total of 15 were submitted to 150 rapid (wet) freeze-thaw cycles. The cycles were designed in accordance with the North American standards governing the evaluation of environmental weathering. A total of three embedment lengths, referred to as sock lengths, were investigated for the anchors. These include 75mm and 150mm for ambient conditions and dry freeze-thaw cycles as well as 75mm, 150mm and 200mm for the rapid freeze-thaw cycles.

Visual inspections performed on the samples prior to and after weathering did not reveal any signs of degradation or any significant weight loss during cycling. Similarly, the pullout tests did not reveal any influence of weathering on the capacity or the performance of the anchors. The Cintec anchors were tested to failure and the loads achieved with a 9mm diameter A325M stainless steel anchor body was well above expectations by a factor of 9 and no bond loss between the grout and the Ohio sandstone masonry blocks. The first type of failure consisted of steel failure in the threaded rod immediately above the washer placed at the bottom of the grouted portion of the anchor. The second consisted of steel failure in the threaded rod within the gauge length extending from the surface of the stonework to the anchorage plates used for loading. Results for the capacity of anchors with 75mm sock lengths revealed slightly more variability than those obtained for anchors with 150mm sock lengths. The use of 150mm sock length was also not found to provide additional improvements on the capacity of the repair technique when compared to that achieved with 75mm sock lengths. The same observation was made for anchors with 200mm sock lengths but more research is required to confirm the result for this specific embedment length. All of the samples have been sectioned and pictures have been taken to provide a visual documentation of damage incurred during pullout testing.

1. Introduction

Historic buildings are an important part of history. They are a tangible record of cultural heritage and provide current society with a visual record of the art and skill of ancestry. Stone masonry buildings built in Canada before the twentieth century were not designed to the extent of requirements found in current building codes. As a result, there is a growing need for evaluating different strengthening techniques that can maintain structural integrity of heritage structures throughout Canada. The technique investigated in this document consists of inserting a Cintec anchor into the stonework and securing the structural components against movement. The strength and performance of the anchorage system was evaluated based on an extensive experimental program designed to account for the influence of weather conditions expected in the Canadian climate.

2. Background

This project was designed to evaluate the compatibility of using an anchorage system to secure the stone walls of the West Block building located on Parliament Hill in Ottawa, Canada. The West Block is one of three buildings on Parliament Hill and is an asymmetrical structure built in the Victorian High Gothic style with load bearing masonry walls. The main part of the structure was constructed by 1875 and some additional segments were added during the course of the last century. The construction history of the structure is summarized in Figure 1 along with an overall view of the building in 1875 as well as in its current state. It currently accommodates suites for House of Commons Members of Parliament along with different committee and ceremonial rooms, which renders its preservation vital from the perspective of preserving democratic institutions. Since most of this structure has already passed its design life, Public Works and Government Services Canada (PWGSC) has been committed to providing an evaluation of the structural state of the building through masonry surveys in the final stages of the second millennium. They have also started investigating possible strengthening techniques to conserve the structure in the early years of the third millennium.

3. Compatible Strengthening Technique for Heritage Structures

The West Block building, like many other historic stone masonry structures in Canada, was constructed with two-wythe stone walls. The walls, shown in Figure 2(a), include a rubble core separating an inner limestone wythe from an outer sandstone wythe. Masonry surveys performed by UMA Engineering Ltd. for PWGSC between 1994 and 1996 suggest that the long-term exposure of the building to harsh Canadian weather has caused the outer wythe to separate from the rubble core at several locations on the structure. The separation is shown in Figure 2(b) and the severity of this deterioration was further evaluated by PWGSC with an additional survey in 2005. A summary of the results from this survey are shown in Figure 3.

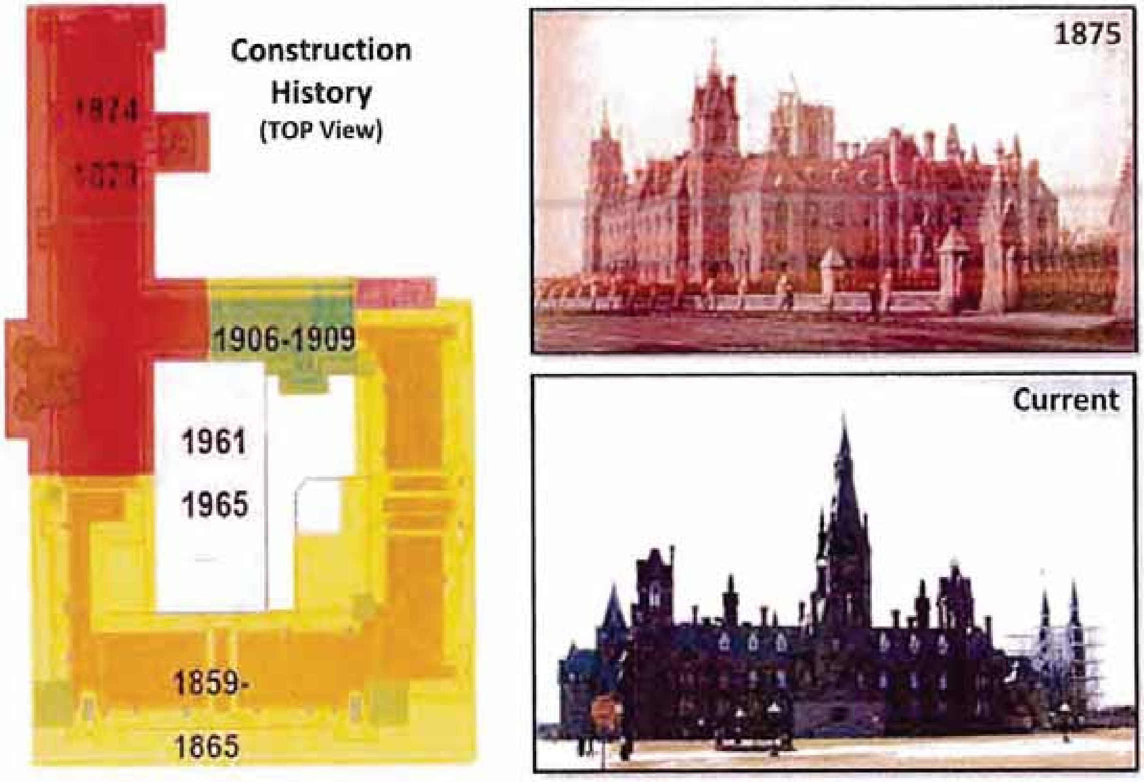
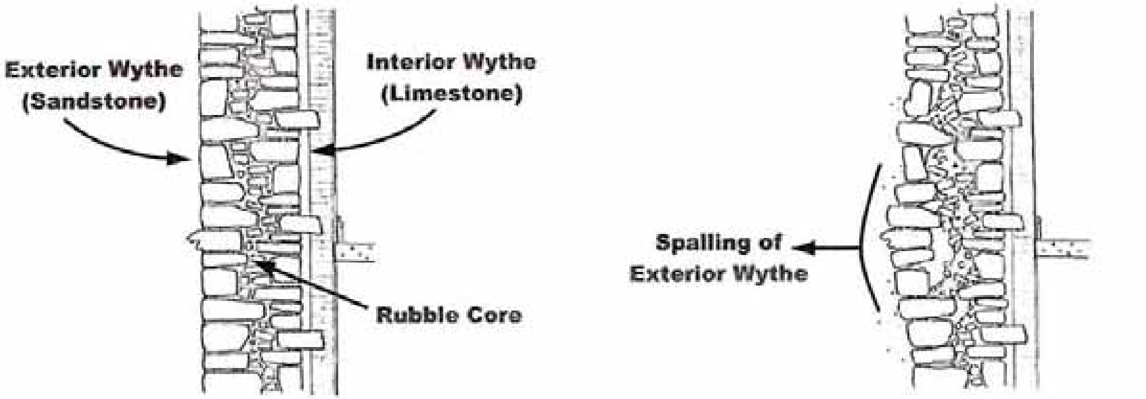


Figure 1 – West Block Structure: Construction History and Overall View



(a)Good Condition

(b) Wall Condition Requiring Major Intervention

Figure 2 – West Block Structure Wall Details and Conditions

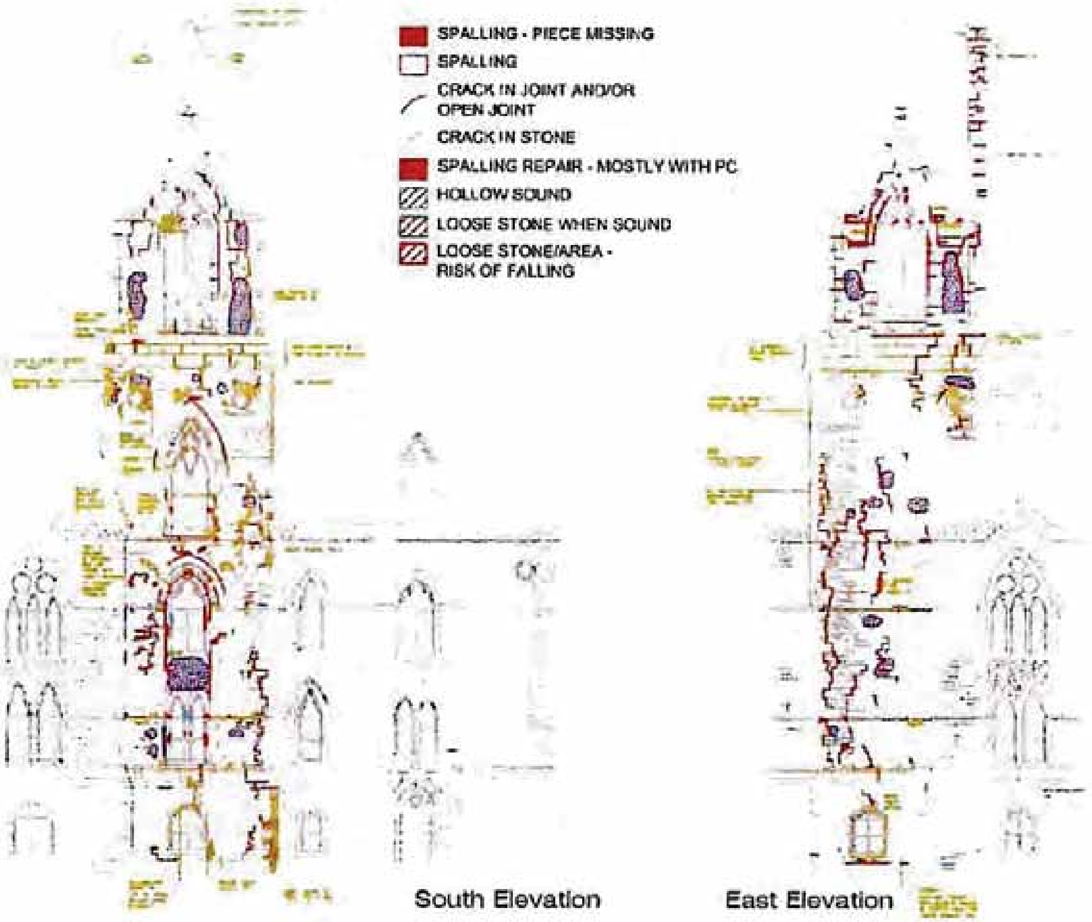
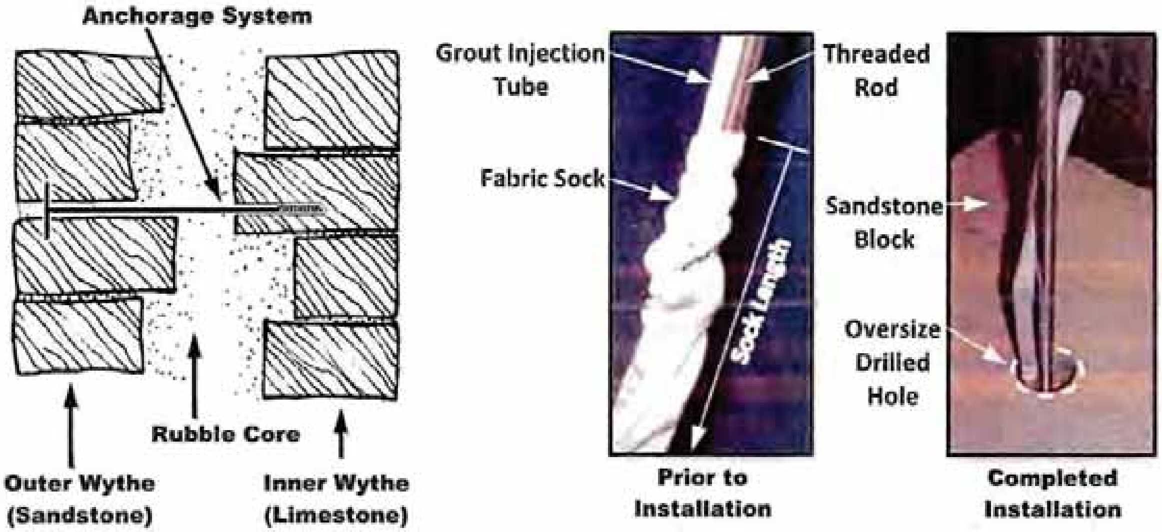


Figure 3 – Outer Sandstone Wythe Deterioration Severity (PWGSC Masonry Survey 2005)

As shown in Figure 4(a), the separation of the wall segments can be repaired or prevented by anchoring the outer wythe (sandstone) to the inner wythe (limestone). This strengthening technique requires the insertion of anchors, and therefore foreign materials, within the stonework. These materials should be chosen with care to prevent any detrimental impact on the stonework. Many researchers (Benedetti and Castoldi 1982, Benedetti and Pezzoli 1996, Tomazevic et al. 1993, Tomazevic et al. 1996) have conducted experimental investigations on the use of steel ties to strengthen heritage stone masonry structures. Although steel ties are susceptible to corrosion, most rehabilitation techniques are designed to limit moisture uptake and protect the anchorage system from detrimental weathering conditions. Research from Binda et al. (1997) and Tomazevic (1999) has also suggested that the use of grout to secure the ties in anchorage systems improves compatibility with the stonework and can provide additional improvement on the strengthening of masonry structures.



(a)Suggested Repair

(b) Cintec Anchoring System

Figure 4 – Outer Wythe Reparation Scheme and Details

Based on these findings, a study was developed by PWGSC where sandstone blocks similar to the ones in the West Block building were instrumented with an anchorage system used by Cintec Canada Ltd. As illustrated in Figure 4(b), the patented Cintec anchoring system chosen for this project consists of injecting a cementitious fluid around a stainless steel threaded rod that is surrounded by a fabric sock and has been placed in an oversized hole previously drilled in the medium that requires rehabilitation.

4. Objectives of the Study

The main objective of the study outlined by PWGSC was to evaluate the performance of Cintec anchors in a material similar to the one found in the outer wythe of the West Block building, while accounting for the influence of weather conditions in the Canadian climate. The objective translates into two major benchmarks for the program:

[1] CONDITIONG – subject the samples to weathering criteria listed in the relevant North American Standards with consideration for other international standards.

[2] TESTING – evaluating the pullout behaviour of anchors in both control and conditioned samples under static loads.

5. Experimental Program

5.1. Sample Specifications

Ohio sandstone masonry blocks similar to those found in the West Block building were provided by PWGSC as samples for the project. In order to obtain a comparative reference from the results of the study, all specimens tested in this program were 350mm wide by 350mm long by 300mm high. The anchorage system illustrated in Figure 4 was installed in the stonework by Cintec Canada Ltd. between May 2nd and 6th 2011 in the Plouffe Park shop, Ottawa. A 32mm (1 $^1/_4$in) diameter and 200mm (7 $^7/_8$in) deep hole was drilled in each of the stone blocks to allow insertion of the Cintec anchor assemblies. A total of sixteen Ohio sandstone blocks were instrumented with an anchorage system having a sock length of 75mm and another sixteen with a sock length of 150mm. Finally, an additional six were installed with a sock length of 200mm. Threaded stainless steel rods were used and a Presstec grout was injected in the fabric sock during installation.

One sample from each of the sock lengths investigated was retained by Cintec Canada Ltd. for future reference. The remaining samples were shipped to the University of Manitoba for thermal weathering and subsequent pullout testing. A list of all samples received by ISIS Canada from PWGSC on June 10th 2011 is elaborated in Table 1 along with relevant information pertaining to the parameters considered for the study. It was also requested from Cintec Canada Ltd. that two blocks of stone be left untouched without any drilling or anchorage installation. The samples are to be submitted to the same weathering tests as the blocks with anchors in order to evaluate weight loss from degradation.

5.2. Weathering Conditions

As indicated in Table 1, a total of two conditioning schemes were considered for the experimental program in this study. Thermal weathering was accomplished using CONVIRON environmental chambers capable of generating temperatures between -40°C and 40°C. The chambers are equipped with thermocouples that allow temperature fluctuations to be monitored during the cycles.

Table 1 - Sample Specifications

Specimens	Sock Length [mm]	Description / Weathering Conditions
C75-1	75	Control Samples (Ambient Laboratory Conditions) TEMPERATURE: ~20°C HUMIDITY: negligible effect
C75-2		
C75-3		
C75-4		
C75-5		
C150-1	150	
C150-2		
C150-3		
C150-4		
C150-5		
U75-1	75	Dry Freeze-Thaw Samples (ASTM E1512-01) -18°C ≤ TEMPERATURE ≤ 4°C HUMIDITY: negligible effect
U75-2		
U75-3		
U75-4		
U75-5		
U150-1	150	
U150-2		
U150-3		
U150-4		
U150-5		
R75-1	75	Wet Freeze-Thaw Samples (ASTM C666/C666M-03) -23°C ≤ TEMPERATURE ≤ 40°C HUMIDITY: 100%
R75-2		
R75-3		
R75-4		
R75-5		
R150-1	150	
R150-2		
R150-3		
R150-4		
R150-5		
R200-1	200	
R200-2		
R200-3		
R200-4		
R200-5		

The first scheme was performed in accordance with ASTM E1512 (2001) and consisted of subjecting five of the samples with 75mm sock length and five of the samples with 150mm sock length to a total of 150 thermal cycles ranging from -23°C to 40°C. The relative humidity was maintained to a negligible level during conditioning. The extremes of temperature were maintained for 3 hours with a ramping of 1.75°C every 5 minutes. The temperature variation for these dry freeze-thaw cycles is illustrated in Figure 5 over the course of approximately 4 days.

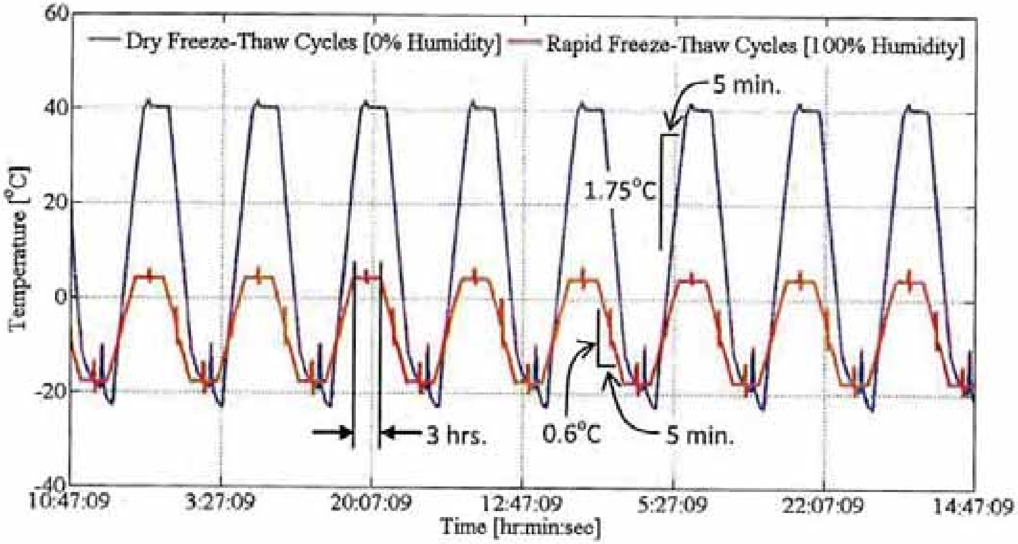


Figure 5 – Temperature Fluctuation during Conditioning: Chamber Records

The second conditioning scheme consisted of subjecting five of the samples for each of the 75mm, 150mm and 200mm sock lengths considered to a total of 150 thermal cycles ranging from -18°C to 4°C. The conditioning was performed in accordance with ASTM C666/C666M (2003), which required a relative humidity of 100% to be maintained during each cycle. As indicated in Figure 5, the extremes of temperature were also maintained during 3 hours with a ramping of 0.6°C every 5 minutes. The relative humidity for this conditioning scheme is shown in Figure 6 and indicates that it is difficult to maintain a level of 100% during each cycle. This slight discrepancy arises from the fact that temperature is generated by convection using large fans that circulate air from the back of the chamber. This flow of air creates a temporary state of drying during the ramping stages of the cycles when the temperature increases from -18°C to 4°C. There are also some fluctuations at -18°C that arise from the chamber defrosting stages. Nevertheless, the chamber was able to maintain an average relative humidity of 80% during most of the cycle durations.

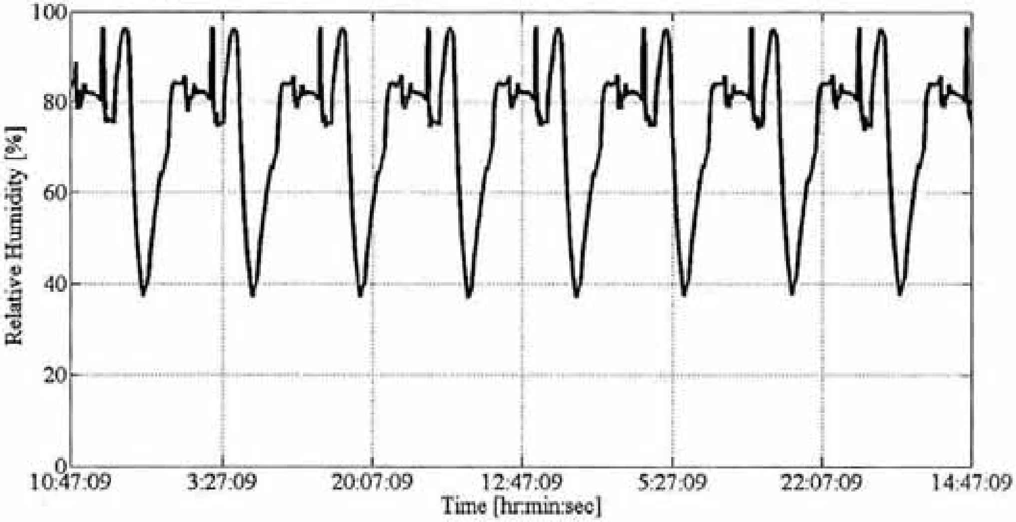
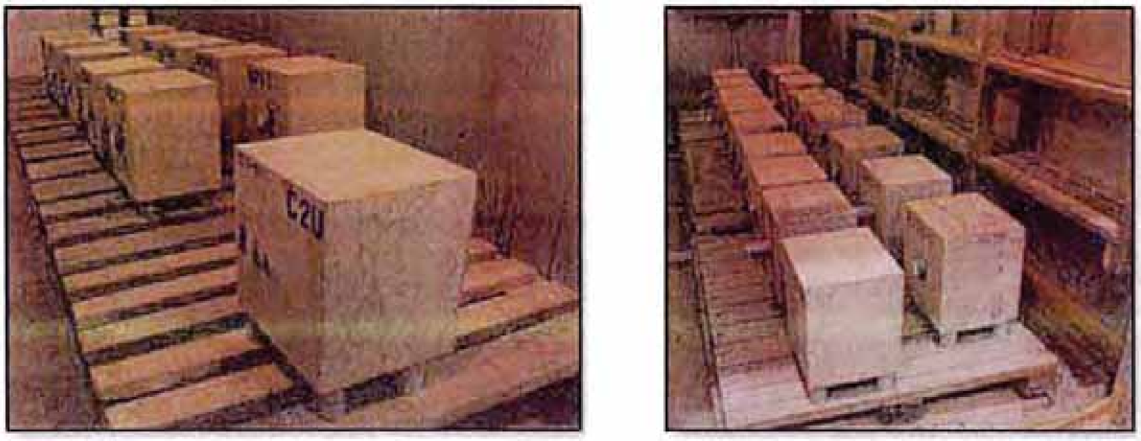


Figure 6 – Relative Humidity during Rapid Freeze-Thaw Cycles

5.1.1. Sample Preparation

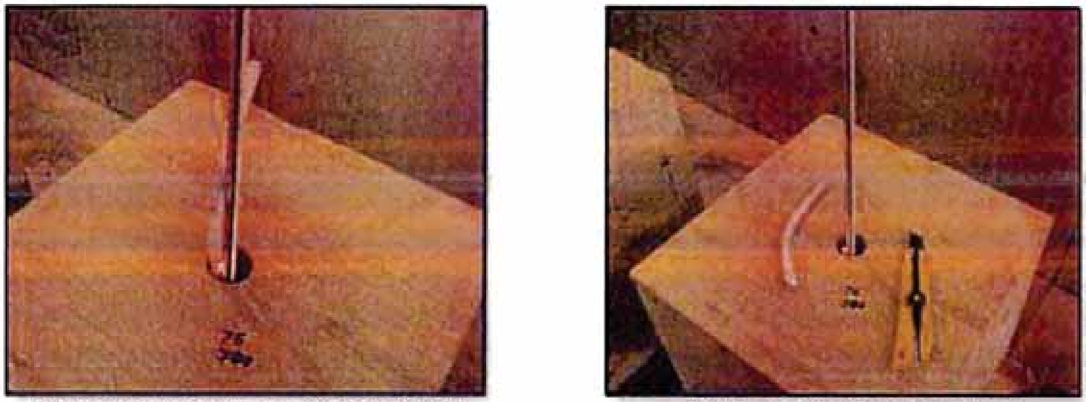
It should be noted at this stage that the dry freeze-thaw cycles and the rapid freeze-thaw cycles were performed simultaneously using two chambers during a total of 2 $^1/_2$ months (75 days). The sample layout is shown in Figure 7(a) for the dry freeze-thaw cycles and Figure 7(b) for the rapid freeze-thaw cycles. Several pertinent observations can be made from these figures. The first concerns the absence of the stainless steel rods extruding from the masonry blocks. The absence resulted from a request that rod tails be sectioned flush with the stonework and protected with insulation to prevent infiltration of cold temperature and moisture during conditioning.



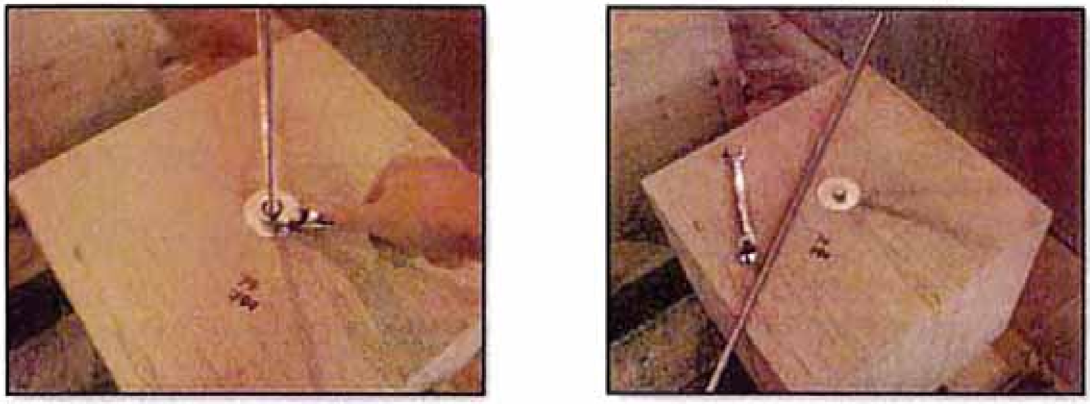
(a) Dry Freeze-Thaw Cycle Chamber (b) Rapid Freeze-Thaw Cycle Chamber

Figure 7 – Sample Layout in the Environmental Chambers

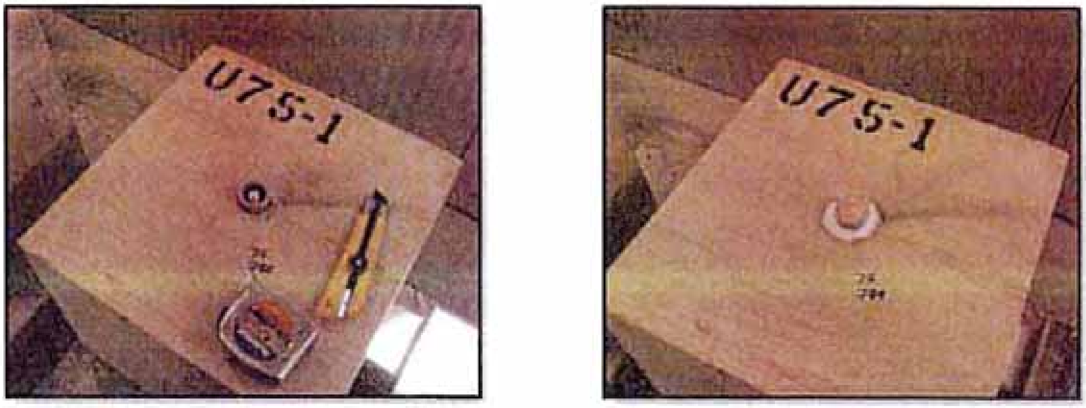
The sectioning procedure is outlined in Figure 8 and consists of four steps. The first step involves removal of the rod using a reciprocating saw equipped with a BI-Metal blade (Figure 8(a) to (d)). The rod was secured from excess vibration with a wooden jig that was fabricated from three 2in by 4in studs. A 2in outside diameter, 3/8in inside diameter washer, hand tightened with a nut, was also provided to offer additional stability during each of the sectioning procedures.



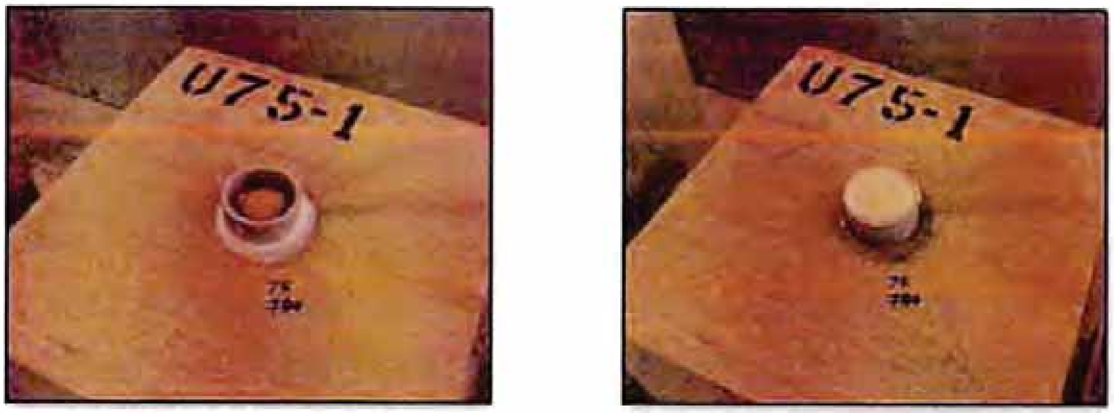
(a) Original Stone (*75mm Sock Length*) (b) Sectioning Grouting Tube



(c) Rod Stabilization (*2"OD -3/8"ID Washer & Nut*) (d) Sectioned Threaded Rod



(e) External PVC Confinement within Hole (f) Insertion of Insulation around the Rod (*Silicon added to Seal the Hole*)



(g) External PVC Confinement on the Stone Surface (*Silicon added to Seal the Hole*)

(h) Insulating Foam against Moisture Ingress (*Expansive Insulating Foam Used*)

Figure 8 – Sectioning Procedure

Once the rod was sectioned, a segment of 1in diameter PVC conduit was inserted in the stonework hole and filled with R-20 FIBERGLASS PINK® insulation (Figure 8(e) to (f)). The use of a washer and nut to stabilize the anchor during the sectioning process provided a threaded rod stub of approximately 9.5mm (3/8in) that extruded from the stone. As a result, an external 2in PVC confinement was placed on the surface of the stone and expansive insulating foam was inserted to protect the top of the rod from temperature and moisture ingress (Figure 8(g) to (h)).

The second observation that can be made from the layout shown in Figure 7 is the fact that all samples were placed sideways on wooden pallets to provide a 3° inclination with respect to the chamber floor. This inclination was provided in accordance with the fact that samples were shipped with anchors installed at a right angle from the surface of the stone. Original drawings provided by PWGSC suggest that anchors should have been installed at 3° with respect to the horizontal to prevent moisture ingress when using the repair technique in the field. A diagram of the shop drawings provided in the Request for Proposal document submitted by PWGSC can be found in Figure 9.

The third and final observation from the chamber layout relates to the height of the samples with respect to the supporting pallets. A 2in diameter segment of PVC conduit was placed under each corner of every sample to provide a 3in clearance at the base. The procedure was adopted to prevent water accumulation at the base of the samples during conditioning that would otherwise not occur under service conditions.

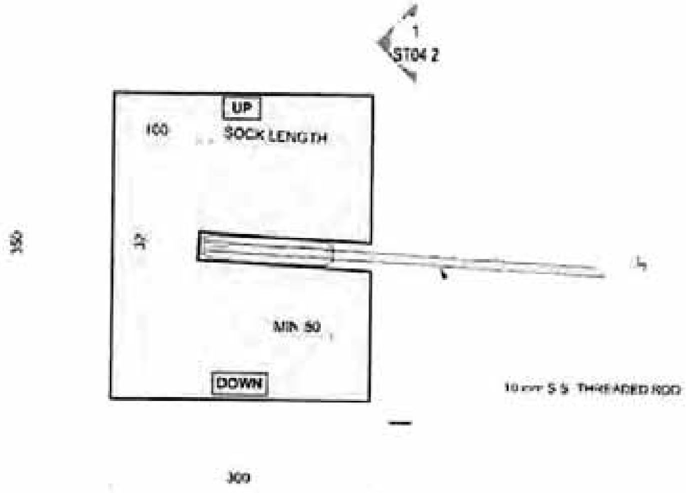


Figure 9 – Requirement for Sample Inclination: Shop Drawings (PWGSC)

5.1.2. Sample Weight Monitoring

As mentioned earlier, two masonry blocks were left untouched and submitted to the same weathering tests as the blocks with anchors in order to evaluate weight loss from conditioning. Consequently, these samples were weighed prior to and after cycling. For the samples subjected to rapid freeze-thaw cycling, an additional weight measurement was taken immediately after the misting procedure (~72 hrs) as well as immediately after conditioning to measure water absorption. The misting procedure produced a weight gain of approximately 1kg and the wet conditioning environment brought a weight gain of approximately 3kg to the masonry block. The final weight measurements for all samples were taken approximately 2 months after completion of conditioning in order to allow adequate drying. The weight loss after weathering was negligible (400g for dry freeze-thaw cycles, 200g for rapid freeze-thaw cycles).

Table 2 – Sample Weight Progression

Test Stage	Dry Freeze-Thaw Sample [kg]	Rapid Freeze-Thaw Sample [kg]	
		DRY	WET
Prior to Weathering	83	81.4	82.4(1)
After Weathering	82.6(3)	81.2(3)	85.4(2)

(1) After 72 hrs of misting (2) Immediately after weathering (3) 2 months after completion of weathering

5.3. Static Pullout Test Setup and Details

After conditioning, the samples were extracted from the chambers and the anchors were subjected to pullout load as described in ASTM E1512 (2001) using a 1000kN capacity MTS machine. The stones were firmly attached to the strong floor with four threaded bars, two steel angles as well as two steel straps. A picture outlining the details of the test setup can be found in Figure 10. The figure also shows that a 45mm (~1.75in) long coupler was used to extend the threaded rod stub extruding from the stonework to the anchorage plates for loading. The stub was extended using the same portion of the threaded rod that was removed during sectioning. The figure also shows that the jig supporting the LVDT sensors was secured below the coupler to minimize external sources of displacement. Finally, a rocker bearing was inserted for load application in order to accommodate the possibility of eccentric loading.

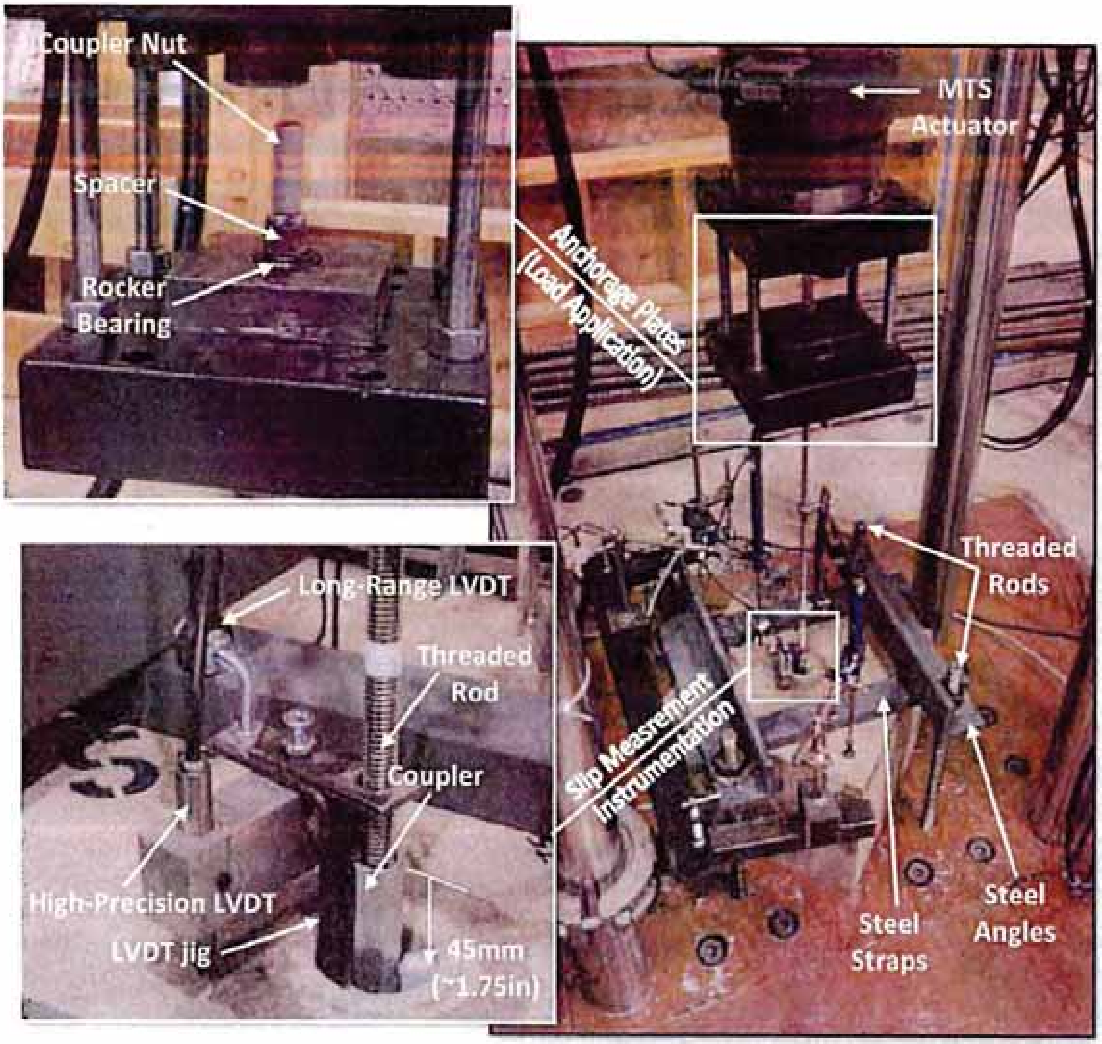


Figure 10 – Pullout Test Setup: 1000kN MTS Machine

The anchor elongation during each static pullout test was measured using two Linear Variable Displacement Transducers (LVDTs). The first LVDT was chosen to have a limited stroke of 3mm but higher precision to monitor the relatively smaller elongation values expected at the beginning of each test. The second LVDT was chosen to have larger stroke (125mm) but sufficient precision to register elongation values beyond the stroke of the first LVDT once larger loads are reached during the tests. An additional set of two LVDTs were also used to account for movement of the stone with respect to the strong floor. Once again, the first LVDT was chosen to have smaller stroke but higher precision for the early stages of the test and the second was chosen to have larger stroke to capture movement at the end of each test. The values obtained from all these sensors were then combined to evaluate net elongation during each test.

6. Test Results and Discussion

Results from all tests performed in this project are shown in Table 3 in terms of the ultimate load and type of failure. The failure loads are consistent among all specimens and weathering conditions considered. The table also shows that two main failure types were observed. These include steel failure in the threaded rod within the grouted portion of the anchor followed by slippage but also failure of the steel in the rod between the stonework and the anchorage plates. The ultimate loads recorded during the tests are shown in Figure 11 with respect to sock length as well as in terms of weathering conditions.

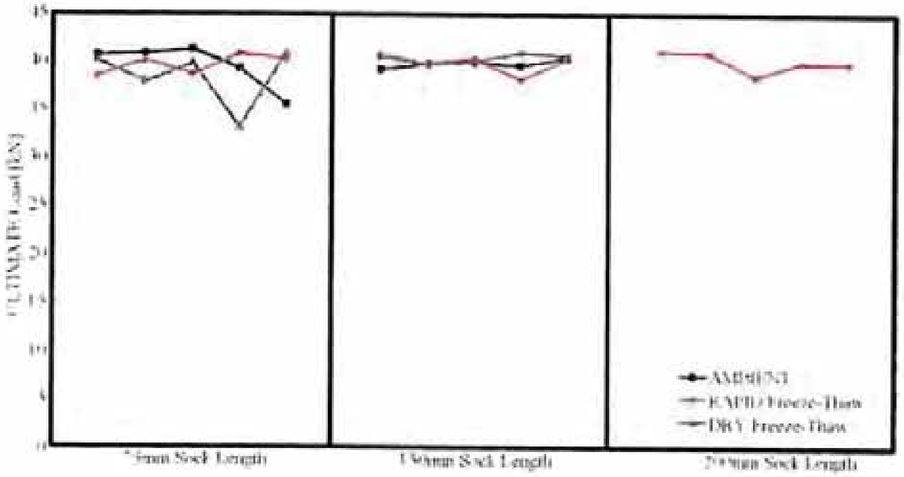


Figure 11 – Anchorage System Capacity in Ohio Sandstone (All Samples)

Results in this figure do not show sufficient evidence to conclude that rapid freeze-thaw or dry freeze-thaw conditions have any influence on the capacity of Cintec anchors embedded in Ohio sandstone masonry blocks using either 75mm or 150mm sock lengths. Figure 11 also shows that providing a

150mm sock length does not visibly improve the capacity of the repair technique from what can be achieved with a 75mm sock length. The result is also true when considering samples repaired with a 200mm sock length but more specimens need to be tested with this configuration. It should also be noted from the results of this figure that the capacity of anchors with 75mm sock length display more variability (±2.23kN standard deviation) than for anchors with 150mm sock length (±0.69kN standard deviation).

Table 3 – Pullout Test Results

Specimens	Sock Length [mm]	Ultimate Load [kN]	Failure Type	Description / Weathering Conditions
C75-1	75	40.7	Steel Failure (@Washer)	Control Samples (Ambient Laboratory Conditions) TEMPERATURE: ~20°C HUMIDITY: negligible effect
C75-2		40.9	Steel Failure	
C75-3		41.3	Steel Failure	
C75-4		39.3	Steel Failure (@Washer)	
C75-5		35.6	Steel Failure (@Washer)	
C150-1	150	39.2	Steel Failure (@Washer)	
C150-2		39.7	Steel Failure (@Washer)	
C150-3		39.9	Steel Failure (@Washer)	
C150-4		39.7	Steel Failure (@Washer)	
C150-5		40.4	Steel Failure (@Washer)	
U75-1	75	40.1	Steel Failure	Dry Freeze-Thaw Samples (ASTM E1512-01) -18°C ≤ TEMPERATURE ≤ 4°C HUMIDITY: negligible effect
U75-2		37.9	Steel Failure (@Washer)	
U75-3		39.8	Steel Failure (@Washer)	
U75-4		33.2	Steel Failure (@Washer)	
U75-5		40.8	Steel Failure	

Table 4 – Pullout Test Results (*continued...*)

U150-1	150	40.4	Steel Failure (@Washer)	Dry Freeze-Thaw Samples (ASTM E1512-01) -18oC ≤ TEMPERATURE ≤ 4oC HUMIDITY: negligible effect
U150-2		39.7	Steel Failure	
U150-3		40.0	Steel Failure (@Washer)	
U150-4		40.9	Steel Failure	
U150-5		40.5	Steel Failure (@Washer)	
R75-1	75	38.4	Steel Failure (@Washer)	Wet Freeze-Thaw Samples (ASTM C666/C666M-03) -23°C ≤ TEMPERATURE ≤ 40°C HUMIDITY: 100%
R75-2		40.1	Steel Failure (@Washer)	
R75-3		38.6	Steel Failure (@Washer)	
R75-4		40.8	Steel Failure	
R75-5		40.2	Steel Failure (@Washer)	
R150-1	150	40.8	Steel Failure (@Washer)	
R150-2		39.8	Steel Failure (@Washer)	
R150-3		40.3	Steel Failure (@Washer)	
R150-4		38.1	Steel Failure	
R150-5		40.2	Steel Failure (@Washer)	
R200-1	200	41.1	Steel Failure (@Washer)	
R200-2		40.9	Steel Failure	
R200-3		38.5	Steel Failure	
R200-4		39.8	Steel Failure (@Washer)	
R200-5		39.8	Steel Failure (@Washer)	

It was also made apparent from the analysis of test results that considerable elongation of the threaded rod took place for both types of failure. The elongation was captured by the longer range LVDT and was attributed to yielding of the threaded rod prior to failure. The extent of elongation is illustrated more clearly in Figure 12 and appears to be sustained under loads gradually increasing towards failure.

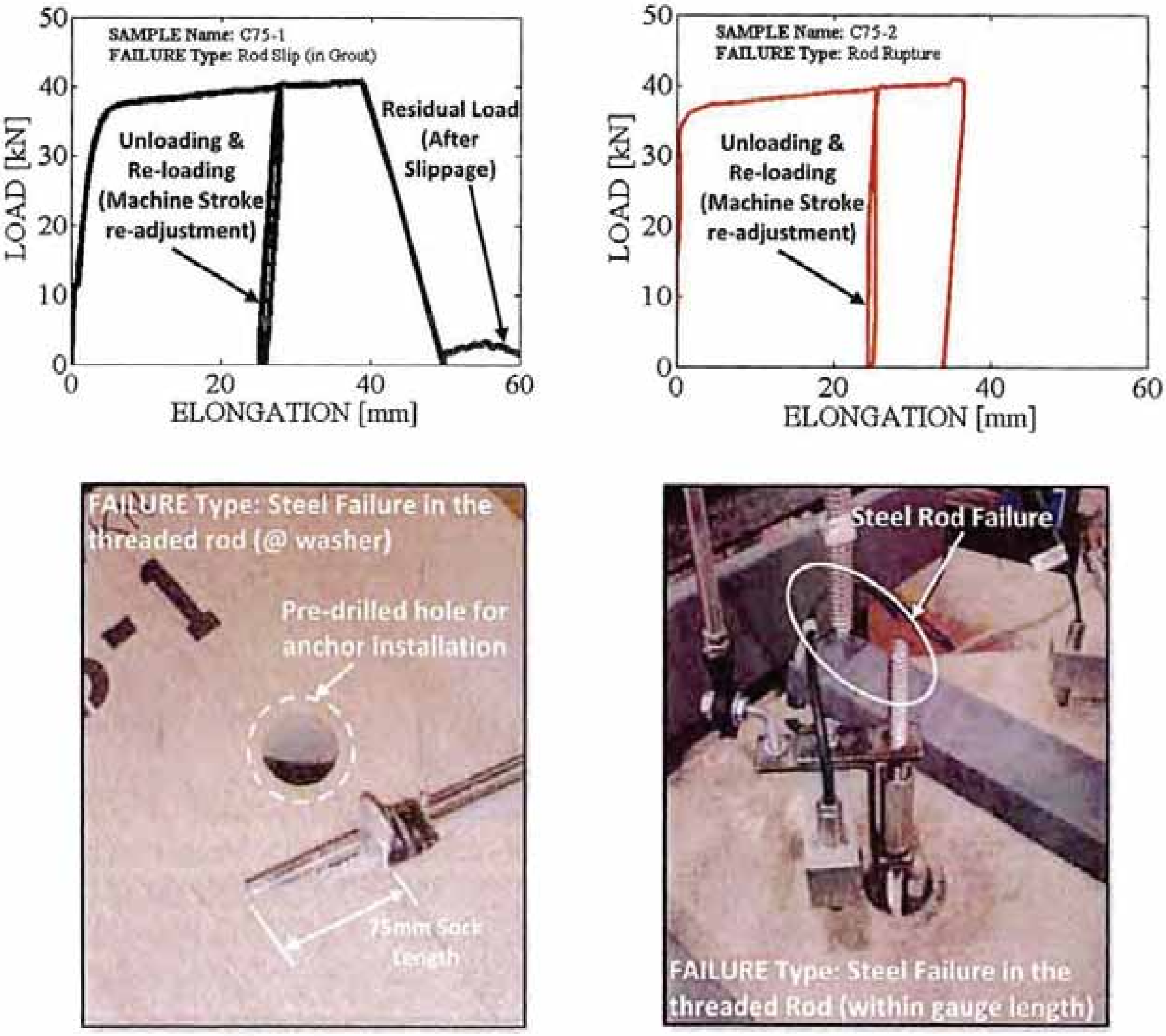


Figure 12 – Load-Elongation Behaviour (Control Samples – 75mm Sock Length)

This ductile behaviour provided by the Cintec repair technique is strongly advantageous because it provides ample warning of impending failure while sustaining a surcharge comparable to the capacity of the anchor. Figure 12 also shows that there is a slight recovery of load once the threaded rod has initiated slip within the grouted portion of the anchor. This residual load gradually reduces until the rod is completely removed from the assembly. Finally, the figure displays an unloading/re-loading stage that was required in most of the tests to re-adjust the stroke of the machine once the limit was reached. The load-elongation behaviour for all samples tested in this study can be found in Appendix A of this report.

Another key observation made after testing relates to the quality of the grouted portion of the anchor, particularly at the interface with the stonework within the hole that was drilled for installation. Failure is initiated by yielding of the rod, after which considerable elongation causes damage to the grout surrounding the rod during testing. Figure 13 suggests that this damage is contained in the vicinity of the rod as well as at the top of the grouted hole. It does not extend towards the interface to affect the bond between the fabric sock and the stonework. The result underlines another advantage of the Cintec anchorage system for rehabilitating structures similar to the West Block building on Parliament Hill.

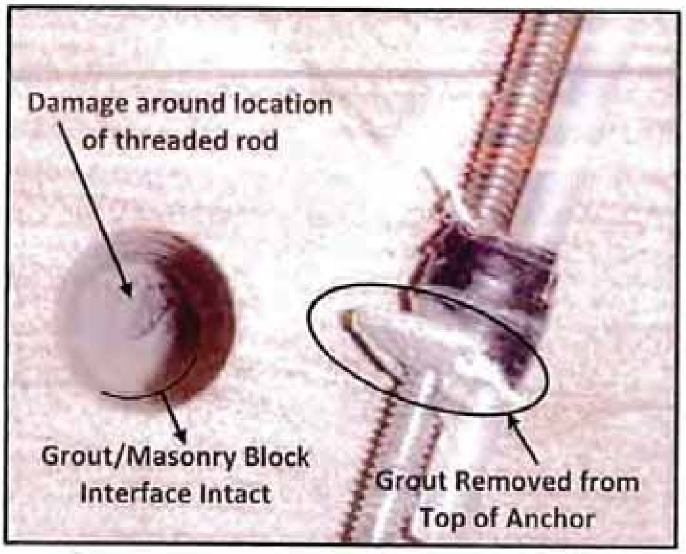


Figure 13 – Grouted Hole after Threaded Rod Pullout (Control Sample C75-1)

7. Estimation of Pullout Loads and Failure Modes

As observed in Table 3 and mentioned in the previous section, there are two main failure modes observed for the Cintec anchors embedded in the Ohio Sandstone blocks provided by PWGSC. These include steel failure in the rod between the stonework and the machine fixtures. In order to evaluate the first of these failure modes, we refer to test data provided in the BRE Technical Consultancy Report (November 1990) for Cintec anchors. The data was obtained from tests conducted on masonry samples that were instrumented with 8mm diameter steel rods grouted in 40mm diameter holes that were 60mm in length. The sample geometry is shown in Figure 14 and, using force equilibrium, can be used to derive an expression (EQ.1) for the average bond strength between the steel rod and grout.

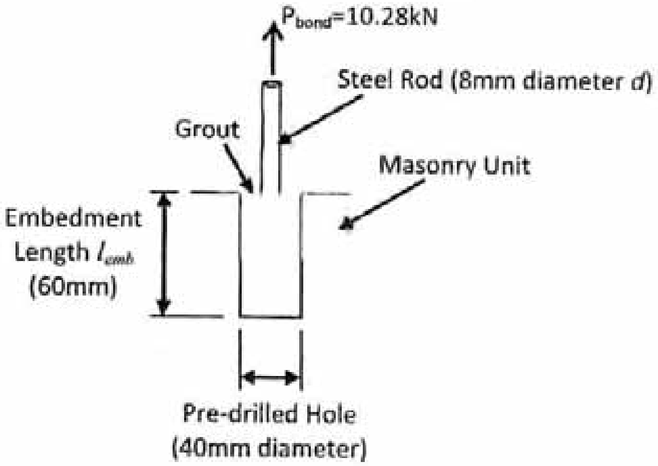


Figure 14 – Grouted Cintec Anchor Assembly (BRE Technical Consultancy Report, 1990)

$$\tau_{bond} = \frac{P_{avg}}{\pi l_{emb} d} \qquad \text{EQ.1}$$

In this equation, τ_{bond} is the average bond strength between the steel rod and grout, P_{avg} is the average recorded pullout load reported in the document (10.3kN), l_{emb} is the embedment length (60mm) and *d* is the diameter of the pre-drilled hole (40mm). Based on this equation and the sample geometry shown in Figure 14, the average bond strength of steel rods grouted using the Cintec method can be evaluated as 6.83MPa. This value can be used to evaluate the load P_{bond} required to pull the threaded rods from the Presstec grout used in this project. The average bond strength must be multiplied by the circumferential area surrounding the rod (EQ.2). This area is a function of the embedment length chosen for the study. As mentioned in previous sections, the lengths were chosen to vary from 75mm to 150mm and finally 200mm.

$$P_{bond} = \tau_{bond} \pi l_{emb} d \qquad \text{EQ.2}$$

Substituting the values for average bond strength and nominal threaded rod diameter (9mm) gives a more convenient expression for establishing the ultimate load initiated by bond failure during the pullout tests in this study (EQ.3). The embedment length remains unknown and can be substituted depending on the sample under consideration.

$$P_{bond} = 0.193 l_{emb} \qquad \text{EQ.3}$$

The second type of failure is governed by yielding, and eventually steel failure in the threaded rod. The ultimate load expected from this type of failure (EQ.4) can be evaluated by considering clause 13.12.1.2 of the CISC Handbook of Steel Construction (2008) for bolts or threaded rods in tension. It should be noted that the resistance factor was not considered because we are seeking an accurate representation of the steel failure load, without any allowance for conservatism.

$$P_{\text{steel failure}} = 0.75F_uA_b \qquad \text{EQ.4}$$

In this expression, $P_{steel\,fialure}$ is the load required to cause steel failure in the threaded rod during the test, F_u is the minimum nominal strength of a bolt or threaded rod in tension and A_b is the nominal area of the bolt or threaded rod. If a nominal tensile strength of 825MPa for the stainless steel threaded rods (type A325M) after strain hardening is assumed along with a nominal diameter of 9mm, the steel failure load can be evaluated as 39.4kN. This value along with those obtained from EQ.3 when varying the embedment length from 75mm to 150mm and 200mm are summarized in Table 1 to give information on the mode of failure that is expected from the pullout tests performed on the stone blocks provided by PWGSC.

Table 5 - Strength Estimation and Failure Modes

Embedment/Sock Length [mm]	P_{bond} [kN]	$P_{\text{steel failure}}$ [kN]	Failure Mode
75	14.5	39.4	Bond (P_{bond}<$P_{rutpure}$)
150	29.0	39.4	Bond (P_{bond}<$P_{rutpure}$)
200	38.6	39.4	Bond (P_{bond}<$P_{rutpure}$)

It should be noted at this stage that the strength values for bond of the threaded rods in the Presstec grout (P_{bond}) in Table 5 follow a linear trend with embedment length. Although this behavior is anticipated when considering the fundamentals of bond transfer, the ultimate loads observed during the pullout tests conducted on the stone blocks provided by PWGSC did not confirm this result. The ultimate loads for samples exhibiting slippage in the grout were found to be much higher and consistent with those describing steel failure in the threaded rod ($P_{steel\,failure}$). The outcome can be attributed to the fact that a 25mm diameter, 6.5mm thick steel washer was tapped and screwed to the tip of the threaded rod at the bottom of the grouted hole. This assembly, illustrated in Figure 15, provides additional strength and prevents the rods from slipping out of the grout at the loads shown in Table 5. It is believed that failures exhibiting slippage between the threaded rod and grout are initiated by steel failure in the rod at the bottom of the grouted hole, immediately above the washer. This additional strength will increase the ultimate loads listed in Table 5 for bond failure to that which is equivalent to steel failure and thereby confirms the consistency obtained for pullout loads listed in Table 3 despite having used varying embedment (sock) lengths for the anchors.

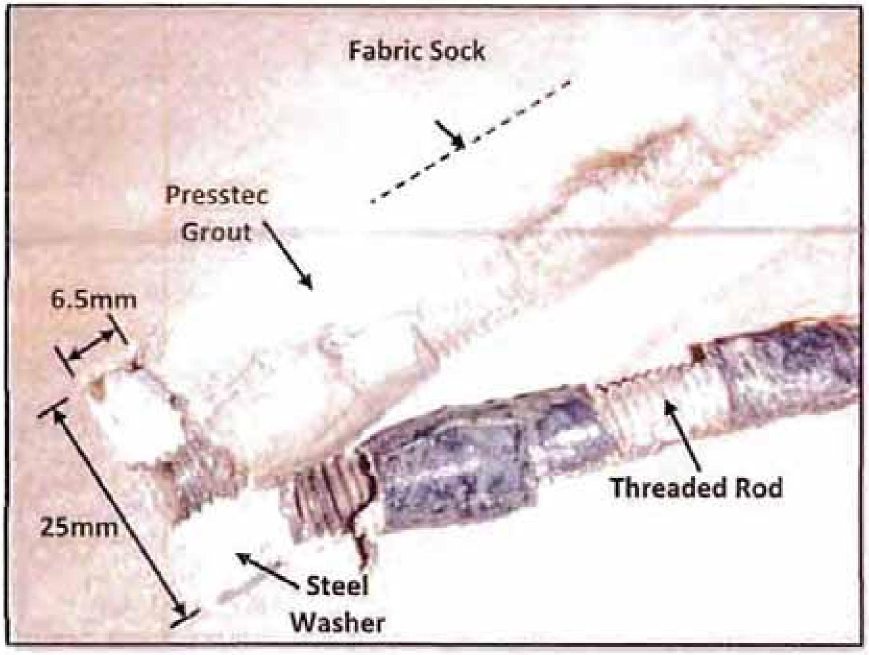
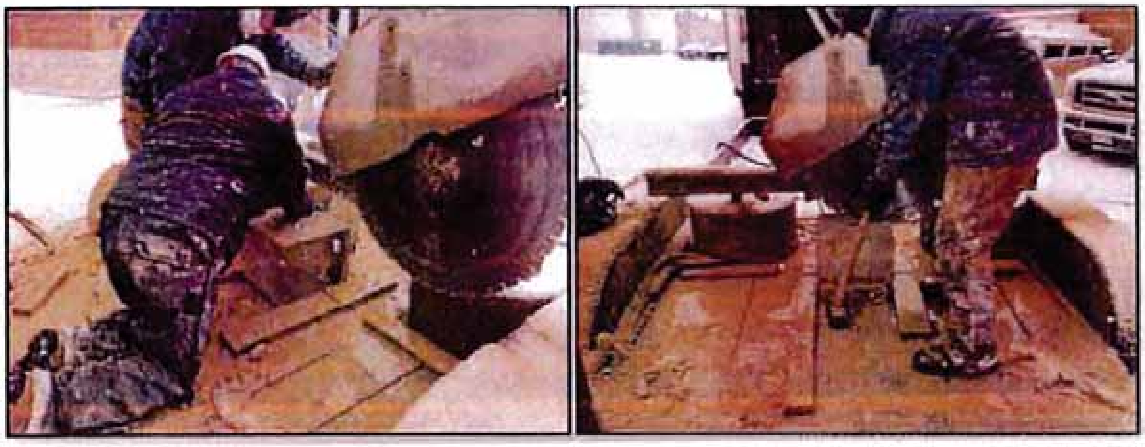


Figure 15 – Cintec Anchor Assembly with Bottom Threaded Washer

A complete illustrative documentation of the failure planes similar to the one shown in Figure 15 after testing is provided in Appendix B of this report. The illustrations do not show evidence of damage in the grouted portion of the anchor for any of the failure modes, which indicates that the Cintec rehabilitation technique is resilient despite the consideration of thermal weathering. It should be noted that the failure planes in these illustrations were exposed by sectioning the samples down the center of the grouted hole. Sectioning was performed by DiTECH International Inc. and took place at the University of Manitoba. Several pictures of the sectioning procedure are shown in Figure 16.



(a) Placement (b) Adjustment under the Blade

(c) Cutting (d) Removal of Sectioned Pieces

Figure 16 – Sectioning Procedure (DiTECH International Inc.)

8. Conclusions and Recommendations

Several conclusions and recommendations can be drawn from the findings reported in this document. They pertain to the results of pullout tests performed on Ohio sandstone masonry blocks instrumented with a Cintec anchor having various sock lengths and subjected to weathering conditions expected in the Canadian climate:

(1) After close examination prior to and after conditioning, the masonry blocks did not reveal any form of deterioration from the application of adverse weathering environments and showed minimal weight loss due to conditioning.

(2) The ultimate loads recorded during pullout testing are consistent among all samples in this study and do not reveal any form of evidence that would suggest a reduction in the capacity of the anchorage system in Ohio sandstone after 150 dry freeze-thaw or rapid freeze-thaw cycles.

(3) Results indicate that the samples with 150mm sock length anchors do not provide additional capacity from that initially obtained for samples instrumented with a 75mm sock length anchor. The same outcome was observed for samples instrumented with 200mm sock lengths. The outcome is attributed to the fact that a steel washer is screwed to the threaded rod at the bottom of the grouted hole to prevent slippage.

(4) The load-elongation behaviour of the anchorage assemblies used in this study contains a significant amount of elongation from the threaded rod prior to failure. This allows ample warning of impeding failure while loads close to the capacity of the anchor are being sustained.

(5) The amount of elongation monitored during the pullout tests is attributed to the fact that the repair technique has sufficient strength to cause yielding of the rod before any signs of slippage can be detected.

(6) Although several of the threaded rods failed by steel failure between the surface of the stone and the gripping mechanism (anchorage plates) of the machine, the analysis provided in this report for evaluating pullout loads and failure modes suggests that steel failure also occurred at the base of the grouted hole. Once initiated, this steel failure mechanism was the cause for the excessive slippage recorded during the tests. Slippage continued at smaller loads until the rod was fully removed from the sample.

(7) The sectioning procedure performed on the stones revealed that the damage for samples exhibiting slippage was only localized to the vicinity of the threaded rod. It was not found to radiate outward towards the interface separating the grout, the fabric sock and the stonework, which illustrates the quality of the anchorage system despite the consideration of thermal weathering.

(8) It is recommended that future work be undertaken to expand the current project to investigate the performance of full scale multi-wythe walls under the same weathering conditions and rehabilitated with the same Cintec anchorage system.

9. References

(1) American Society for Testing and Materials. (2007). ASTM Standard C666/C 666M-03: *Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing*. Philadelphia, PA: American Society for Testing and Materials.

(2) American Society for Testing and Materials. (2007). ASTM Standard E1512-01: *Standard Test Method for Testing Bond Performance of Bonded Anchors*. Philadelphia, PA: American Society for Testing and Materials.

(3) Arora, S.K., *"Moisture/Temperature Cycling Tests on the CINTEC Remedial Wall Tie."* BRE Technical Consultancy Report, Structural Integrity Division, Garston Watford, England, United Kingdom, November 1990, 32p.

(4) Benedetti, D., and Castoldi, A. (1982). *Dynamic and static experimental analysis of stone-masonry buildings*. Proceedings of 7th European Conference on Earthquake Engineering, 5, pp. 179-188. Athens.

(5) Benedetti, D., & Pezzoli, P. (1996). *Shaking table tests on masonry buildings. Results and Comments*. Politecnico di Milano. Seriate: ISMES.

(6) Binda, L., Modena, C., Baronio, G., & Abbaneo, S. (1997). *Repair and Investigation Techniques for Stone Masonry Walls*. Construction and Building Materials, *11* (3), 133-142.

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(9) Tomazevic, M., Lutman, M., & Weiss, P. (1993). *The seismic resistance of historical urban buildings and the interventions in their floor systems: an experimental study*. The Masonry Society Journal, 12 (1), 77-86.

APPENDIX A

Load-Elongation Behaviour Figures

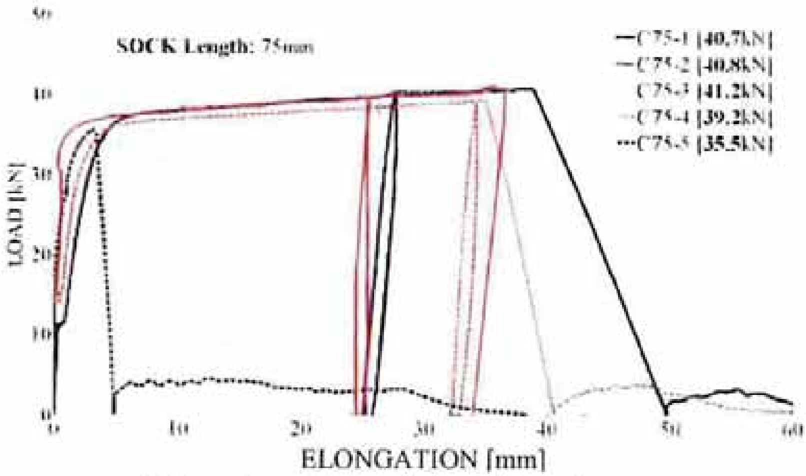


Figure A.1 - Load-Elongation Behaviour (Control Samples - 75mm Sock Length)

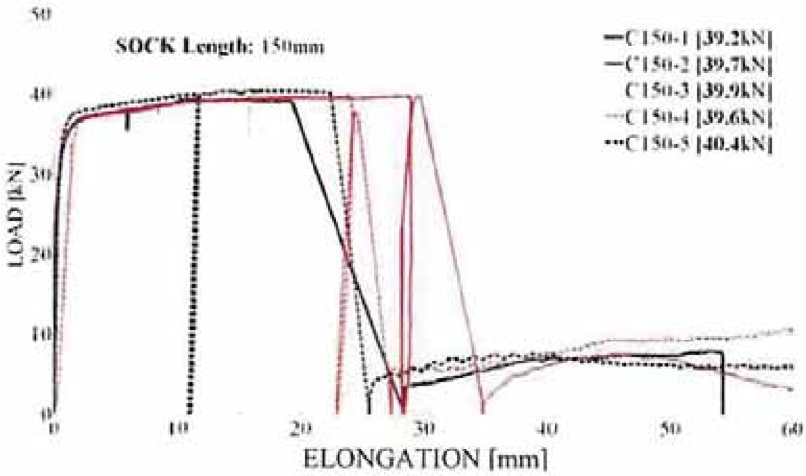


Figure A.2 - Load-Elongation Behaviour (Control Samples - 150mm Sock Length)

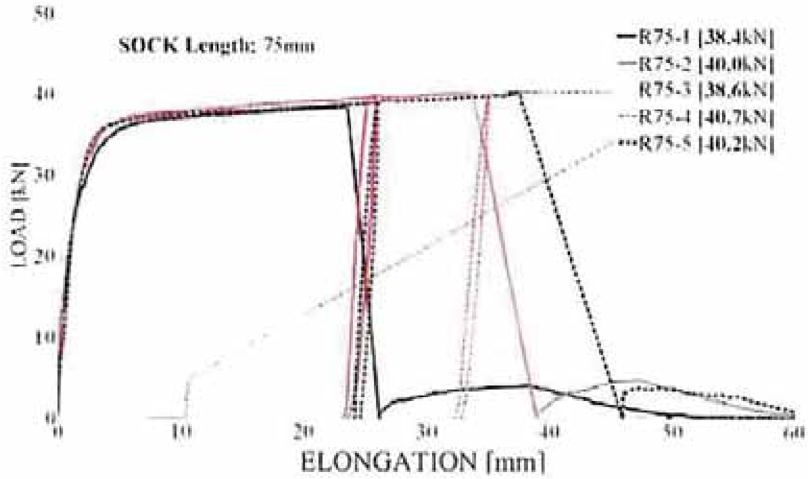


Figure A.3 - Load-Elongation Behaviour (Rapid Freeze-Thaw Samples - 75mm Sock Length)

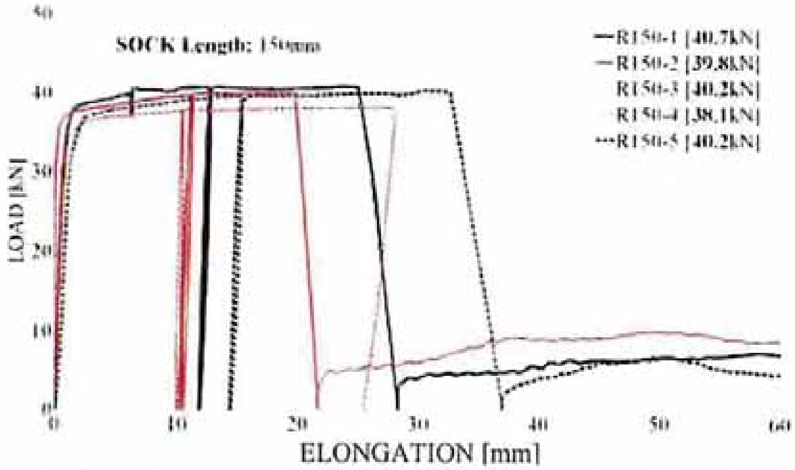


Figure A.4 - Load-Elongation Behaviour (Rapid Freeze-Thaw Samples - 150mm Sock Length)

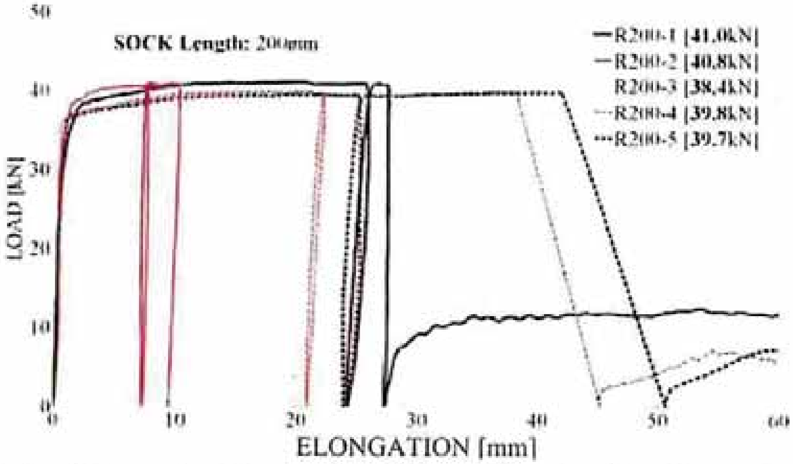


Figure A.5 - Load-Elongation Behaviour (Rapid Freeze-Thaw Samples - 200mm Sock Length)

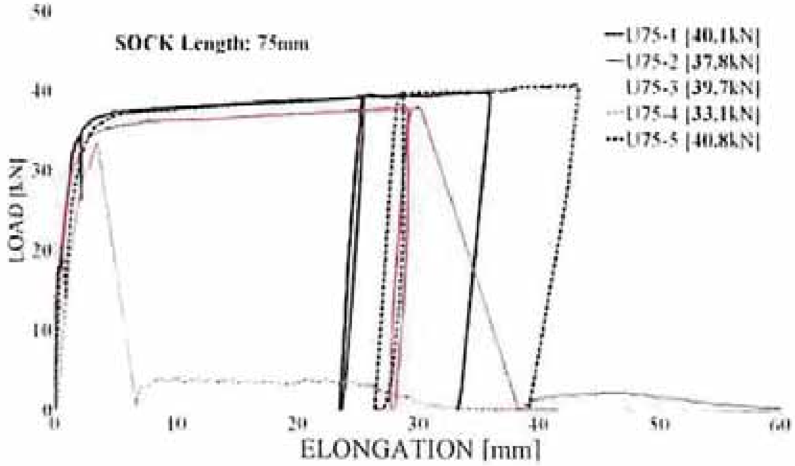


Figure A.6 - Load-Elongation Behaviour (Dry Freeze-Thaw Samples - 75mm Sock Length)

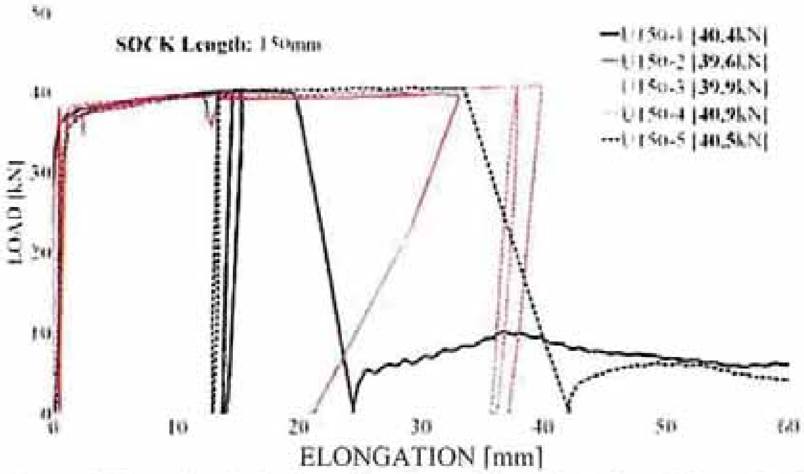
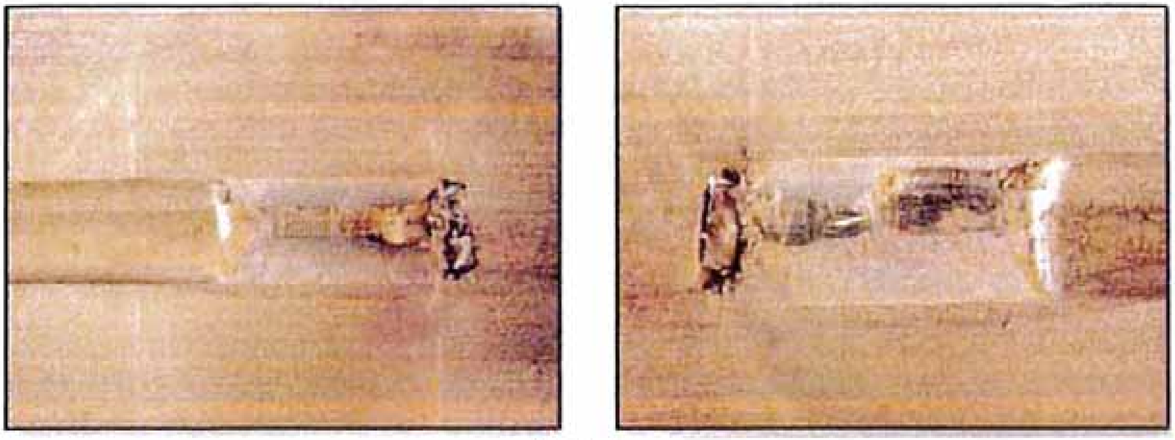


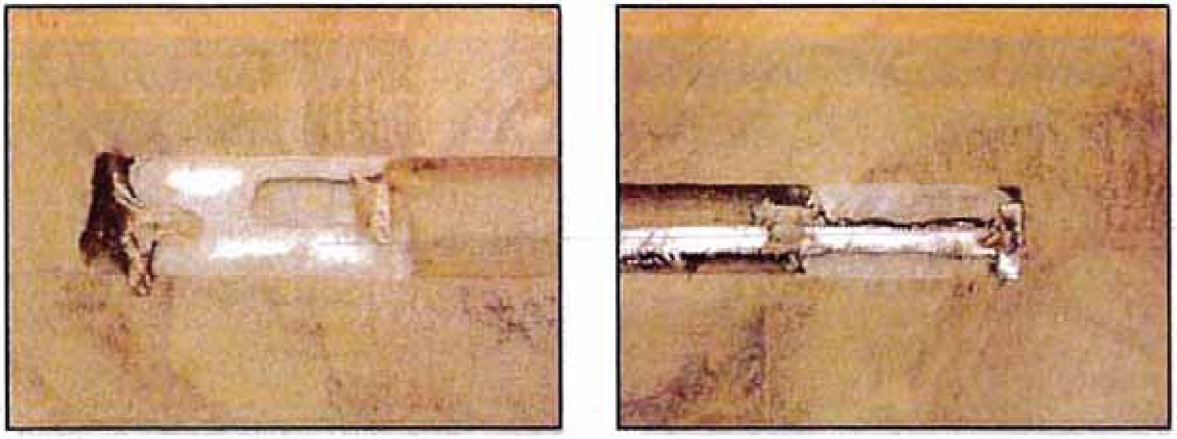
Figure A.7 - Load-Elongation Behaviour (Dry Freeze-Thaw Samples - 150mm Sock Length)

APPENDIX B

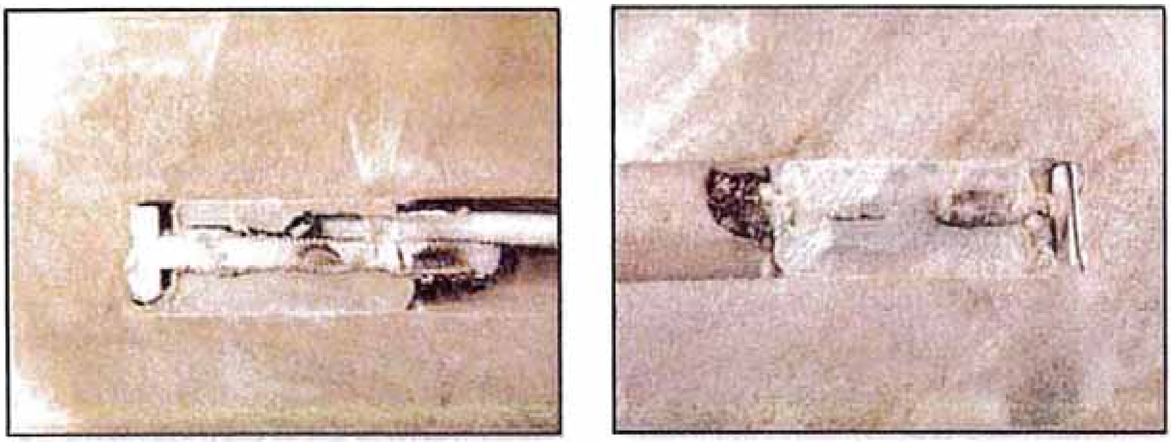
Stone Sectioning Pictures



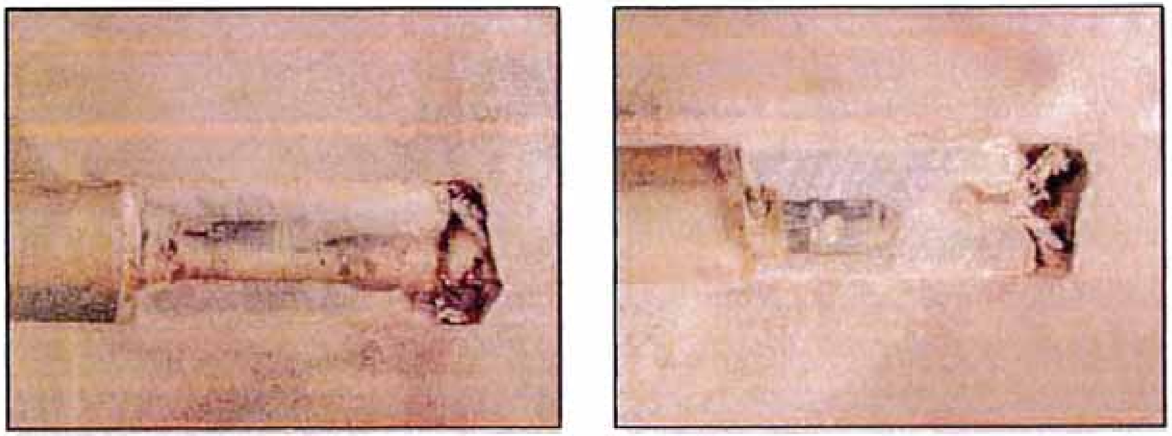
(a)C75-1



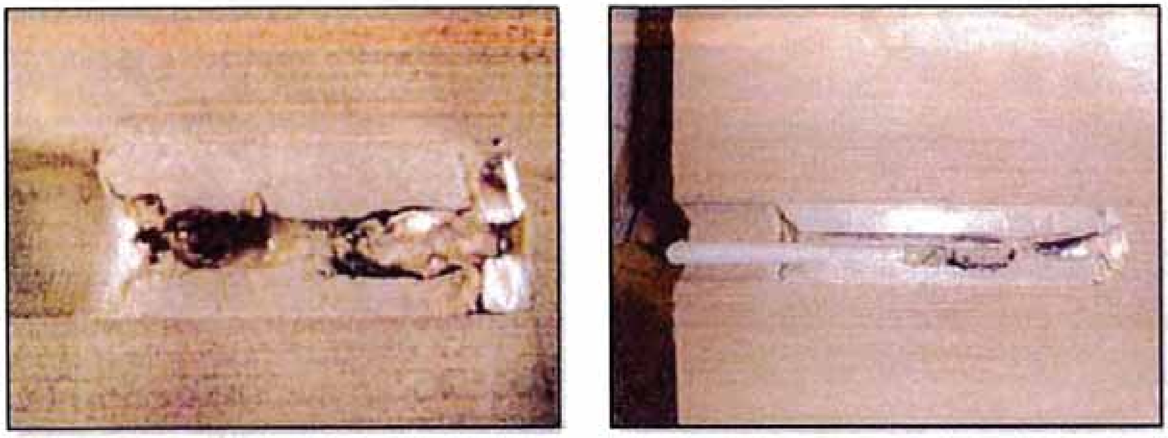
(b)C75-2



(c)C75-3

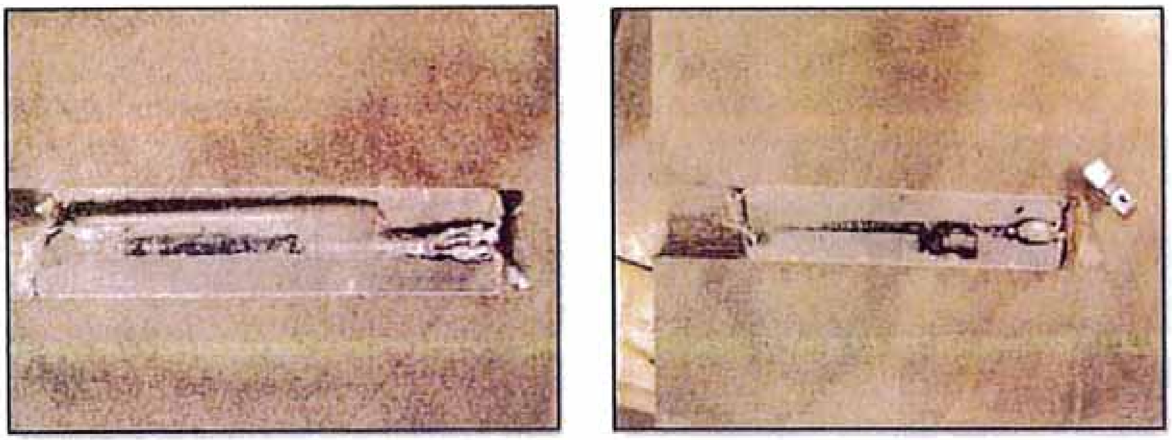


(d)C75-4

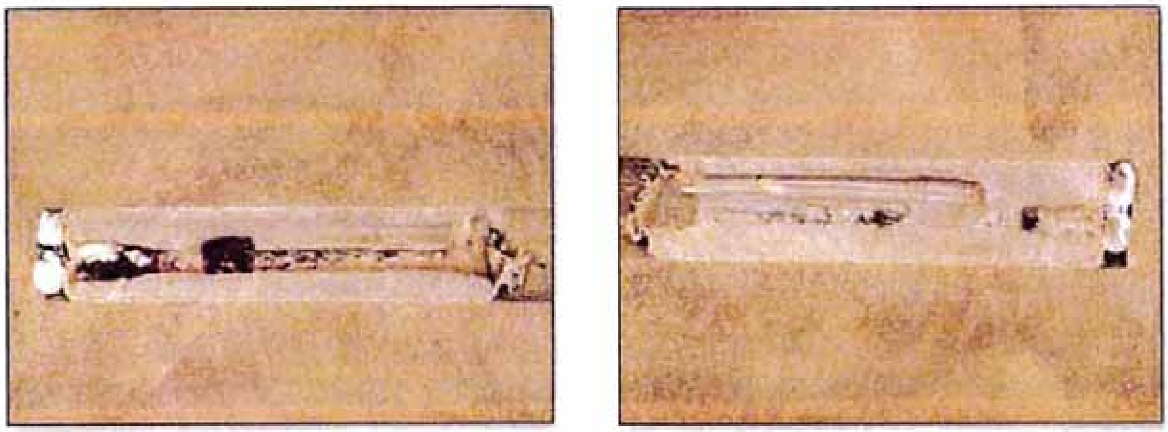


(e)C75-5

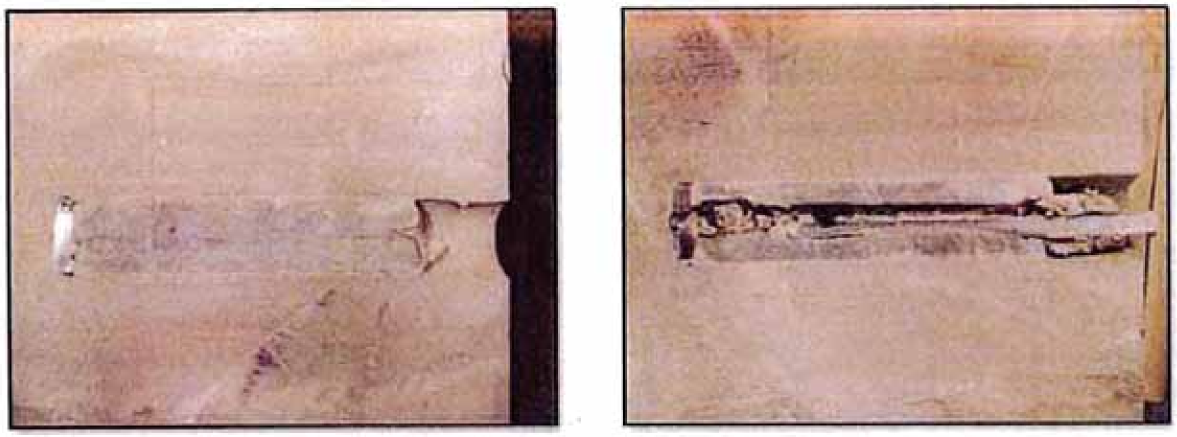
Figure B.1 – Control Samples (75mm Sock Length)



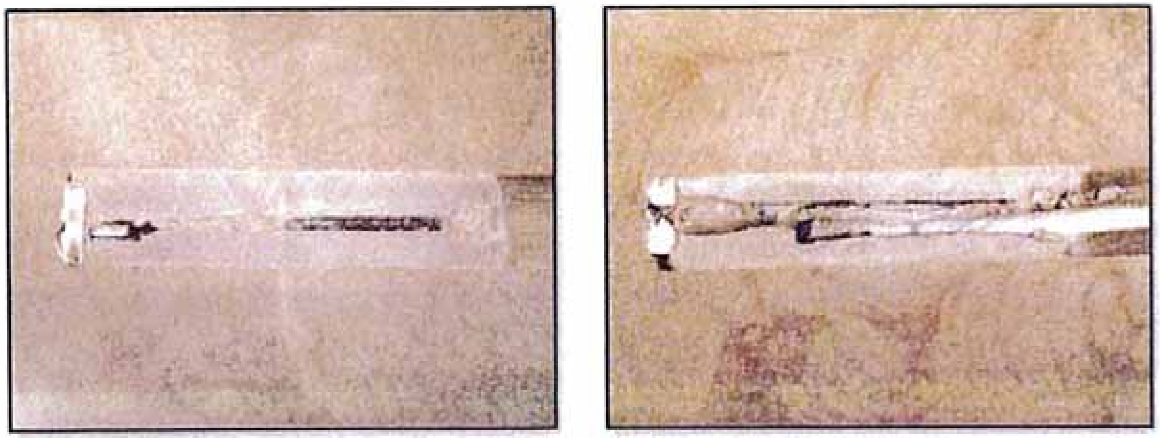
(a)C150-1



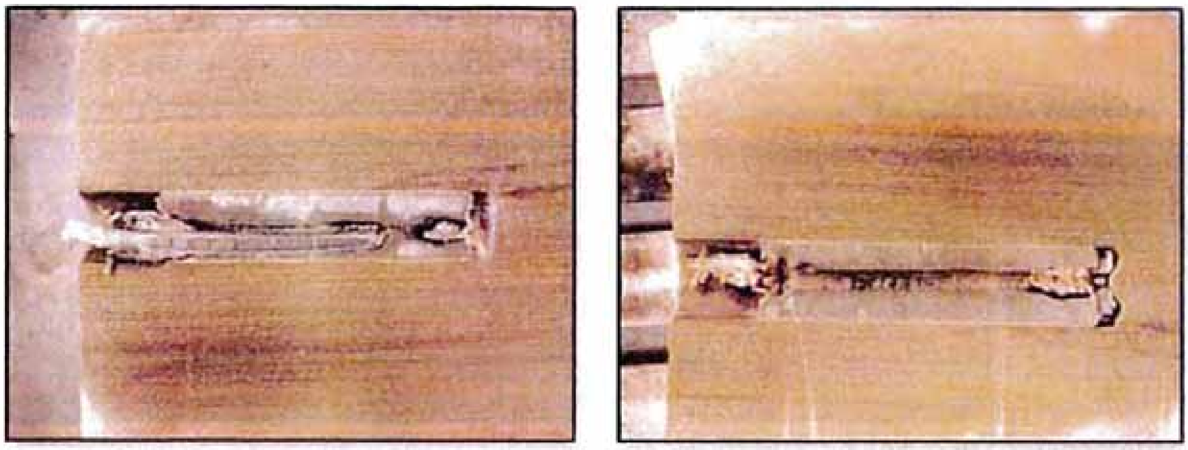
(b) C150-2



(c) C150-3

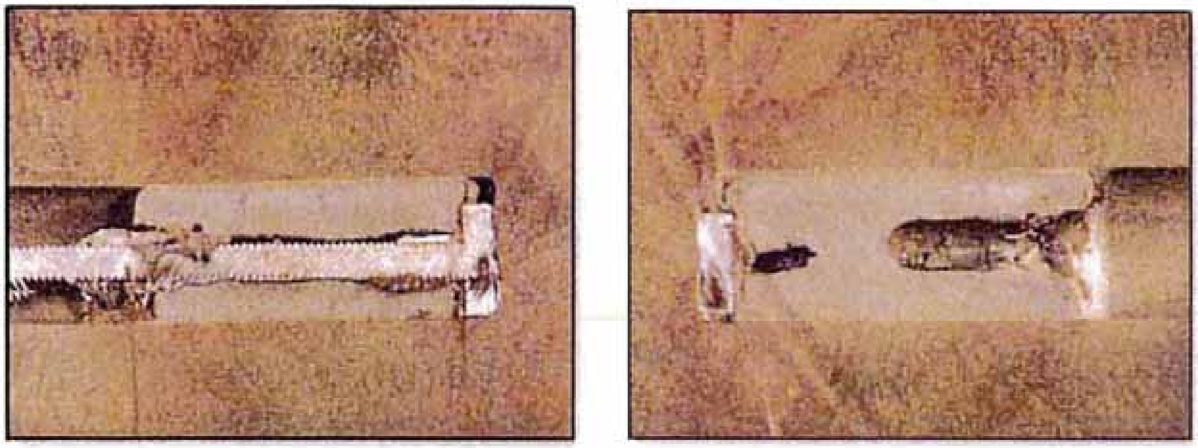


(d) C150-4

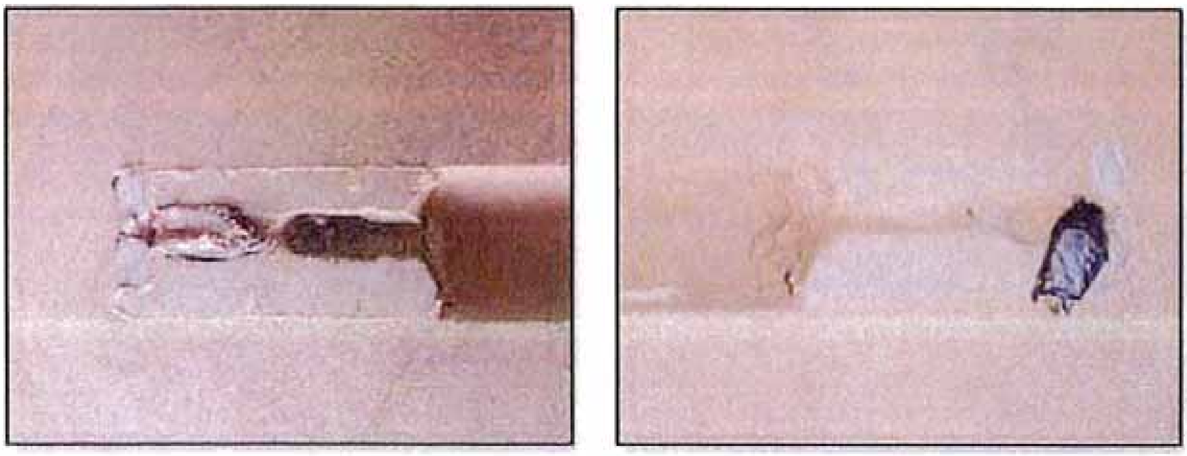


(e) C150-5

Figure B.2 – Control Samples (150mm Sock Length)



(a)U75-1



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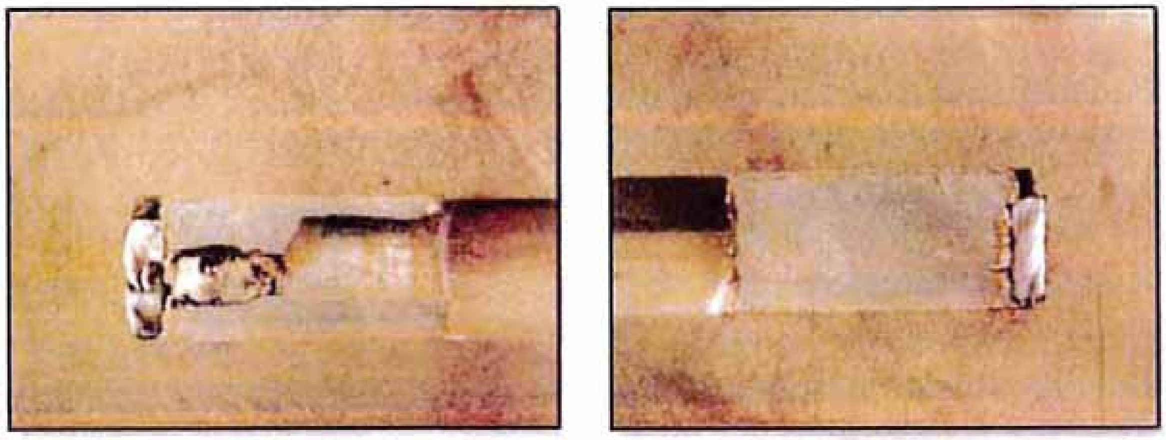

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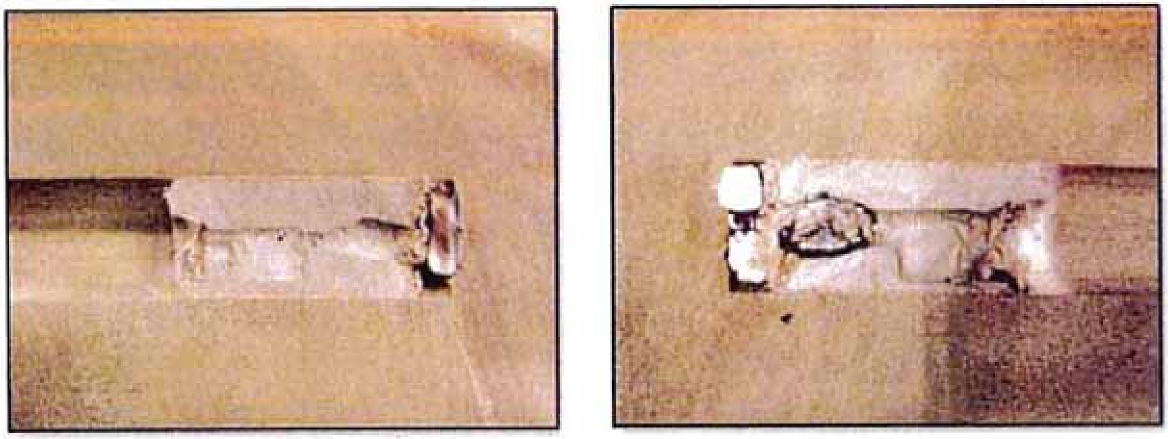

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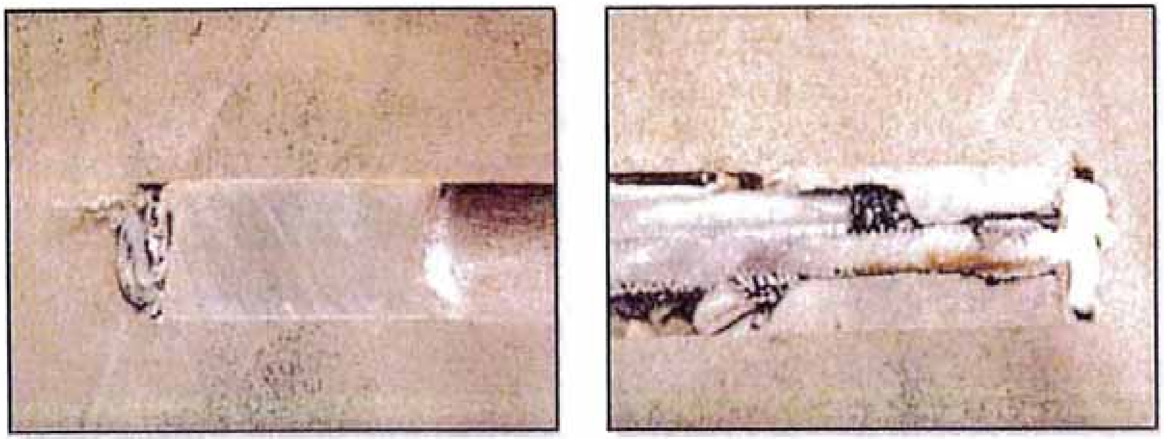

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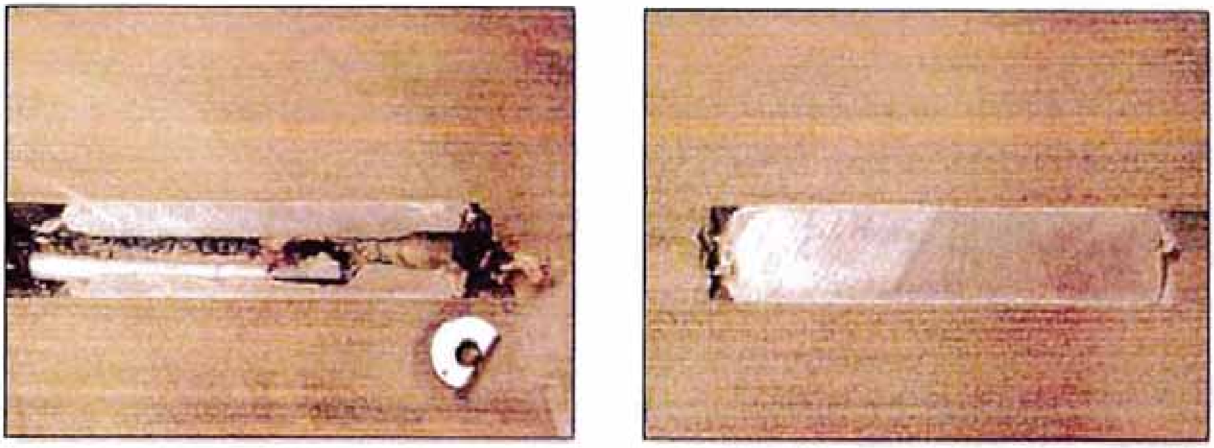
Figure B.3 – Dry Freeze-Thaw Samples (75mm Sock Length)



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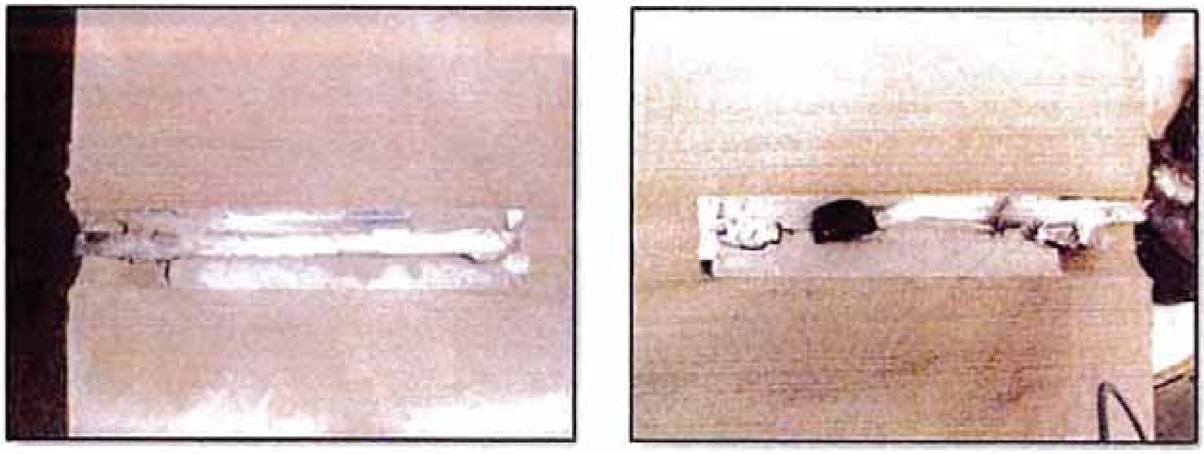

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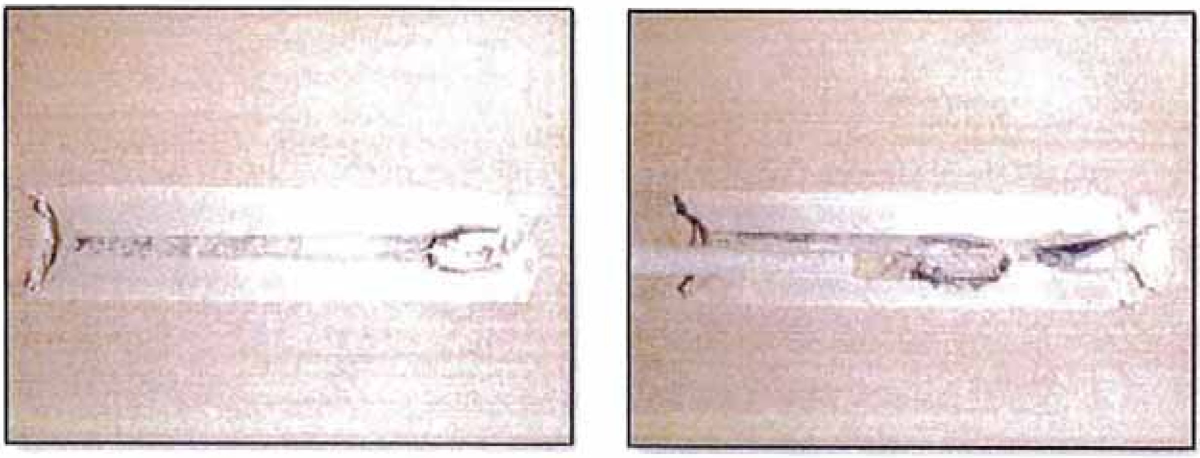

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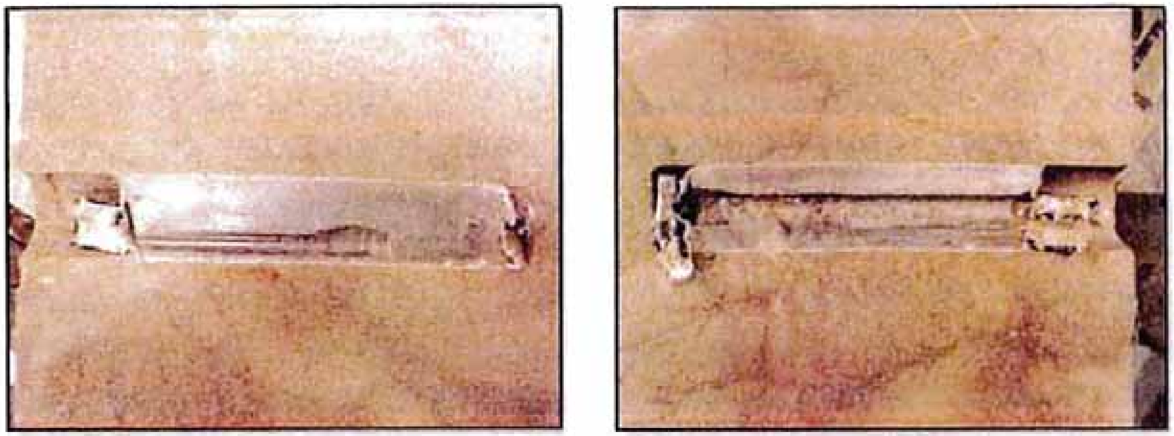

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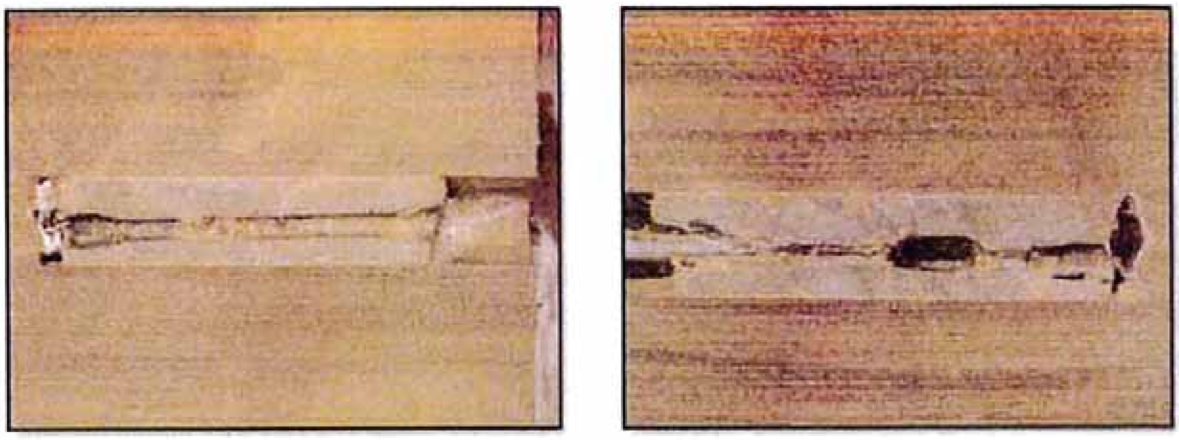
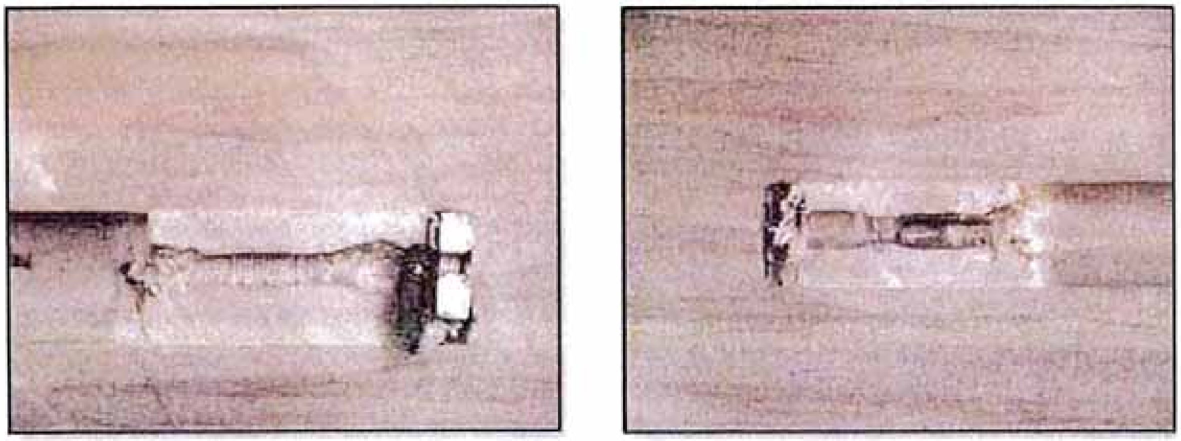


(e)U150-5

Figure B.4 – Dry Freeze-Thaw Samples (150mm Sock Length)



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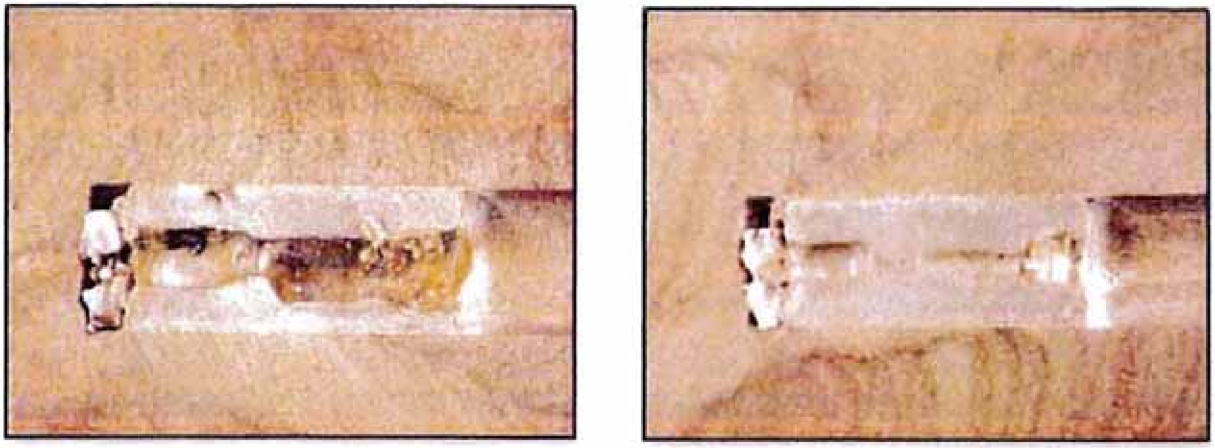

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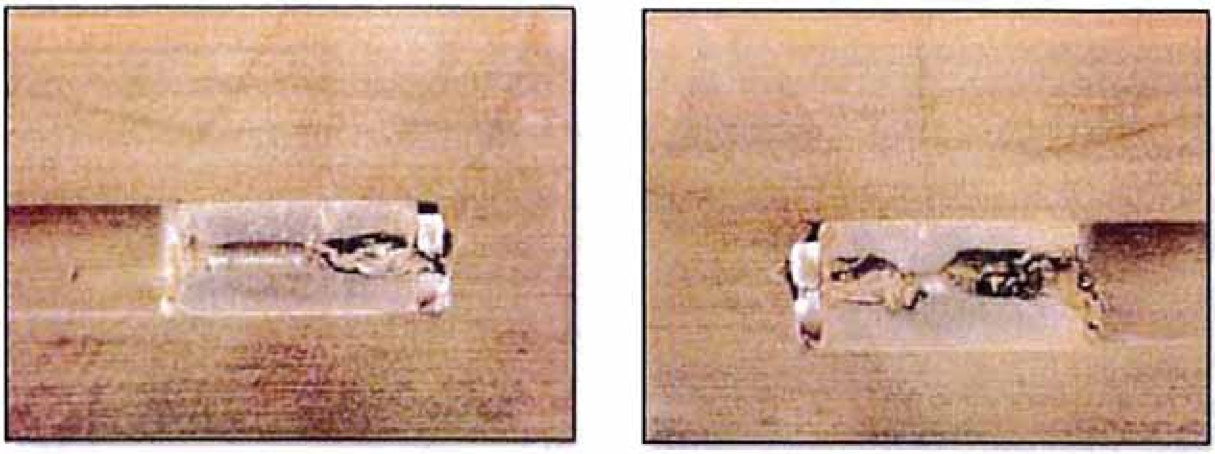

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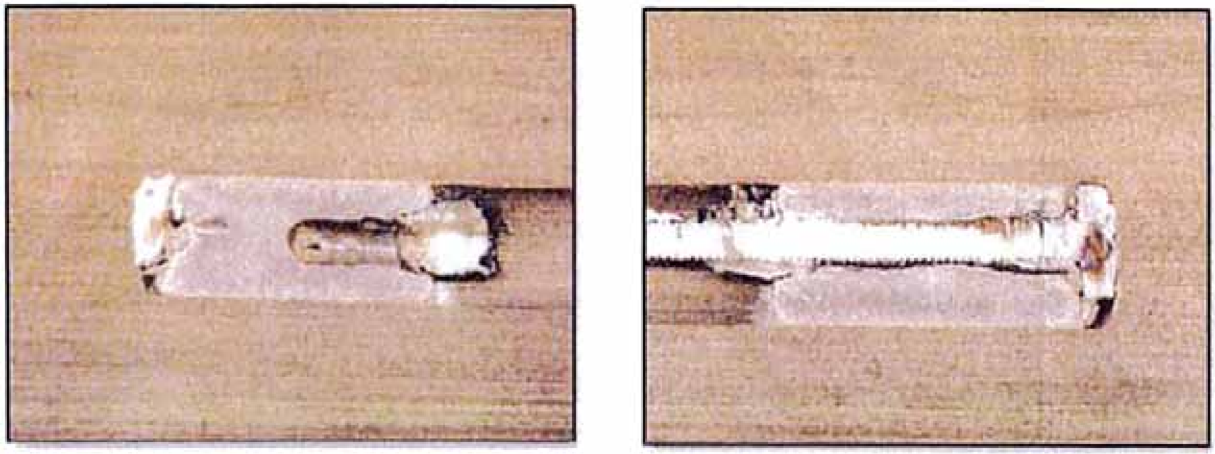
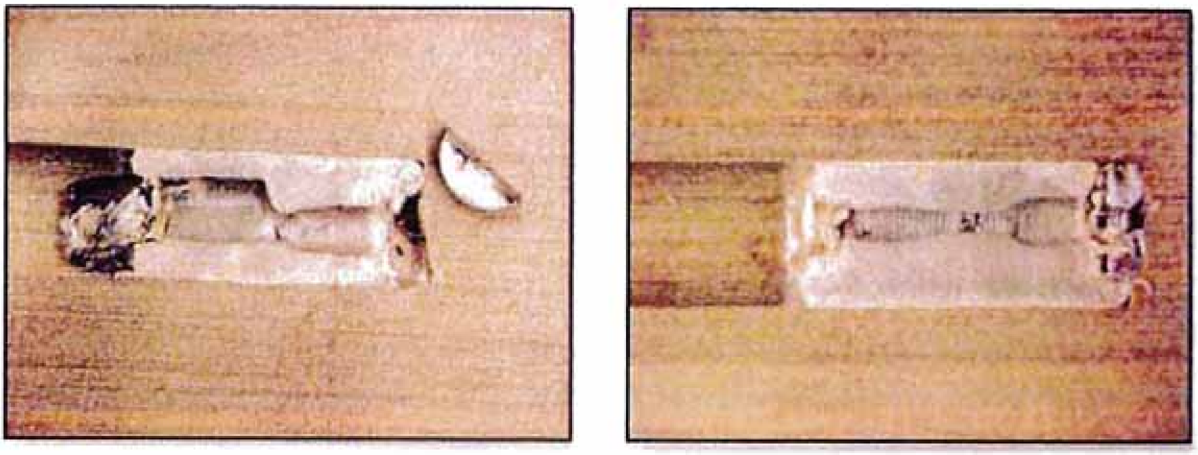
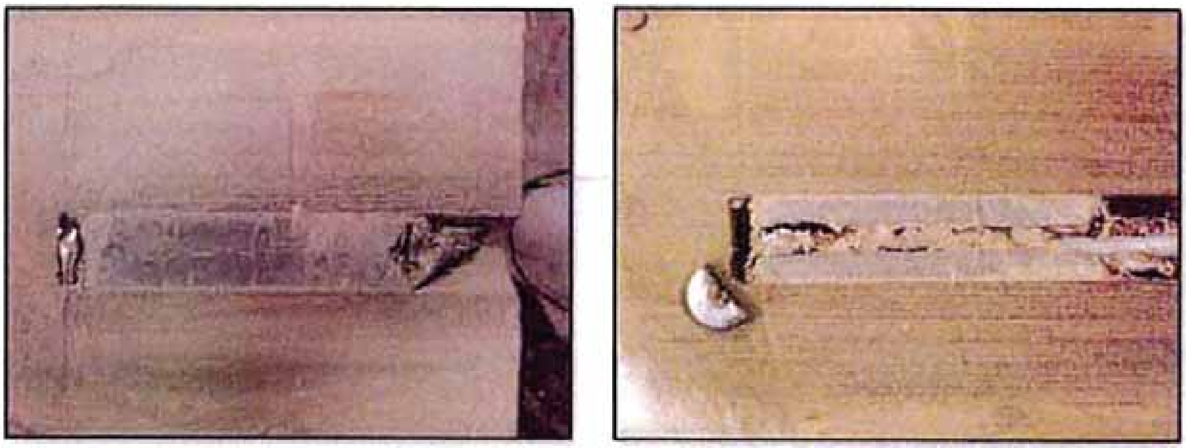


(d)R75-4



(e)R75-5

Figure B.5 – Wet Freeze-Thaw Samples (75mm Sock Length)



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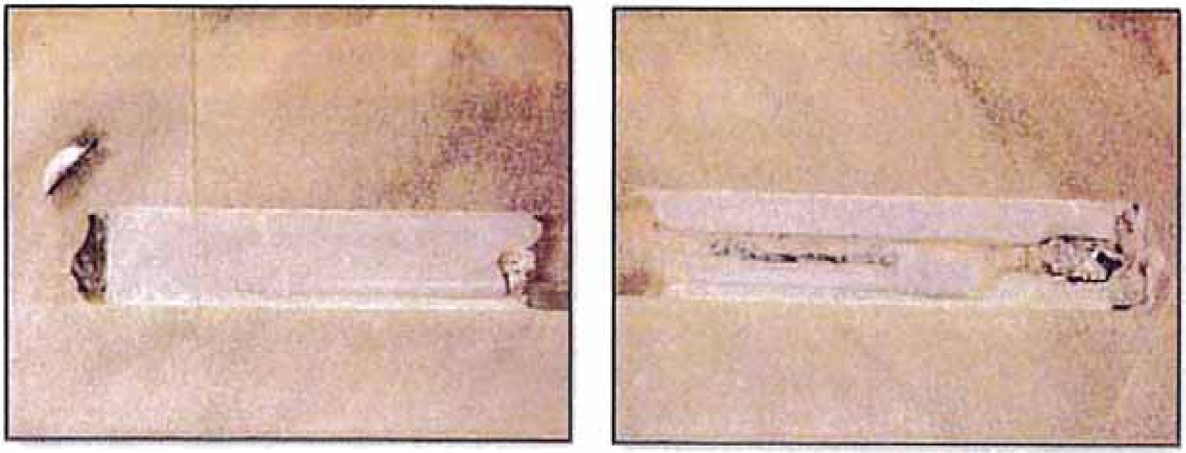

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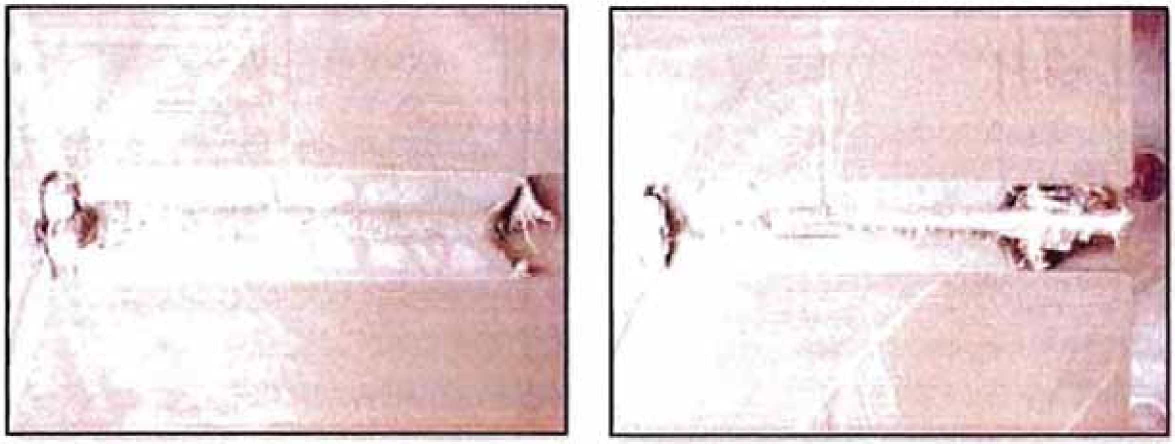

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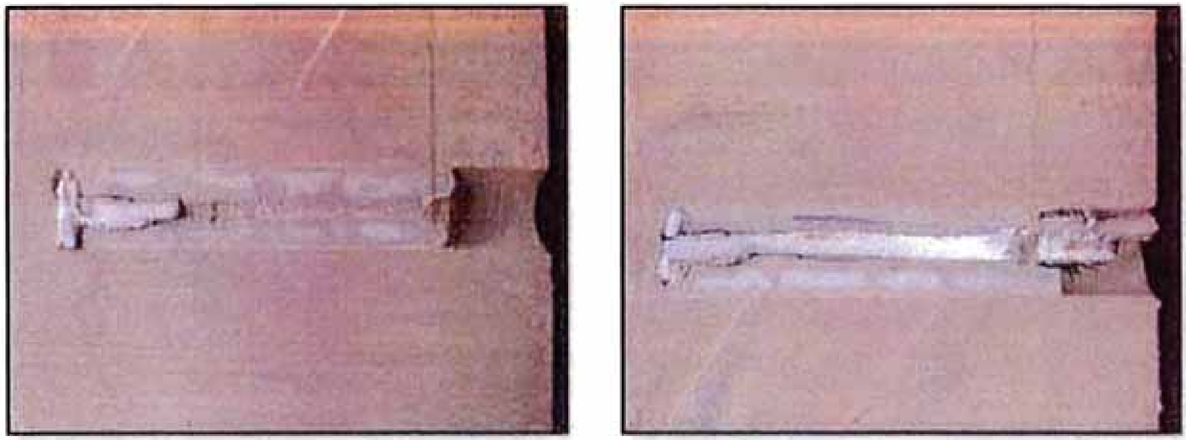

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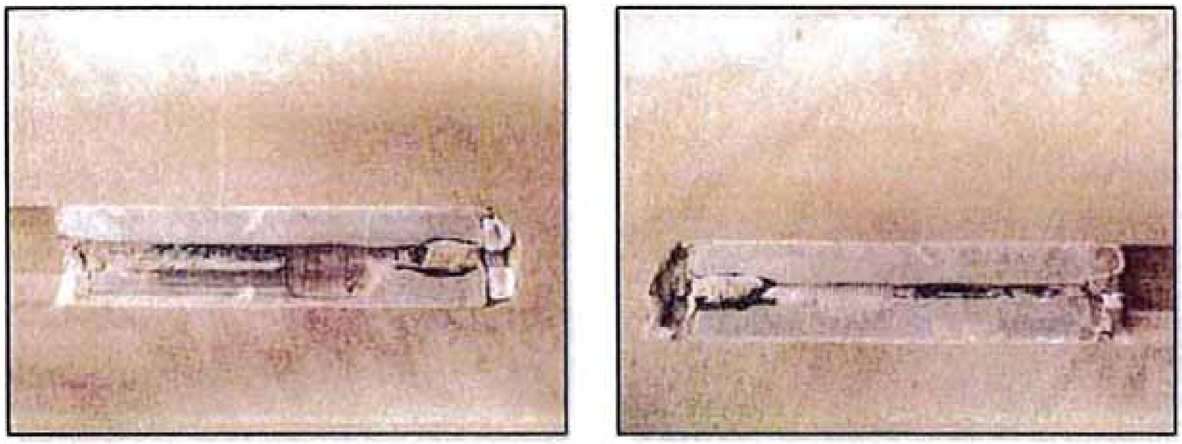
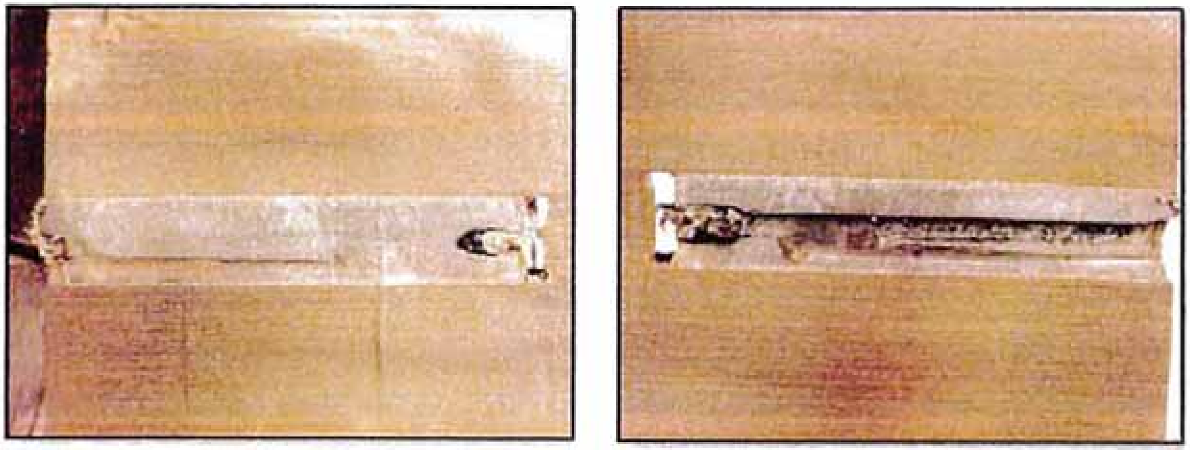
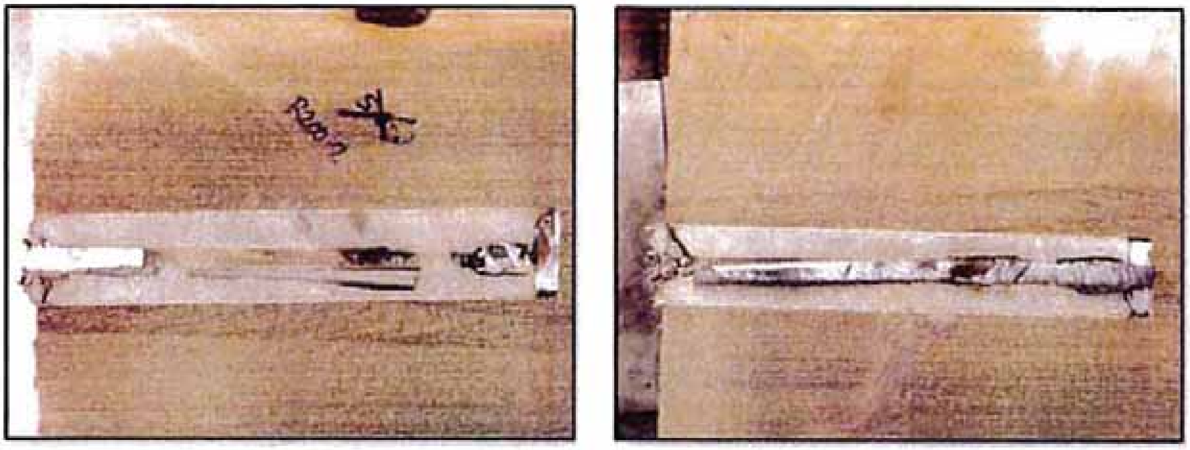


(e)R150-5

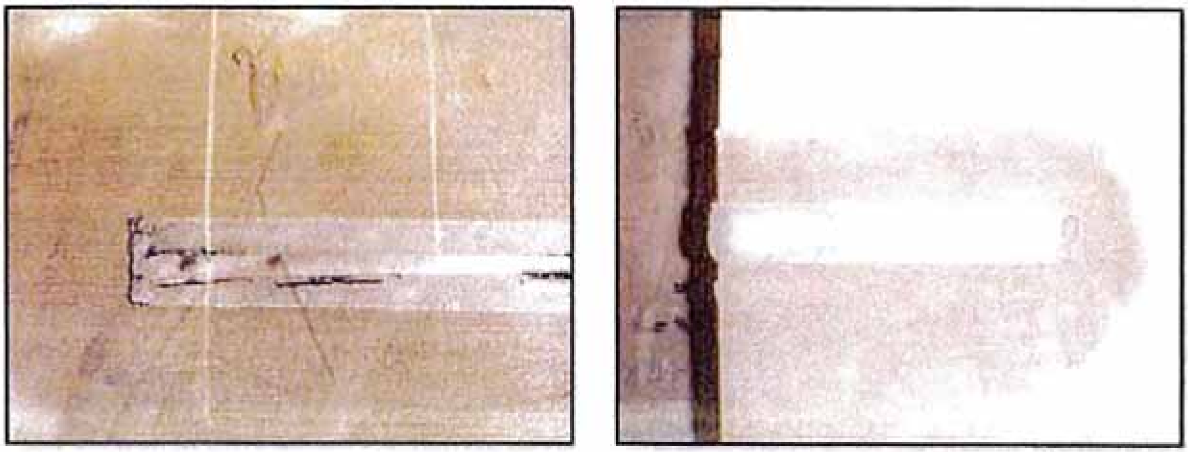
Figure B.6 – Wet Freeze-Thaw Samples (150mm Sock Length)



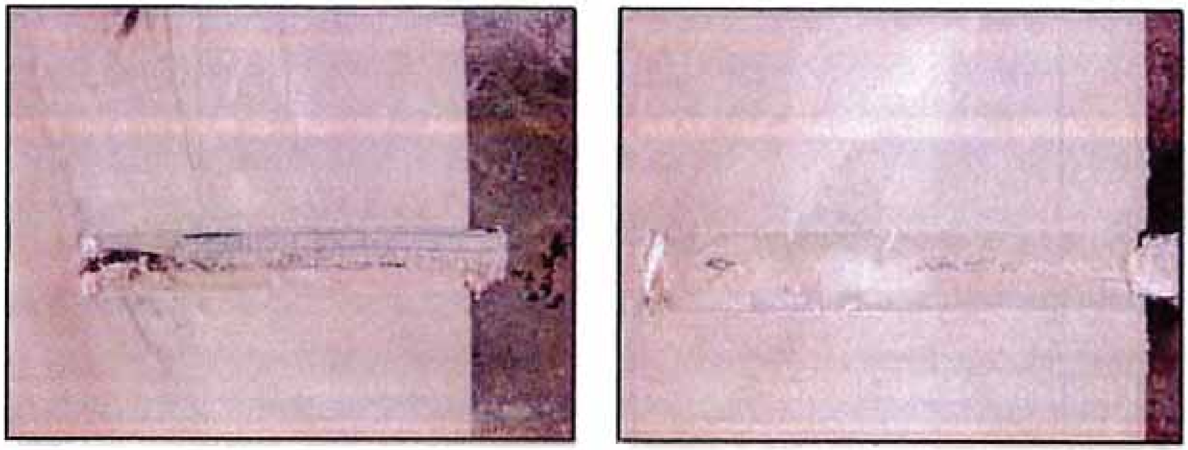
(a) R200-1



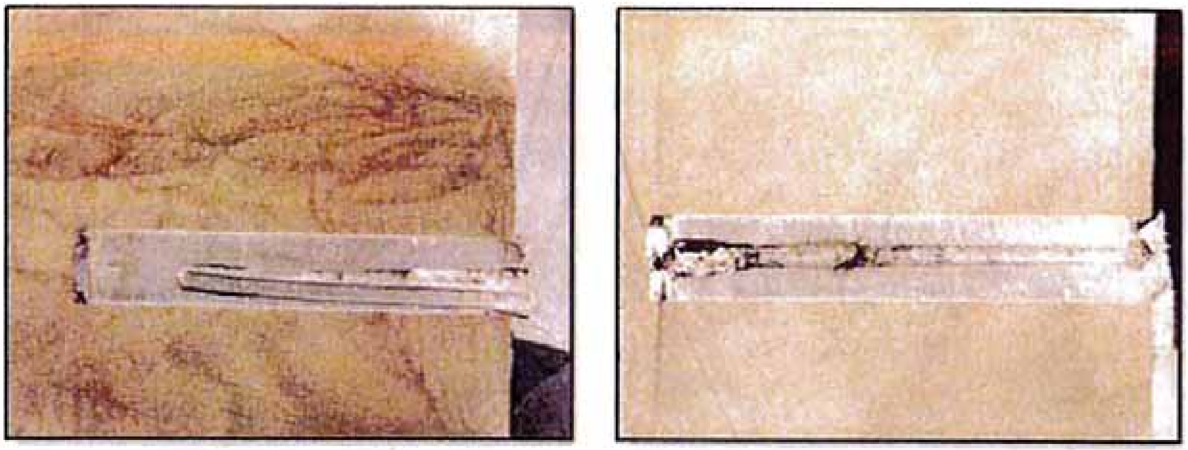
(b) R200-2



(c) R200-3



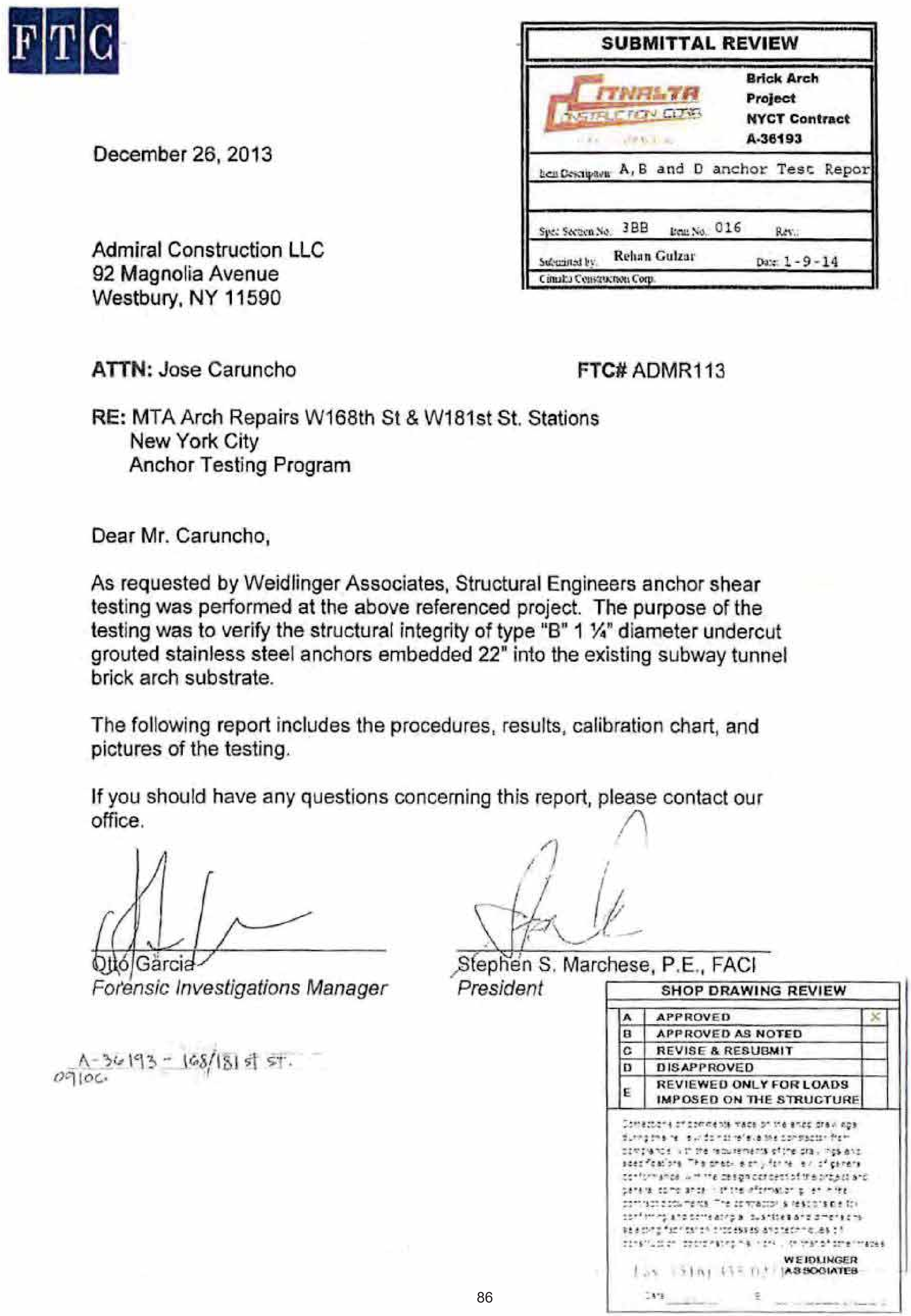
(e) R200-5



(d) R200-4

Figure B.7 – Wet Freeze-Thaw Samples (200mm Sock Length)

TESTING ASTM E 488-9696



FTC

SUBMITTAL REVIEW

Brick Arch Project
NYCT Contract
A-36193

Item Description: A, B and D anchor Test Repor

Spec Section No. 3BB Item No. 016 Rev.:

Submitted by: Rehan Gulzar Date: 1-9-14

Citnalta Construction Corp.

December 26, 2013

Admiral Construction LLC
92 Magnolia Avenue
Westbury, NY 11590

ATTN: Jose Caruncho

FTC# ADMR113

RE: MTA Arch Repairs W168th St & W181st St. Stations
New York City
Anchor Testing Program

Dear Mr. Caruncho,

As requested by Weidlinger Associates, Structural Engineers anchor shear testing was performed at the above referenced project. The purpose of the testing was to verify the structural integrity of type "B" 1 ¼" diameter undercut grouted stainless steel anchors embedded 22" into the existing subway tunnel brick arch substrate.

The following report includes the procedures, results, calibration chart, and pictures of the testing.

If you should have any questions concerning this report, please contact our office.

Otto Garcia
Forensic Investigations Manager

Stephen S. Marchese, P.E., FACI
President

A-36193 - 168/181 st ST.
09100.

SHOP DRAWING REVIEW

A	APPROVED	☒
B	APPROVED AS NOTED	☐
C	REVISE & RESUBMIT	☐
D	DISAPPROVED	☐
E	REVIEWED ONLY FOR LOADS IMPOSED ON THE STRUCTURE	☐

WEIDLINGER ASSOCIATES

MTA Arch Repairs W 168th St & W 181st St. Stations

Anchor Testing Problem

ANCHOR TESTING PROGRAM

INTRODUCTION

On December 12, and 17th, 2013, the above referenced project was visited to perform shear testing on type “B” 1 ¼” diameter undercut grouted stainless-steel anchors. The type “B” 1 ¼” diameter undercut grouted stainless steel anchors were embedded 22” into the existing subway tunnel brick arch substrate. The above anchor testing was performed as indicated in Specification Section 3BB, Part 3/3.1 Pre-Installed Anchor Testing Program.

The purpose of the testing is to perform shear tests to determine the structural integrity of the grouted anchors under a shear load for compliance to design criteria. A test load of 6400 pounds and maximum displacement reading of 0.125 was utilized as directed by Weidlinger Associates, for testing of anchors. Witnesses for the testing were Rehan Gulzar of Cinalta Construction, Michael Ferrell of Cintec North America, and Shahzad Hassan of Weidlinger Associates.

PROCEDURE

To perform the tests, a calibrated center hole hydraulic jack and gauge were utilized. To attach the hydraulic jack to the anchors, a shear plate steel test apparatus is attached to the anchor and a threaded rod is attached perpendicular to a fixed steel apparatus. To measure displacement of an anchor an extensometer (dial gauge) measuring to 0.001” was utilized.

The test began by first attaching the threaded rod and test assembly to the anchor. The jack was attached by utilizing the shear plate steel apparatus, threaded rod and fixed steel apparatus. The load was applied slowly until the test load was achieved or failure occurred. If the test load was achieved, the load was maintained for duration of ten (10) minutes and at this time displacement readings are taken and then the load is released. The area surrounding the anchor is then inspected for signs of distress and/or cracking. The above test procedure and test set up were performed as referenced in ASTM E488-96

CONCLUSION

A total of twelve (12) type “B” 1 ½” diameter undercut grouted strainless steel anchors were tested. Six tests were performed at the W168th St. Station and six tests at the W181st St. Station. All twelve (12) type “B” 1 ½” diameter undercut grouted stainless steel anchors tested did maintain the test load of 6400 pounds provided with minimal displacement for the duration of ten (10) minutes without any signs of distress and/or cracking during the testing procedure. The results of these tests are on the following chart.

FTC

MTA Arch Repairs W 168th St & W 181st St. Stations

New York City

Anchor Testing Program

ANCHOR TESTING PROGRAM RESULTS

Anchor No.	Date Tested	Anchor Location	Test Type	Test Load (Lbs)	Dial Gauge (Inches)	Anchor Condition
B-1	12-12-13	West 168th St. Station	Shear	6400	0.033	No Signs of Any Damage
B-2	12-12-13	West 168th St. Station	Shear	6400	0.048	No Signs of Any Damage
B-3	12-17-13	West 168th St. Station	Shear	6400	0.049	No Signs of Any Damage
B-4	12-17-13	West 168th St. Station	Shear	6400	0.016	No Signs of Any Damage
B-5	12-17-13	West 168th St. Station	Shear	6400	0.052	No Signs of Any Damage
B-6	12-17-13	West 168th St. Station	Shear	6400	0.052	No Signs of Any Damage
B-1	12-17-13	West 181st St. Station	Shear	6400	0.054	No Signs of Any Damage
B-2	12-17-13	West 181st St. Station	Shear	6400	0.049	No Signs of Any Damage
B-3	12-17-13	West 181st St. Station	Shear	6400	0.056	No Signs of Any Damage
B-4	12-17-13	West 181st St. Station	Shear	6400	0.035	No Signs of Any Damage
B-5	12-17-13	West 181st St. Station	Shear	6400	0.062	No Signs of Any Damage
B-6	12-17-13	West 181st St. Station	Shear	6400	0.065	No Signs of Any Damage

FTC

CALIBRATION CHART

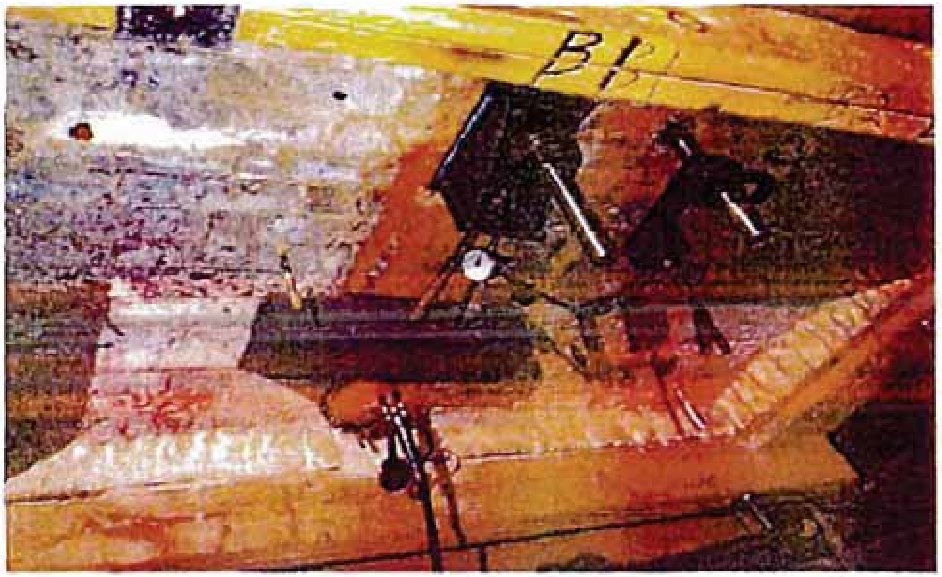
EQUIPMENT CALIBRATED:
DATED: June 17, 2013
EQUIPMENT CALIBRATED
WIKA 10,000 psi Gauge
Serial No.23040
ENERPAC 20Ton Center Hole Jack
Serial No. 001

EQUIPMENT USED:
Test Mark CM-600-iD Compression Machine
Serial No. 120819 Calibrated: January 17, 2013

RESULTS

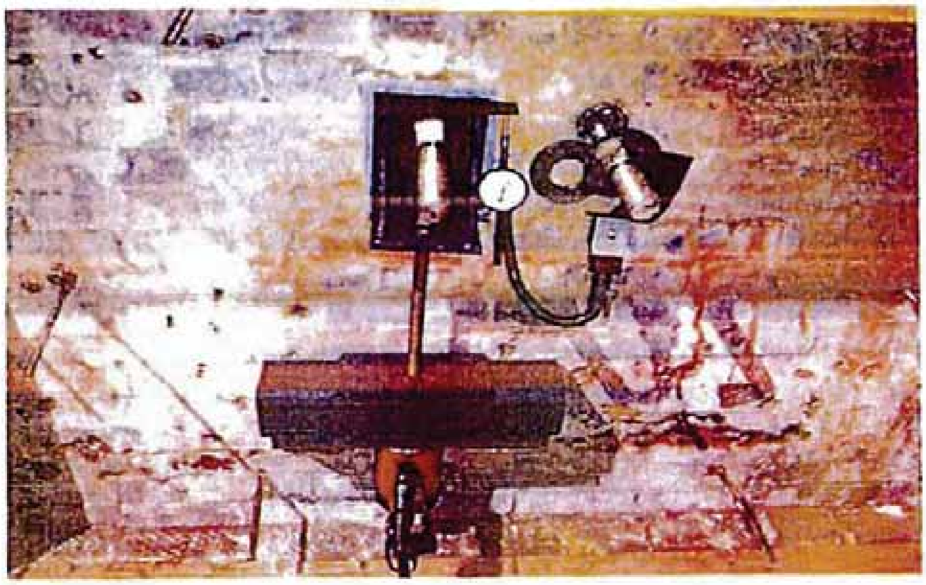
Gauge Reading (psi)	Load (lbs)
100	600
250	1200
300	1400
400	1900
500	2300
600	2500
650	2800
700	3000
800	3500
900	4300
1000	4650
1100	4800
1300	5600
1400	6400
1800	9000
2000	9500
2200	10,000
2500	11,500
2600	12,000
3000	14,100
3500	16,400
4100	19,200
4500	21,500
5000	23,500
5200	24,000
6000	28,500
6500	30,000
7000	32,500
8000	37,500
9000	42,500
10,000	47,000

TYPICAL TEST SET UP
W168th St. STATION # B-1

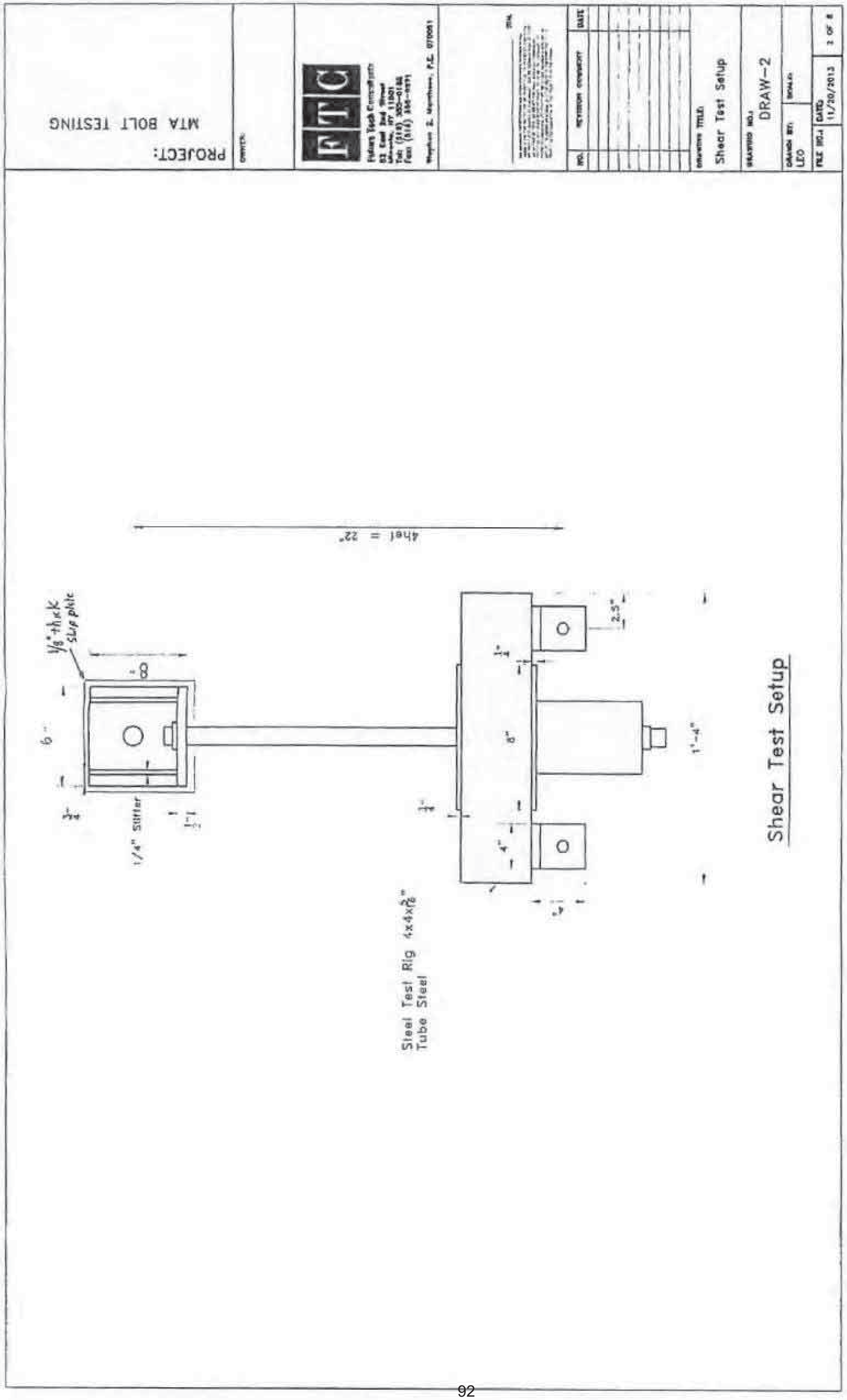


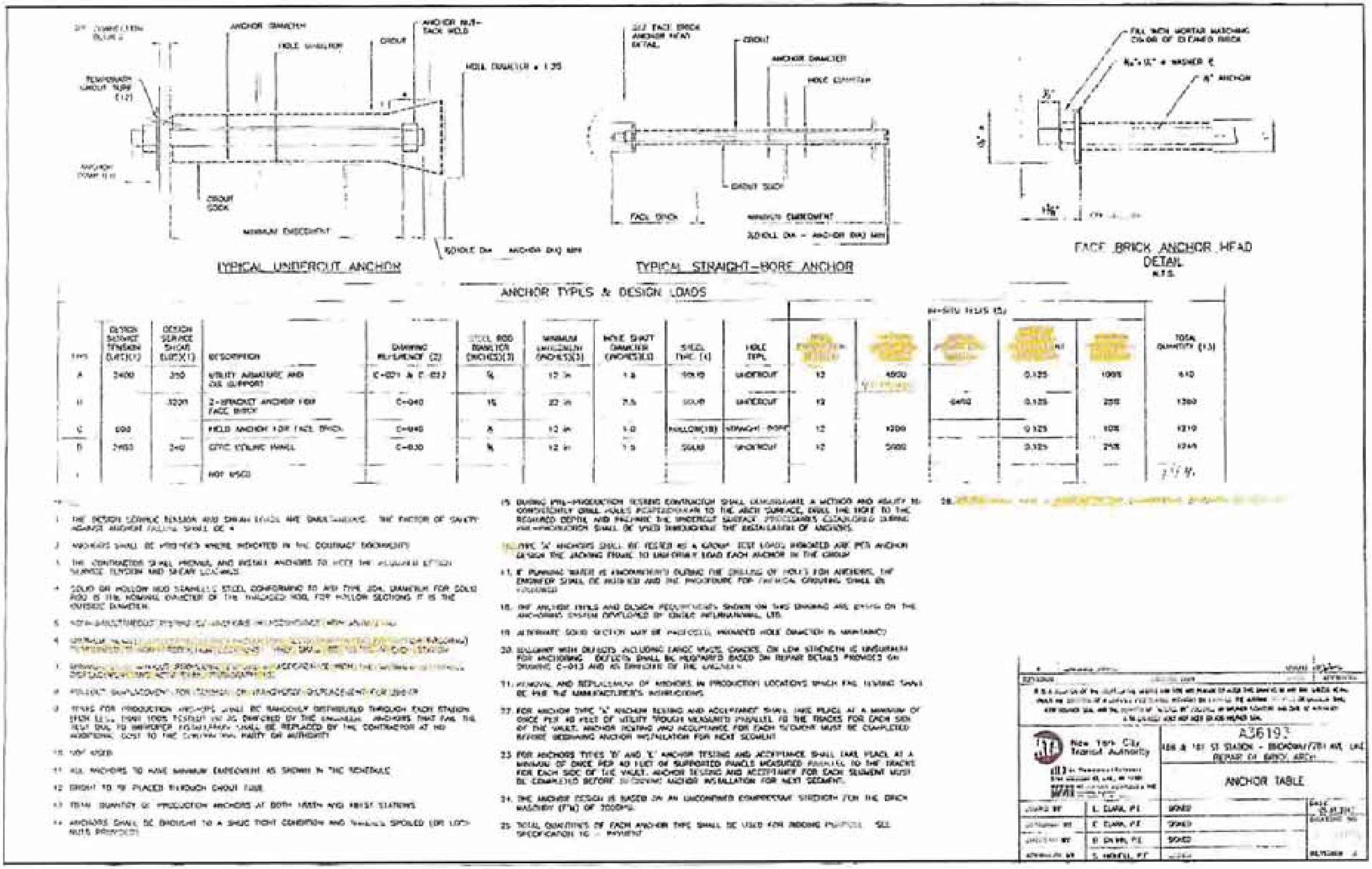
TYPICAL TEST SET UP
W168th St. STATION # B-2

TYPICAL TEST SET UP
W181st St. STATION # B-1



TYPICAL TEST SET UP
W181st St. STATION # B-2


PROJECT:
MTA BOLT TESTING
OWNER:
FTC
Future Tech Consultants
Tel: (718) 355-0186
Fax: (516) 386-0971
P.E. 070051
NO.
REVISION COMMENT
DATE
DRAWING TITLE:
Shear Test Setup
DRAWING NO.:
DRAW—2
DRAWN BY:
LEO
SCALE:
FILE NO.:
DATE:
11/20/2013
2 OF 8
4hef = 22"
1/8" thick slip plate
8"
6"
3/4"
1/4" Stiffer
1 1/2"
1/4"
8"
1"
2.5"
4"
1'-4"
Steel Test Rig 4x4x5/8"
Tube Steel
Shear Test Setup



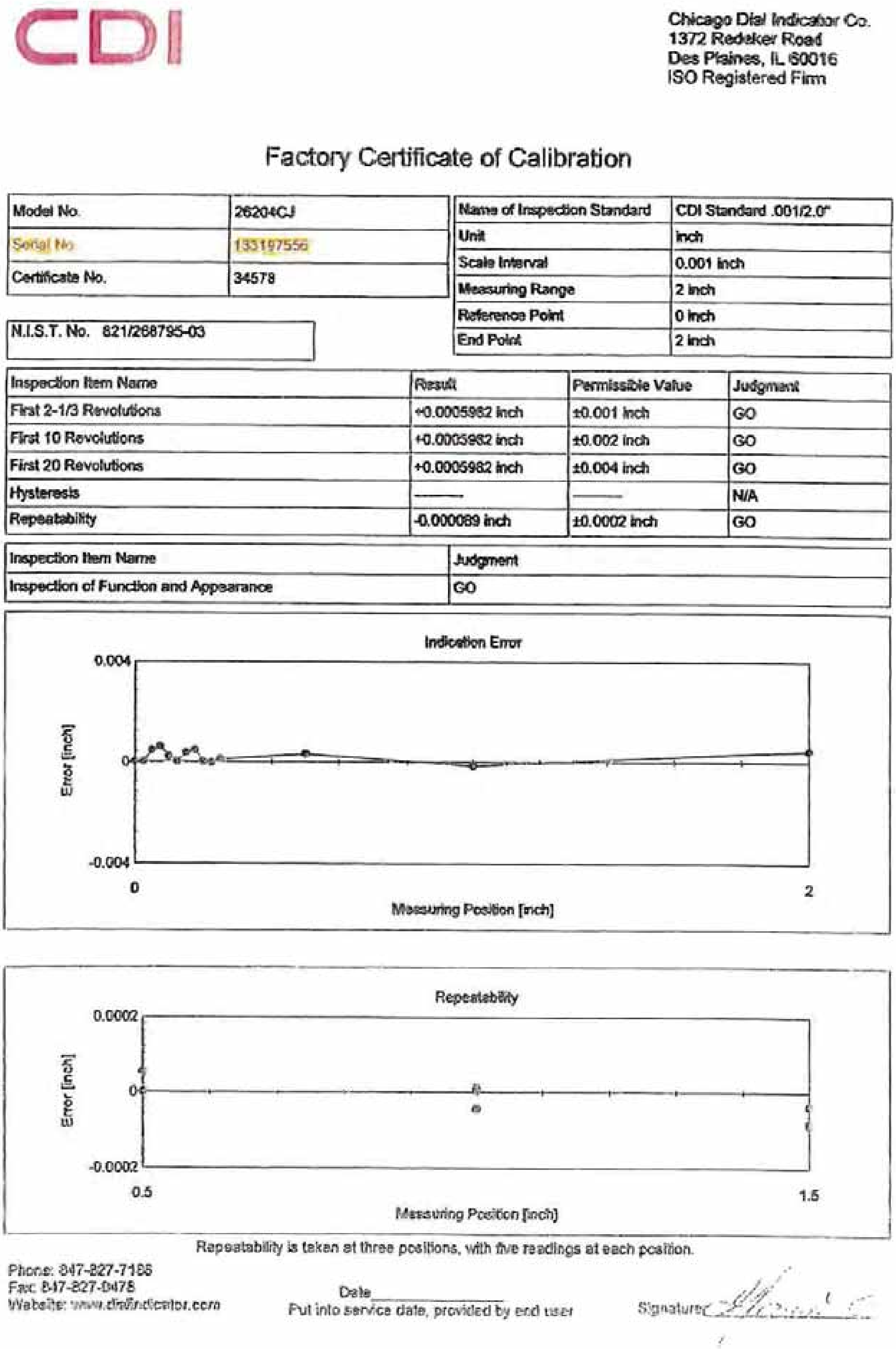
ANCHOR TYPES & DESIGN LOADS

New York City Transit Authority

A36193

REPAIR OF BRICK ARCH

ANCHOR TABLE



CDI

Chicago Dial Indicator Co.
1372 Redeker Road
Des Plaines, IL 60016
ISO Registered Firm

Factory Certificate of Calibration

Model No.	26204CJ
Serial No.	133197556
Certificate No.	34578

N.I.S.T. No. 821/268795-03

Name of Inspection Standard	CDI Standard .001/2.0"
Unit	inch
Scale Interval	0.001 inch
Measuring Range	2 inch
Reference Point	0 inch
End Point	2 inch

Inspection Item Name	Result	Permissible Value	Judgment
First 2-1/3 Revolutions	+0.0005982 inch	±0.001 inch	GO
First 10 Revolutions	+0.0005982 inch	±0.002 inch	GO
First 20 Revolutions	+0.0005982 inch	±0.004 inch	GO
Hysteresis	———	———	N/A
Repeatability	-0.000089 inch	±0.0002 inch	GO

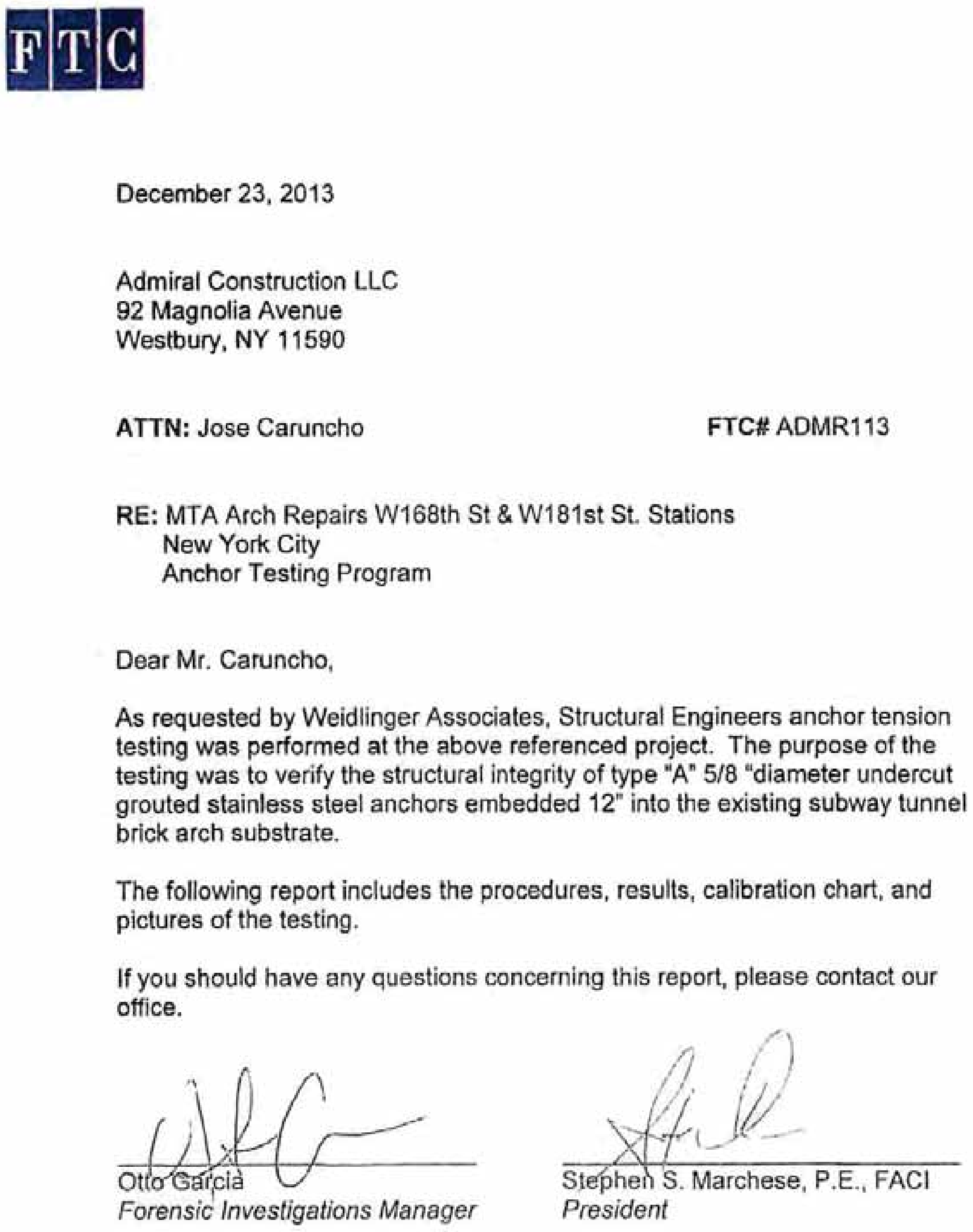
Inspection Item Name	Judgment
Inspection of Function and Appearance	GO

Repeatability is taken at three positions, with five readings at each position.

Phone: 847-827-7186
Fax: 847-827-0478
Website: www.dialindicator.com

Date_______________
Put into service date, provided by end user

Signature_______________



FTC

December 23, 2013

Admiral Construction LLC
92 Magnolia Avenue
Westbury, NY 11590

ATTN: Jose Caruncho **FTC#** ADMR113

RE: MTA Arch Repairs W168th St & W181st St. Stations
New York City
Anchor Testing Program

Dear Mr. Caruncho,

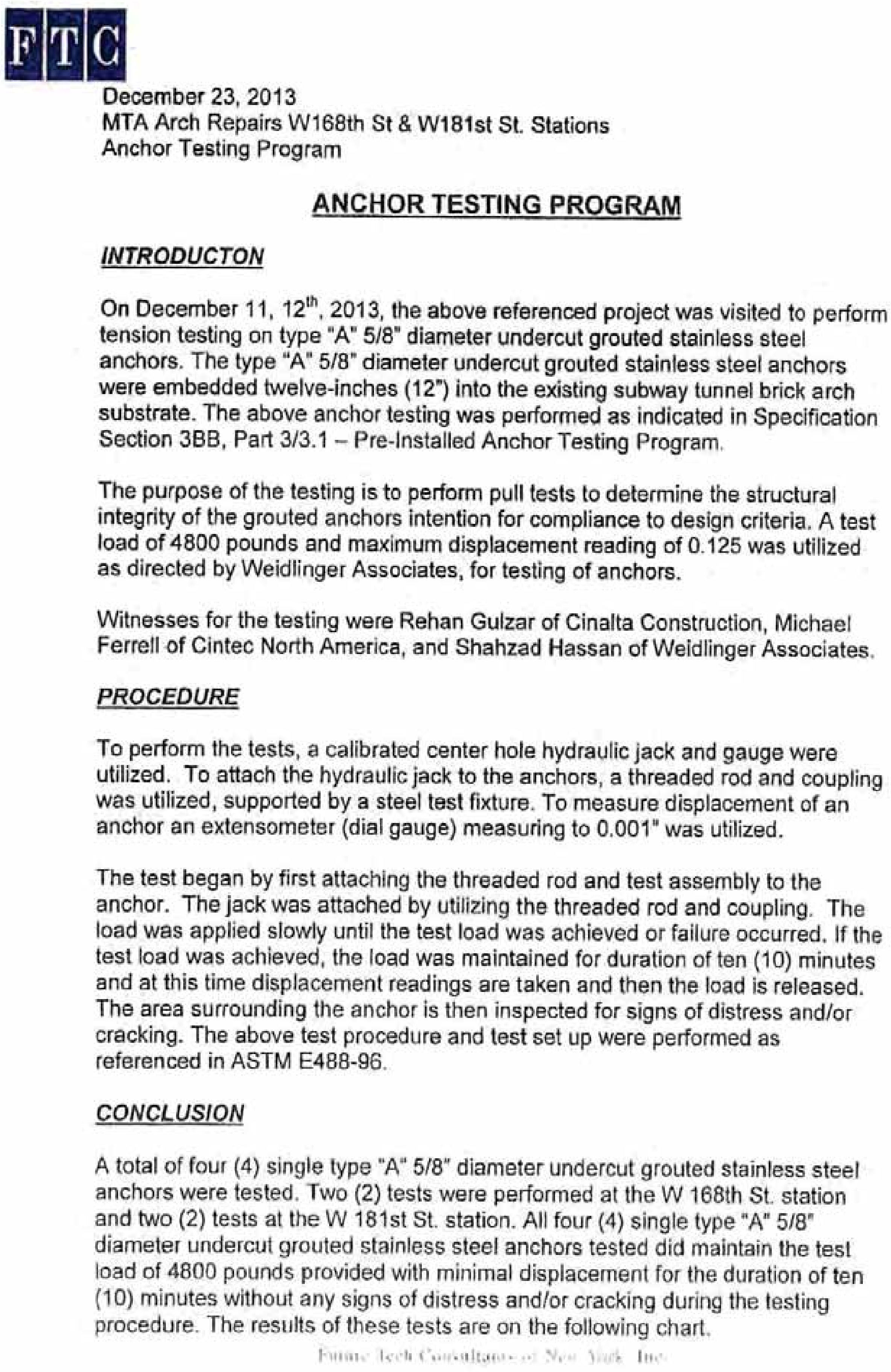
As requested by Weidlinger Associates, Structural Engineers anchor tension testing was performed at the above referenced project. The purpose of the testing was to verify the structural integrity of type "A" 5/8 "diameter undercut grouted stainless steel anchors embedded 12" into the existing subway tunnel brick arch substrate.

The following report includes the procedures, results, calibration chart, and pictures of the testing.

If you should have any questions concerning this report, please contact our office.

Otto Garcia
Forensic Investigations Manager

Stephen S. Marchese, P.E., FACI
President



December 23, 2013
MTA Arch Repairs W168th St & W181st St. Stations
Anchor Testing Program

ANCHOR TESTING PROGRAM

INTRODUCTON

On December 11, 12th, 2013, the above referenced project was visited to perform tension testing on type "A" 5/8" diameter undercut grouted stainless steel anchors. The type "A" 5/8" diameter undercut grouted stainless steel anchors were embedded twelve-inches (12") into the existing subway tunnel brick arch substrate. The above anchor testing was performed as indicated in Specification Section 3BB, Part 3/3.1 – Pre-Installed Anchor Testing Program.

The purpose of the testing is to perform pull tests to determine the structural integrity of the grouted anchors intention for compliance to design criteria. A test load of 4800 pounds and maximum displacement reading of 0.125 was utilized as directed by Weidlinger Associates, for testing of anchors.

Witnesses for the testing were Rehan Gulzar of Cinalta Construction, Michael Ferrell of Cintec North America, and Shahzad Hassan of Weidlinger Associates.

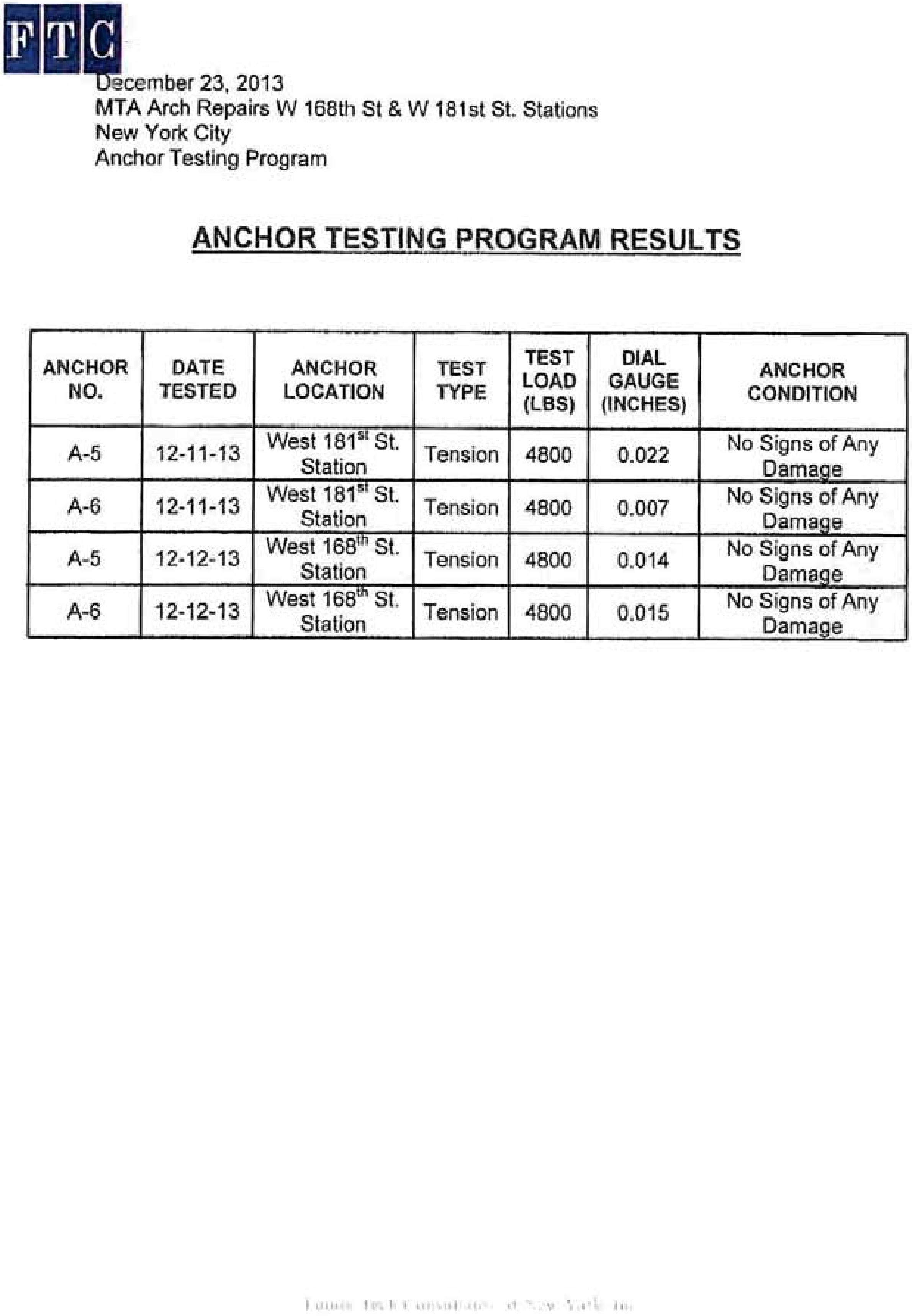
PROCEDURE

To perform the tests, a calibrated center hole hydraulic jack and gauge were utilized. To attach the hydraulic jack to the anchors, a threaded rod and coupling was utilized, supported by a steel test fixture. To measure displacement of an anchor an extensometer (dial gauge) measuring to 0.001" was utilized.

The test began by first attaching the threaded rod and test assembly to the anchor. The jack was attached by utilizing the threaded rod and coupling. The load was applied slowly until the test load was achieved or failure occurred. If the test load was achieved, the load was maintained for duration of ten (10) minutes and at this time displacement readings are taken and then the load is released. The area surrounding the anchor is then inspected for signs of distress and/or cracking. The above test procedure and test set up were performed as referenced in ASTM E488-96.

CONCLUSION

A total of four (4) single type "A" 5/8" diameter undercut grouted stainless steel anchors were tested. Two (2) tests were performed at the W 168th St. station and two (2) tests at the W 181st St. station. All four (4) single type "A" 5/8" diameter undercut grouted stainless steel anchors tested did maintain the test load of 4800 pounds provided with minimal displacement for the duration of ten (10) minutes without any signs of distress and/or cracking during the testing procedure. The results of these tests are on the following chart.



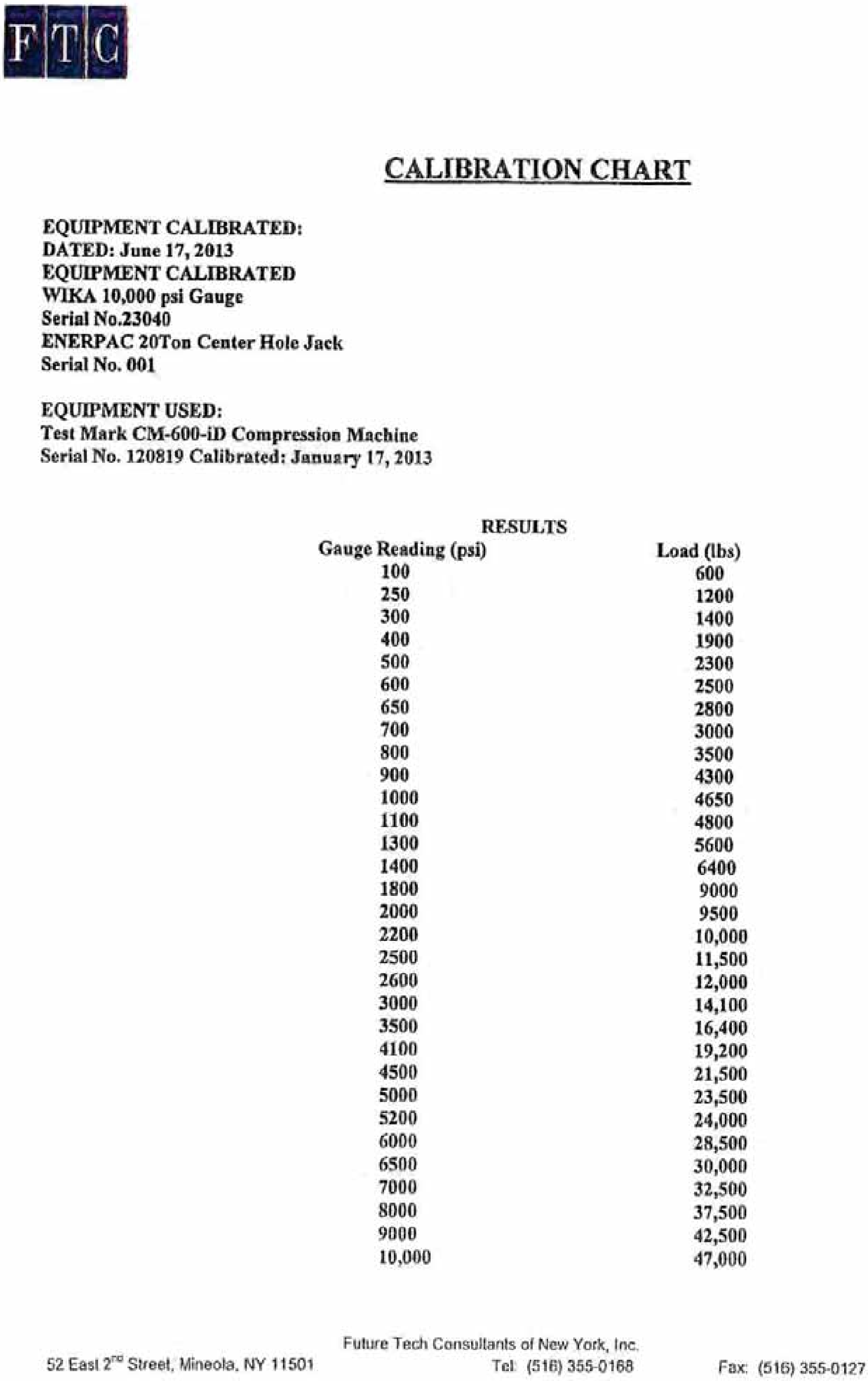
FTC

December 23, 2013
MTA Arch Repairs W 168th St & W 181st St. Stations
New York City
Anchor Testing Program

ANCHOR TESTING PROGRAM RESULTS

ANCHOR NO.	DATE TESTED	ANCHOR LOCATION	TEST TYPE	TEST LOAD (LBS)	DIAL GAUGE (INCHES)	ANCHOR CONDITION
A-5	12-11-13	West 181st St. Station	Tension	4800	0.022	No Signs of Any Damage
A-6	12-11-13	West 181st St. Station	Tension	4800	0.007	No Signs of Any Damage
A-5	12-12-13	West 168th St. Station	Tension	4800	0.014	No Signs of Any Damage
A-6	12-12-13	West 168th St. Station	Tension	4800	0.015	No Signs of Any Damage

[illegible] Tech Consultants of New York, Inc.



FTC

CALIBRATION CHART

EQUIPMENT CALIBRATED:
DATED: June 17, 2013
EQUIPMENT CALIBRATED
WIKA 10,000 psi Gauge
Serial No.23040
ENERPAC 20Ton Center Hole Jack
Serial No. 001

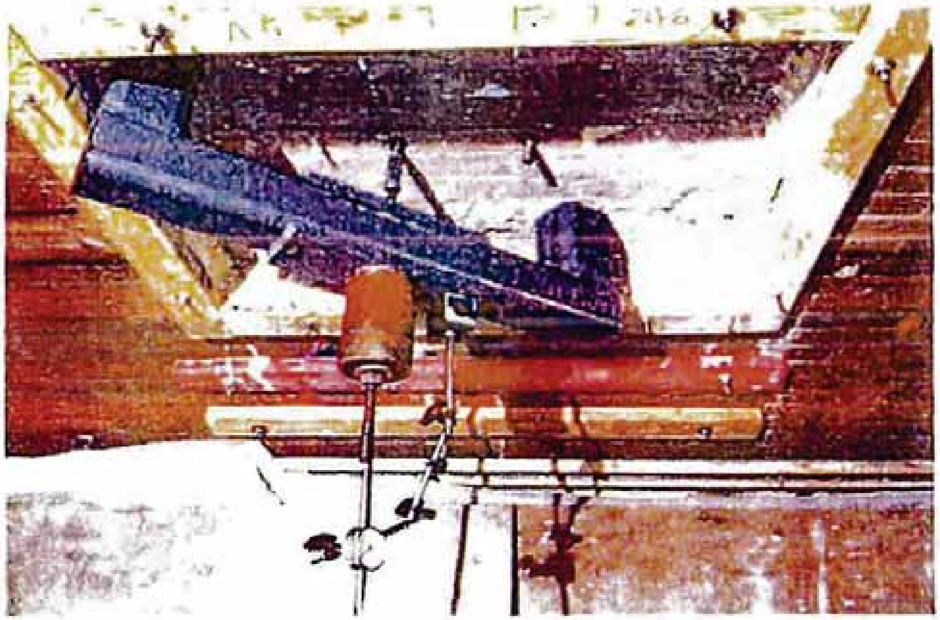
EQUIPMENT USED:
Test Mark CM-600-iD Compression Machine
Serial No. 120819 Calibrated: January 17, 2013

RESULTS

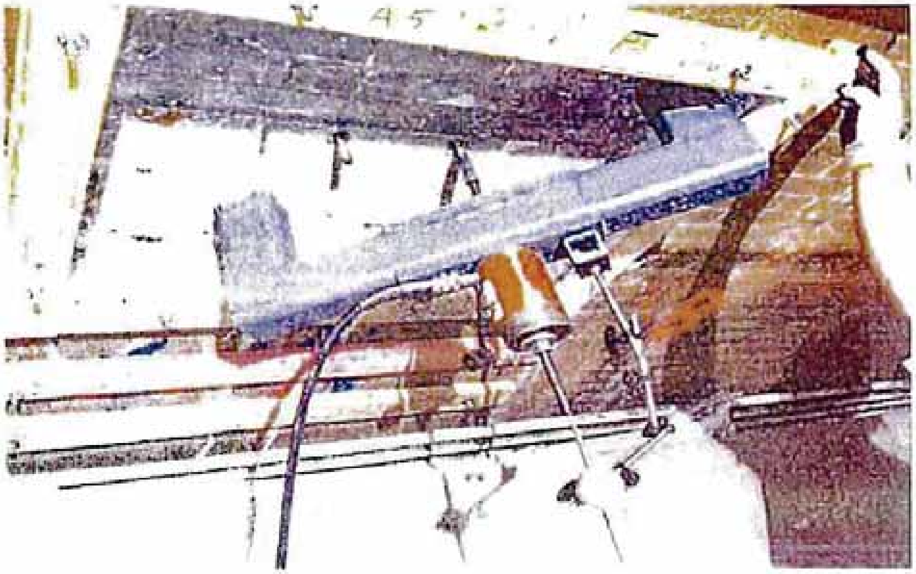
Gauge Reading (psi)	Load (lbs)
100	600
250	1200
300	1400
400	1900
500	2300
600	2500
650	2800
700	3000
800	3500
900	4300
1000	4650
1100	4800
1300	5600
1400	6400
1800	9000
2000	9500
2200	10,000
2500	11,500
2600	12,000
3000	14,100
3500	16,400
4100	19,200
4500	21,500
5000	23,500
5200	24,000
6000	28,500
6500	30,000
7000	32,500
8000	37,500
9000	42,500
10,000	47,000

Future Tech Consultants of New York, Inc.
52 East 2nd Street, Mineola, NY 11501
Tel: (516) 355-0168
Fax: (516) 355-0127

TYPICAL TEST SET UP
W168th St. STATION # A-5

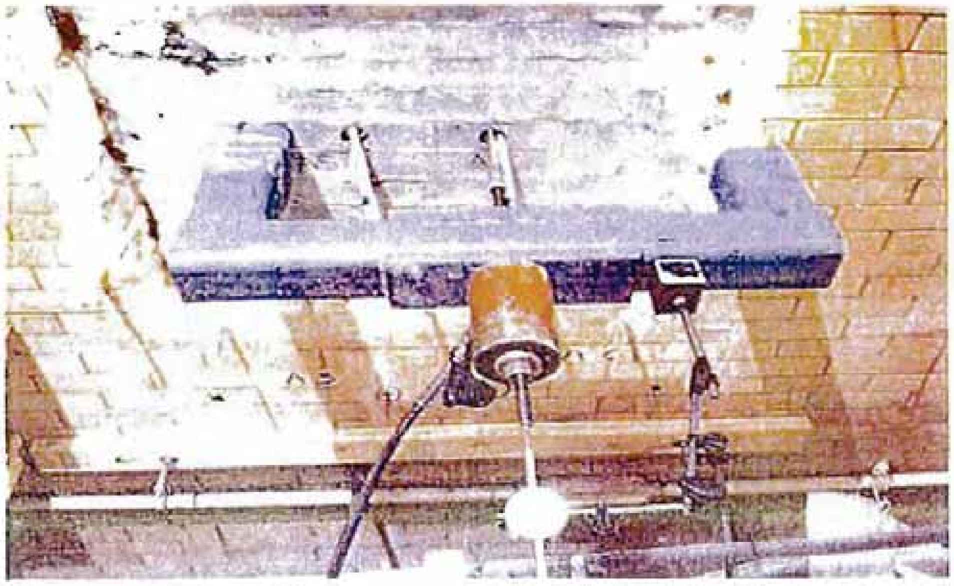


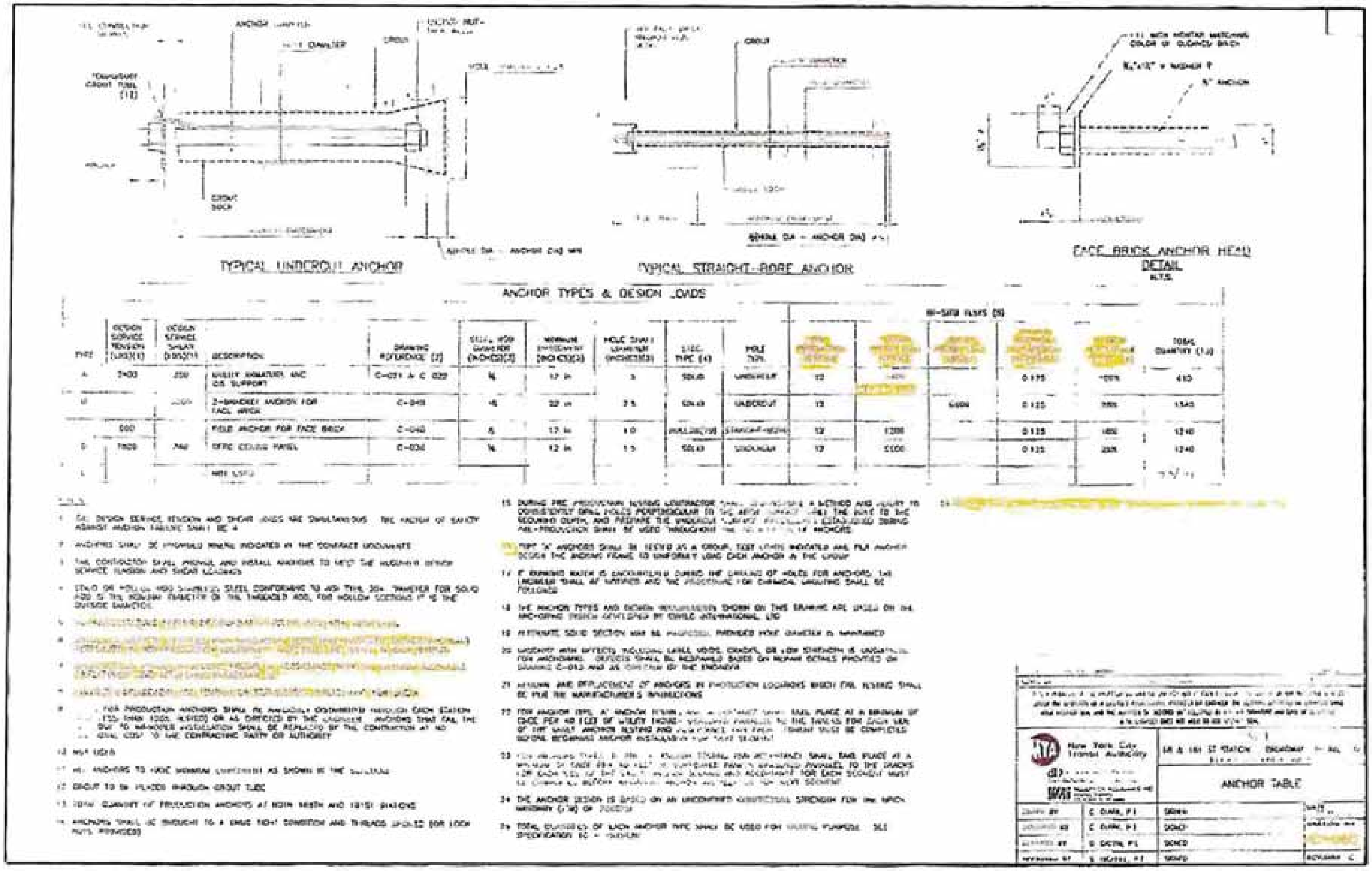
TYPICAL TEST SET UP
W168th St. STATION # A-6

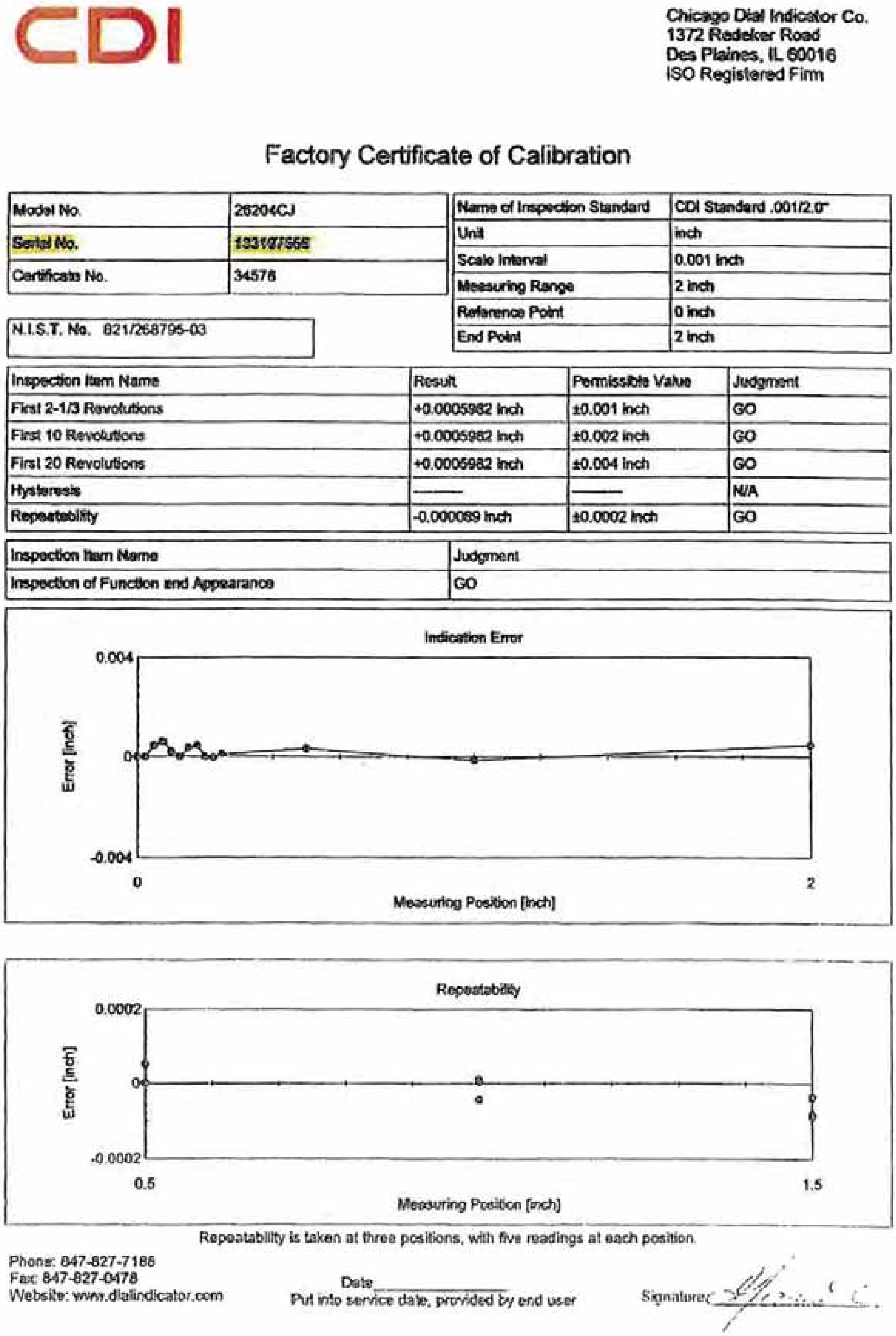


TYPICAL TEST SET UP
W181st St. STATION # A-5

TYPICAL TEST SET UP
W181st St. STATION # A-6




TYPICAL UNDERCUT ANCHOR
TYPICAL STRAIGHT-BORE ANCHOR
FACE BRICK ANCHOR HEAD DETAIL
N.T.S.
ANCHOR TYPES & DESIGN LOADS
New York City Transit Authority
ANCHOR TABLE



CDI

Chicago Dial Indicator Co.
1372 Redeker Road
Des Plaines, IL 60016
ISO Registered Firm

Factory Certificate of Calibration

Model No.	26204CJ
Serial No.	133127558
Certificate No.	34576

N.I.S.T. No. 821/268795-03

Name of Inspection Standard	CDI Standard .001/2.0"
Unit	inch
Scale Interval	0.001 inch
Measuring Range	2 inch
Reference Point	0 inch
End Point	2 inch

Inspection Item Name	Result	Permissible Value	Judgment
First 2-1/3 Revolutions	+0.0005982 inch	±0.001 inch	GO
First 10 Revolutions	+0.0005982 inch	±0.002 inch	GO
First 20 Revolutions	+0.0005982 inch	±0.004 inch	GO
Hysteresis	———	———	N/A
Repeatability	-0.000089 inch	±0.0002 inch	GO

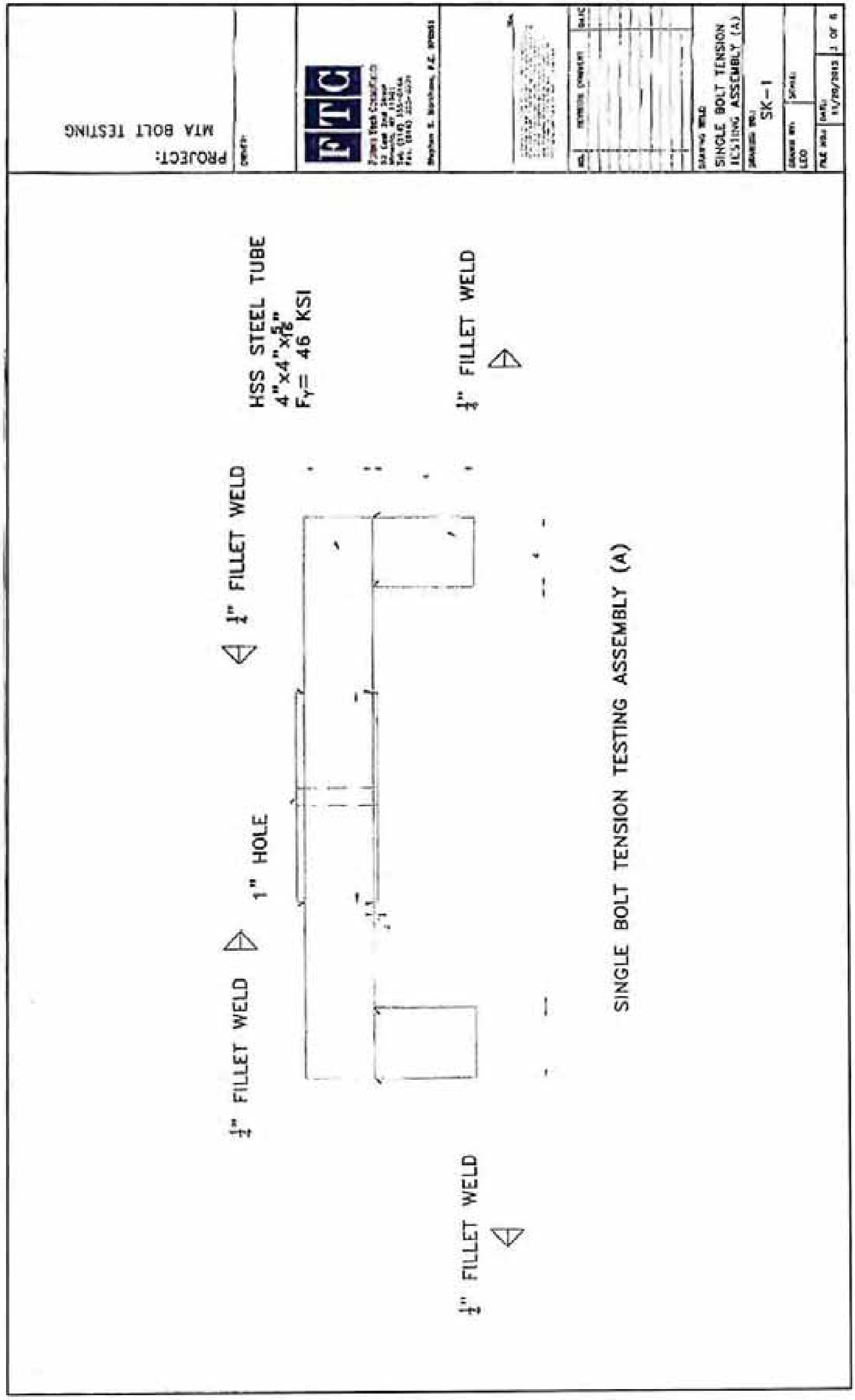
Inspection Item Name	Judgment
Inspection of Function and Appearance	GO

Repeatability is taken at three positions, with five readings at each position.

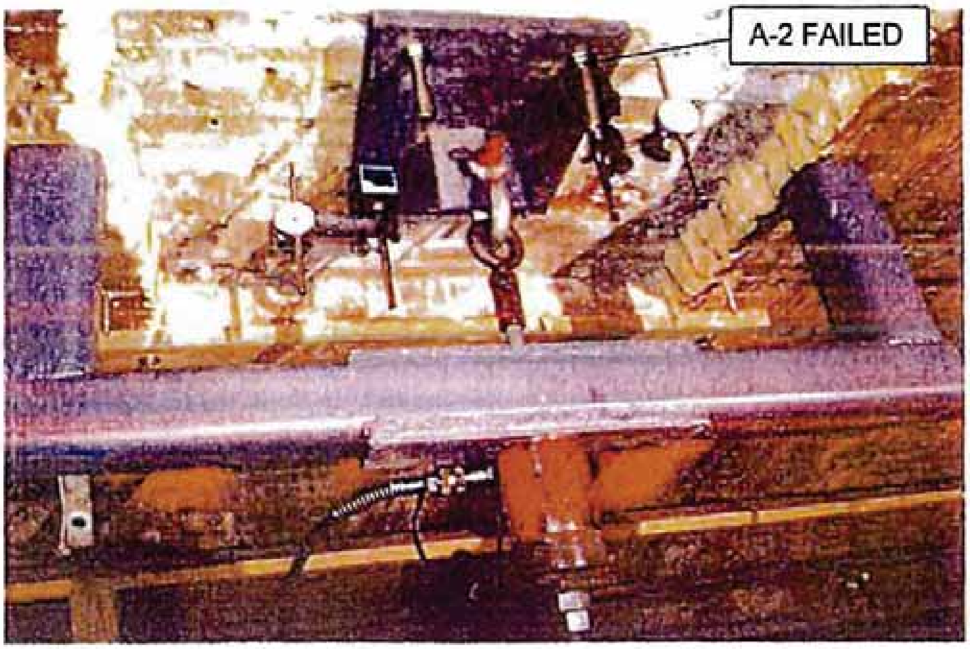
Phone: 847-827-7186
Fax: 847-827-0478
Website: www.dialindicator.com

Date_______________
Put into service date, provided by end user

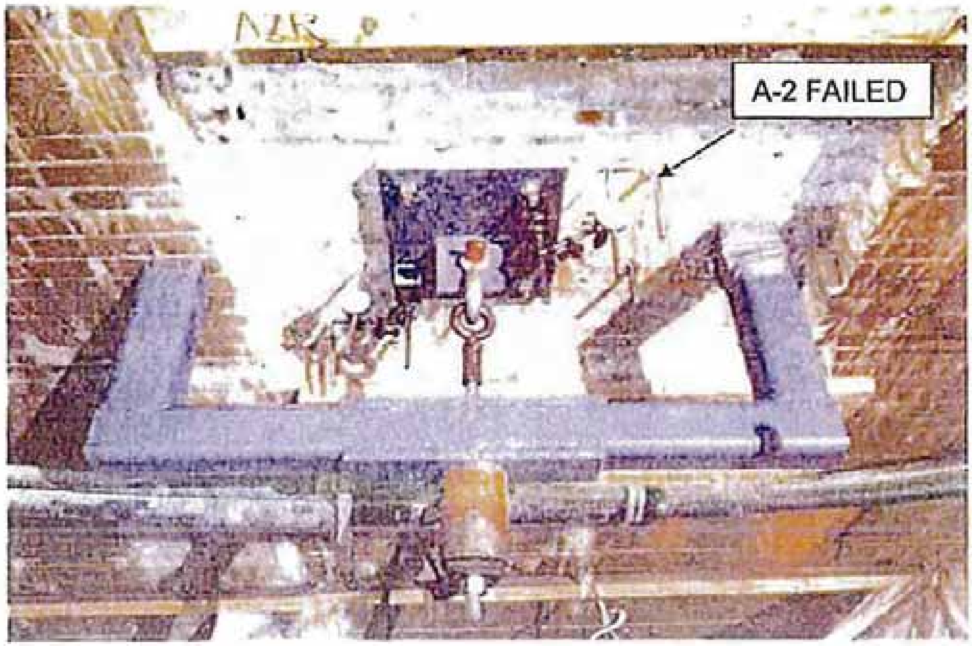
Signature:


PROJECT:
MTA BOLT TESTING
FTC
SINGLE BOLT TENSION TESTING ASSEMBLY (A)
SK-1
LCO
2 OF 6
HSS STEEL TUBE
4"x4"x5/16"
F_Y = 46 KSI
1/2" FILLET WELD
1/2" FILLET WELD
1" HOLE
1/2" FILLET WELD
1/2" FILLET WELD
SINGLE BOLT TENSION TESTING ASSEMBLY (A)

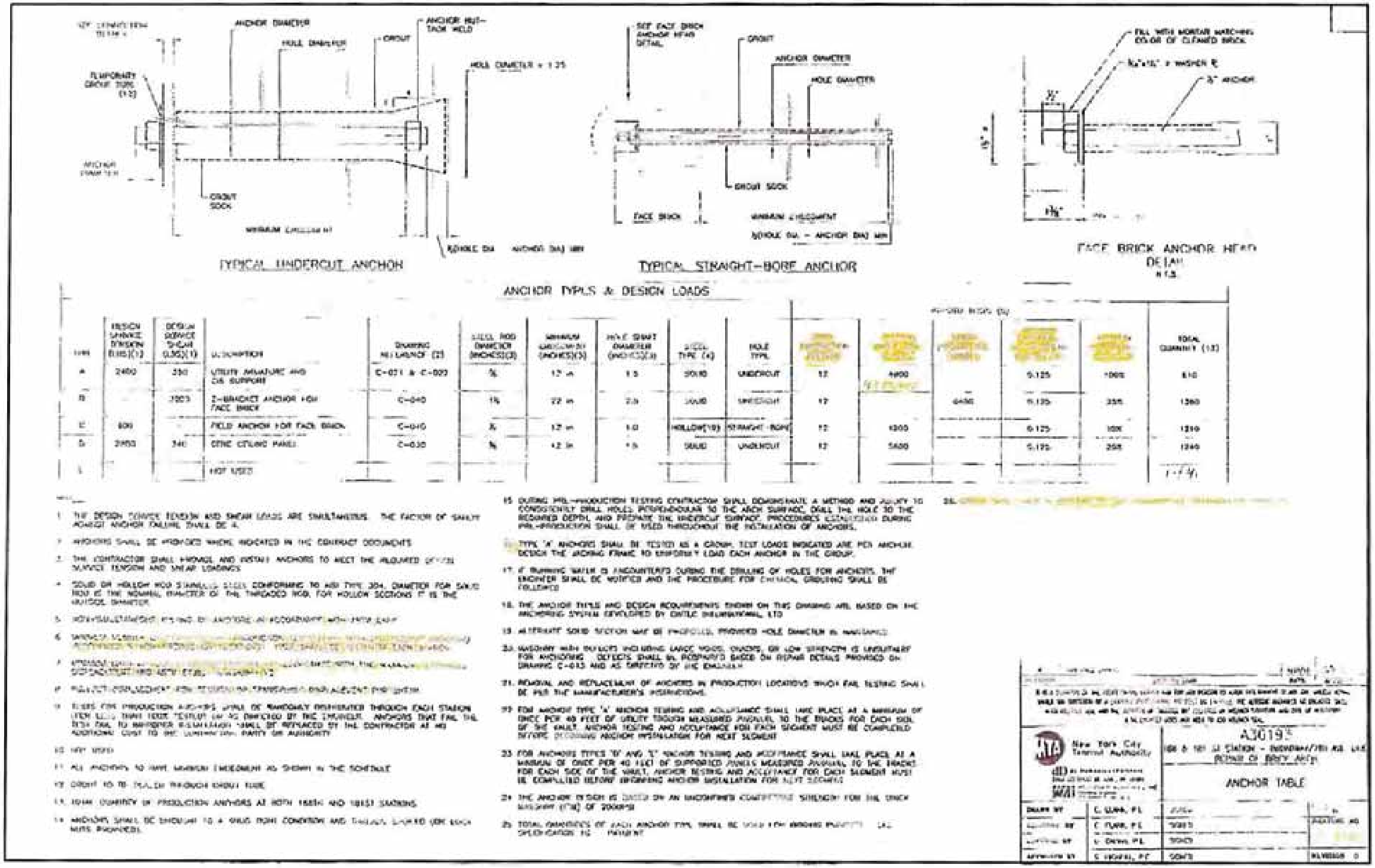
TYPICAL TEST SET UP
W 168TH ST. STATION # GROUP A



TYPICAL TEST SET UP
W 168TH ST. STATION # GROUP A - RETEST



TYPICAL TEST SET UP
W 181ST ST. STATION # GROUP A



TYPICAL UNDERCUT ANCHOR

TYPICAL STRAIGHT-BORE ANCHOR

FACE BRICK ANCHOR HEAD DETAIL
N.T.S.

ANCHOR TYPES & DESIGN LOADS

TYPE	DESIGN SERVICE TENSION (LBS)(1)	DESIGN SERVICE SHEAR (LBS)(1)	DESCRIPTION	DRAWING REFERENCE (2)	STEEL ROD DIAMETER (INCHES)(3)	MINIMUM EMBEDMENT (INCHES)(5)	HOLE SHAFT DIAMETER (INCHES)(3)	STEEL TYPE (4)	HOLE TYPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	TOTAL QUANTITY (13)
A	2400	230	UTILITY ARMATURE AND CA SUPPORT	C-021 & C-022	⅝	12 in	1.5	SOLID	UNDERCUT	12	4900		0.125	1005	810
B		2003	Z-BRACKET ANCHOR FOR FACE BRICK	C-040	1¼	22 in	2.5	SOLID	UNDERCUT	12		6400	0.125	335	1360
C	800		FIELD ANCHOR FOR FACE BRICK	C-040	⅝	12 in	1.0	HOLLOW(19)	STRAIGHT-BORE	12	1200		0.125	10X	1210
D	2950	340	OTHE CEILING PANEL	C-030	⅝	12 in	1.5	SOLID	UNDERCUT	12	5400		0.125	255	1240
E			NOT USED												

NOTES:

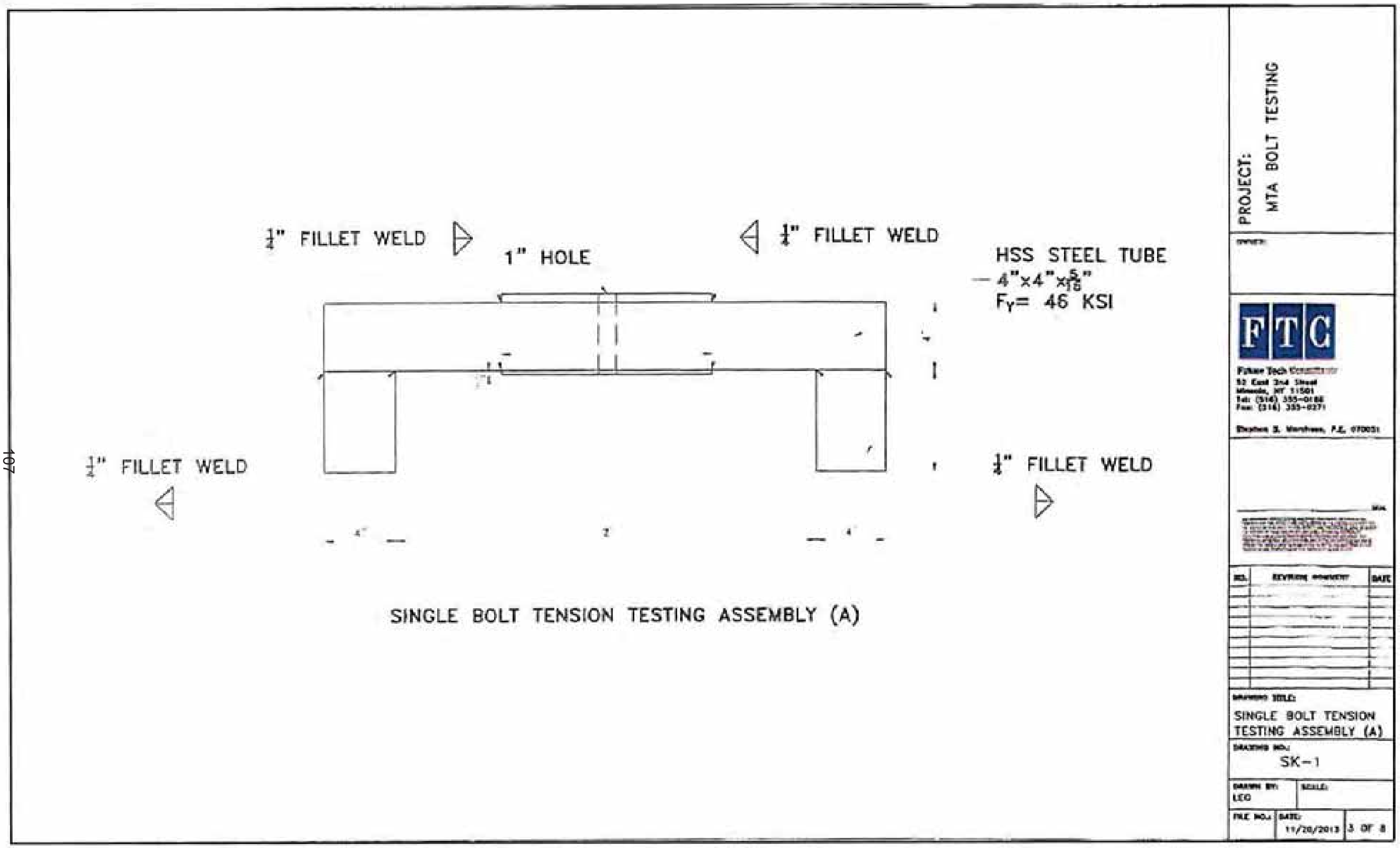
1. THE DESIGN SERVICE TENSION AND SHEAR LOADS ARE SIMULTANEOUS. THE FACTOR OF SAFETY AGAINST ANCHOR FAILURE SHALL BE 4.
2. ANCHORS SHALL BE PROVIDED WHERE INDICATED IN THE CONTRACT DOCUMENTS.
3. THE CONTRACTOR SHALL PROVIDE AND INSTALL ANCHORS TO MEET THE REQUIRED DESIGN SERVICE TENSION AND SHEAR LOADINGS.
4. SOLID OR HOLLOW ROD STAINLESS STEEL CONFORMING TO AISI TYPE 304. DIAMETER FOR SOLID ROD IS THE NOMINAL DIAMETER OF THE THREADED ROD. FOR HOLLOW SECTIONS IT IS THE OUTSIDE DIAMETER.
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible]
9. TESTS FOR PRODUCTION ANCHORS SHALL BE RANDOMLY DISTRIBUTED THROUGH EACH STATION [illegible] AS DIRECTED BY THE ENGINEER. ANCHORS THAT FAIL THE TEST [illegible] SHALL BE REPLACED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE [illegible] PARTY OR AUTHORITY.
10. NOT USED
11. ALL ANCHORS TO HAVE MINIMUM EMBEDMENT AS SHOWN IN THE SCHEDULE.
12. GROUT TO BE [illegible] THROUGH GROUT TUBE.
13. TOTAL QUANTITY OF PRODUCTION ANCHORS AT BOTH 168TH AND 181ST STATIONS.
14. ANCHORS SHALL BE [illegible]
15. DURING PRE-PRODUCTION TESTING CONTRACTOR SHALL DEMONSTRATE A METHOD AND ABILITY TO CONSISTENTLY DRILL HOLES PERPENDICULAR TO THE ARCH SURFACE, DRILL THE HOLE TO THE REQUIRED DEPTH, AND PREPARE THE UNDERCUT SURFACE. PROCEDURES [illegible] DURING PRE-PRODUCTION SHALL BE USED THROUGHOUT THE INSTALLATION OF ANCHORS.
16. TYPE 'A' ANCHORS SHALL BE TESTED AS A GROUP. TEST LOADS INDICATED ARE PER ANCHOR. DESIGN THE JACKING FRAME TO UNIFORMLY LOAD EACH ANCHOR IN THE GROUP.
17. IF RUNNING WATER IS ENCOUNTERED DURING THE DRILLING OF HOLES FOR ANCHORS, THE ENGINEER SHALL BE NOTIFIED AND THE PROCEDURE FOR CHEMICAL GROUTING SHALL BE FOLLOWED.
18. THE ANCHOR TYPES AND DESIGN REQUIREMENTS SHOWN ON THIS DRAWING ARE BASED ON THE ANCHORING SYSTEM DEVELOPED BY CINTEC INTERNATIONAL LTD.
19. ALTERNATE SOLID SECTION MAY BE PROPOSED, PROVIDED HOLE DIAMETER IS MAINTAINED.
20. MASONRY WITH DEFECTS INCLUDING LARGE VOIDS, CRACKS, OR LOW STRENGTH IS UNSUITABLE FOR ANCHORING. DEFECTS SHALL BE REPAIRED BASED ON REPAIR DETAILS PROVIDED ON DRAWING C-013 AND AS DIRECTED BY THE ENGINEER.
21. REMOVAL AND REPLACEMENT OF ANCHORS IN PRODUCTION LOCATIONS WHICH FAIL TESTING SHALL BE PER THE MANUFACTURER'S INSTRUCTIONS.
22. FOR ANCHOR TYPE 'A' ANCHOR TESTING AND ACCEPTANCE SHALL TAKE PLACE AT A MINIMUM OF ONCE PER 40 FEET OF UTILITY TROUGH MEASURED PARALLEL TO THE TRACKS FOR EACH SIDE OF THE VAULT. ANCHOR TESTING AND ACCEPTANCE FOR EACH SEGMENT MUST BE COMPLETED BEFORE BEGINNING ANCHOR INSTALLATION FOR NEXT SEGMENT.
23. FOR ANCHORS TYPES 'B' AND 'C' ANCHOR TESTING AND ACCEPTANCE SHALL TAKE PLACE AT A MINIMUM OF ONCE PER 40 FEET OF SUPPORTED PANELS MEASURED PARALLEL TO THE TRACKS FOR EACH SIDE OF THE VAULT. ANCHOR TESTING AND ACCEPTANCE FOR EACH SEGMENT MUST BE COMPLETED BEFORE BEGINNING ANCHOR INSTALLATION FOR NEXT SEGMENT.
24. THE ANCHOR DESIGN IS BASED ON AN UNCONFINED COMPRESSIVE STRENGTH FOR THE BRICK MASONRY (f'm) OF 2000PSI.
25. TOTAL QUANTITIES OF EACH ANCHOR TYPE SHALL BE [illegible] SPECIFICATION [illegible] PAYMENT.
26. [illegible]

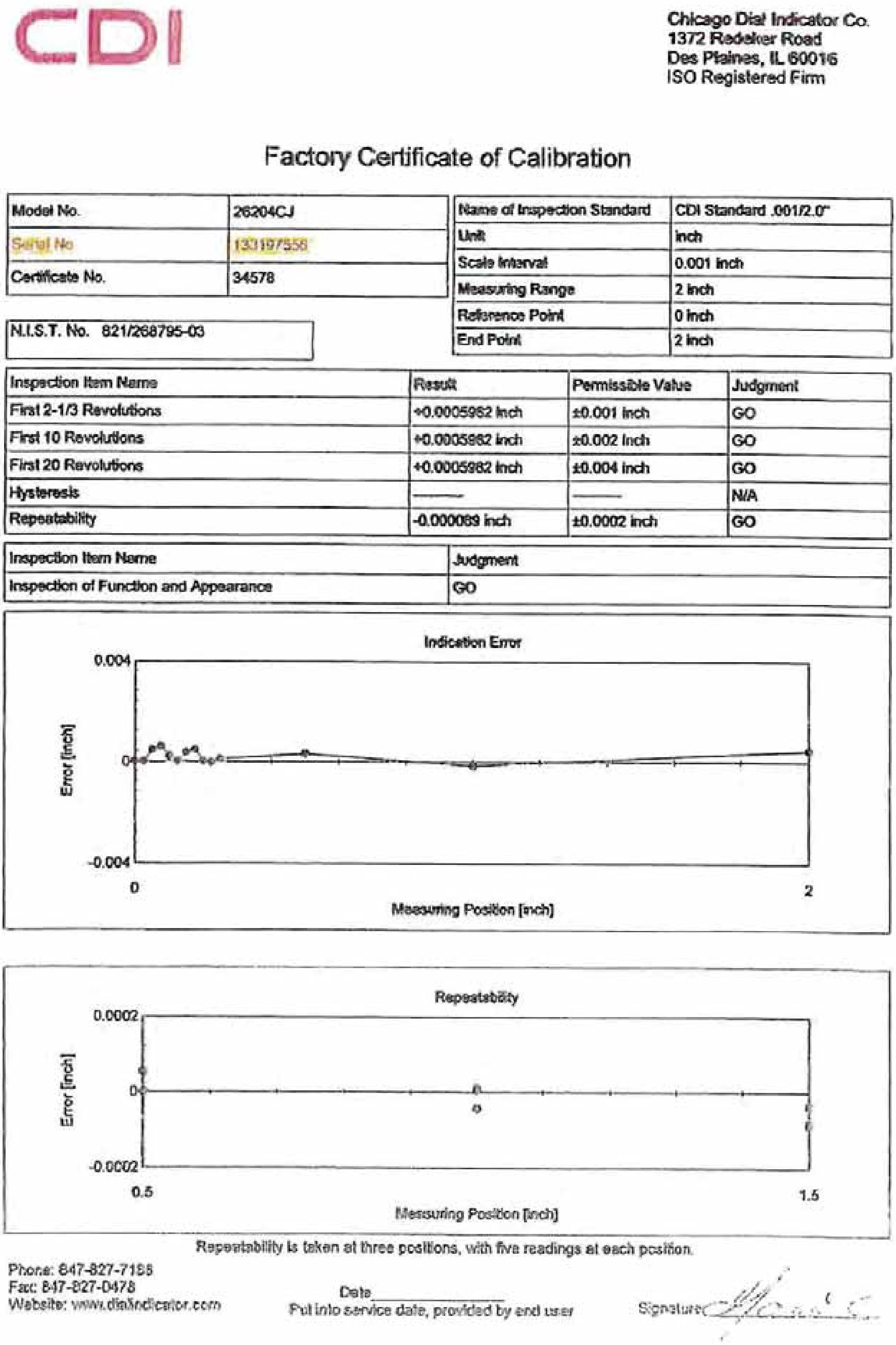
MTA New York City Transit Authority

A30195

168 & 181 St STATION – BROADWAY/7TH AV LINE
REPAIR OF BRICK ARCH

ANCHOR TABLE


½" FILLET WELD
1" HOLE
¼" FILLET WELD
HSS STEEL TUBE
4"x4"x5/16"
FY= 46 KSI
½" FILLET WELD
¼" FILLET WELD
4"
2
4"
SINGLE BOLT TENSION TESTING ASSEMBLY (A)
PROJECT:
MTA BOLT TESTING
OWNER:
FTC
NO.
REVISION COMMENT
DATE
DRAWING TITLE:
SINGLE BOLT TENSION TESTING ASSEMBLY (A)
DRAWING NO.:
SK-1
DRAWN BY:
LEO
SCALE:
FILE NO.:
DATE:
11/20/2013
3 OF 8



Chicago Dial Indicator Co.
1372 Redeker Road
Des Plaines, IL 60016
ISO Registered Firm

Factory Certificate of Calibration

Model No.	26204CJ
Serial No	133197556
Certificate No.	34578

N.I.S.T. No. 821/268795-03

Name of Inspection Standard	CDI Standard .001/2.0"
Unit	inch
Scale Interval	0.001 inch
Measuring Range	2 inch
Reference Point	0 inch
End Point	2 inch

Inspection Item Name	Result	Permissible Value	Judgment
First 2-1/3 Revolutions	+0.0005982 inch	±0.001 inch	GO
First 10 Revolutions	+0.0005982 inch	±0.002 inch	GO
First 20 Revolutions	+0.0005982 inch	±0.004 inch	GO
Hysteresis	———	———	N/A
Repeatability	-0.000089 inch	±0.0002 inch	GO

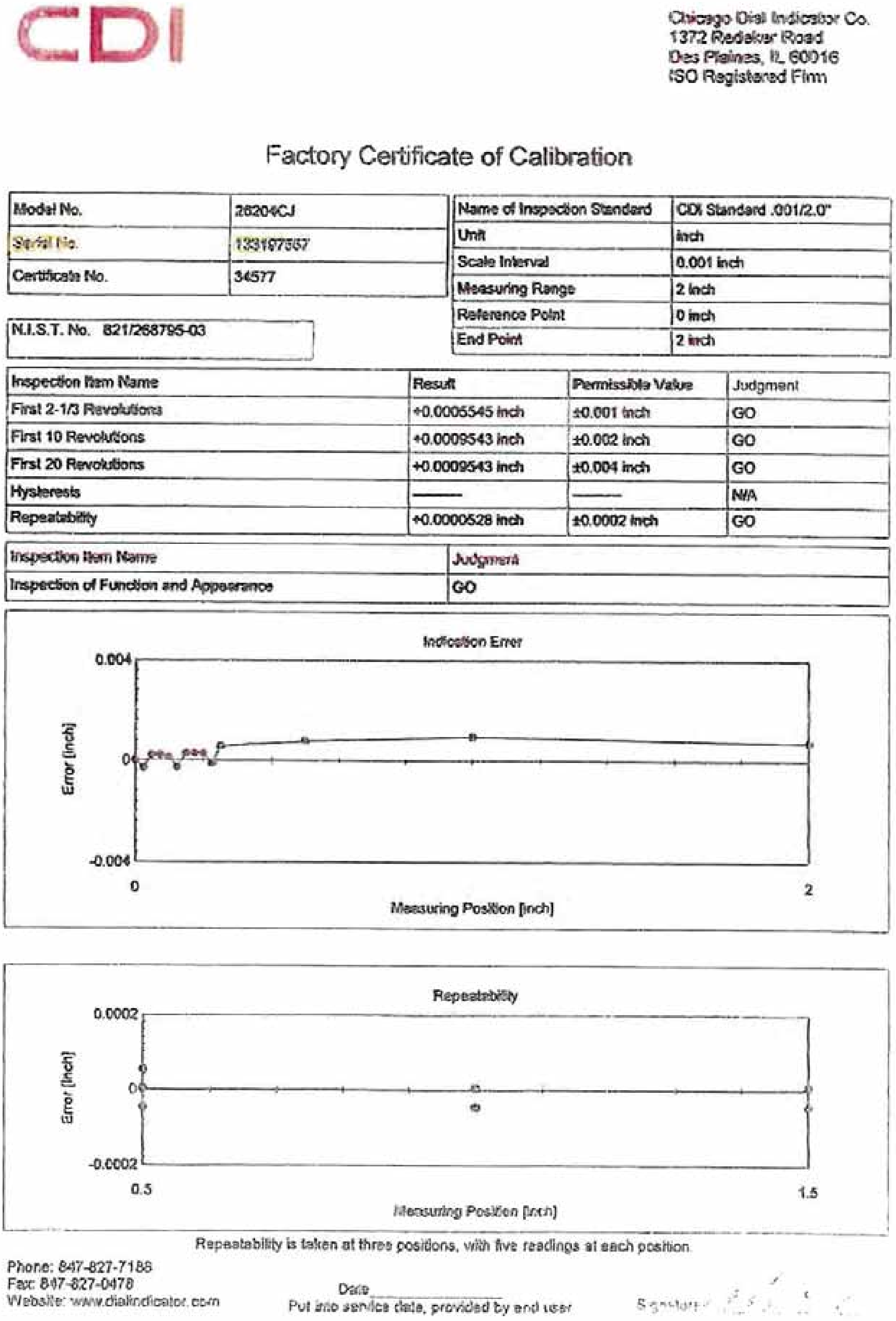
Inspection Item Name	Judgment
Inspection of Function and Appearance	GO

Repeatability is taken at three positions, with five readings at each position.

Phone: 847-827-7186
Fax: 847-827-0478
Website: www.dialindicator.com

Date________________
Put into service date, provided by end user

Signature



CDI

Chicago Dial Indicator Co.
1372 Redeker Road
Des Plaines, IL 60016
ISO Registered Firm

Factory Certificate of Calibration

Model No.	26204CJ
Serial No.	133197557
Certificate No.	34577

N.I.S.T. No. 821/268795-03

Name of Inspection Standard	CDI Standard .001/2.0"
Unit	inch
Scale Interval	0.001 inch
Measuring Range	2 inch
Reference Point	0 inch
End Point	2 inch

Inspection Item Name	Result	Permissible Value	Judgment
First 2-1/3 Revolutions	+0.0006545 inch	±0.001 inch	GO
First 10 Revolutions	+0.0009543 inch	±0.002 inch	GO
First 20 Revolutions	+0.0009543 inch	±0.004 inch	GO
Hysteresis	———	———	N/A
Repeatability	+0.0000528 inch	±0.0002 inch	GO

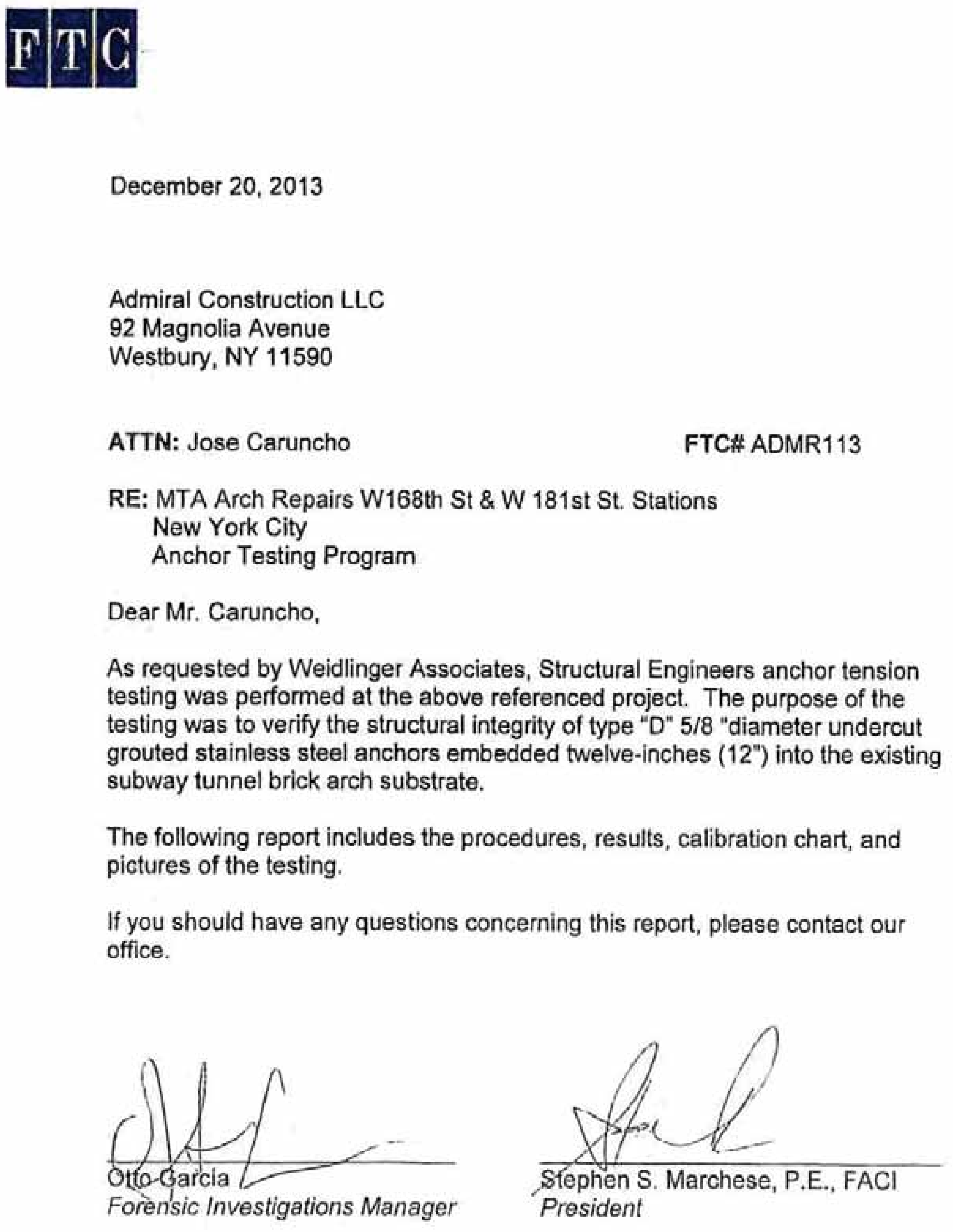
Inspection Item Name	Judgment
Inspection of Function and Appearance	GO

Repeatability is taken at three positions, with five readings at each position.

Phone: 847-827-7188
Fax: 847-827-0478
Website: www.dialindicator.com

Date________________
Put into service date, provided by end user

Signature



FTC

December 20, 2013

Admiral Construction LLC
92 Magnolia Avenue
Westbury, NY 11590

ATTN: Jose Caruncho **FTC#** ADMR113

RE: MTA Arch Repairs W168th St & W 181st St. Stations
New York City
Anchor Testing Program

Dear Mr. Caruncho,

As requested by Weidlinger Associates, Structural Engineers anchor tension testing was performed at the above referenced project. The purpose of the testing was to verify the structural integrity of type "D" 5/8 "diameter undercut grouted stainless steel anchors embedded twelve-inches (12") into the existing subway tunnel brick arch substrate.

The following report includes the procedures, results, calibration chart, and pictures of the testing.

If you should have any questions concerning this report, please contact our office.

Otto Garcia
Forensic Investigations Manager

Stephen S. Marchese, P.E., FACI
President

FTC

December 20, 2013
MTA Arch Repairs W 168th St & W 181st St. Stations
Anchor Testing Program

ANCHOR TESTING PROGRAM

INTRODUCTON

On December 5, 6, 9, 11, 2013, the above referenced project was visited to perform tension testing on type "D" 5/8" diameter undercut grouted stainless steel anchors. The type "D" 5/8" diameter undercut grouted stainless steel anchors were embedded twelve-inches (12") into the existing subway tunnel brick arch substrate. The above anchor testing was performed as indicated in Specification Section 3BB, Part 3/3.1 – Pre-Installed Anchor Testing Program.

The purpose of the testing is to perform pull tests to determine the structural integrity of the grouted anchors intention for compliance to design criteria. A test load of 5600 pounds and maximum displacement reading of 0.125 was utilized as directed by Weidlinger Associates, for testing of anchors.

Witnesses for the testing were Rehan Gulzar of Cinalta Construction, Michael Ferrell of Cintec North America, and Shahzad Hassan of Weidlinger Associates.

PROCEDURE

To perform the tests, a calibrated center hole hydraulic jack and gauge were utilized. To attach the hydraulic jack to the anchors, a threaded rod and coupling was utilized, supported by a steel test fixture. To measure displacement of an anchor an extensometer (dial gauge) measuring to 0.001" was utilized.

The test began by first attaching the threaded rod and test assembly to the anchor. The jack was attached by utilizing the threaded rod and coupling. The load was applied slowly until the test load was achieved or failure occurred. If the test load was achieved, the load was maintained for duration of ten (10) minutes and at this time displacement readings are taken and then the load is released. The area surrounding the anchor is then inspected for signs of distress and/or cracking. The above test procedure and test set up were performed as referenced in ASTM E488-96.

CONCLUSION

A total of twelve (12) type "D" 5/8" diameter undercut grouted stainless steel anchors were tested. Six (6) tests were performed at the W 168th St. station and six (6) tests at the W 181st St. station. All twelve (12) type "D" 5/8" diameter undercut grouted stainless steel anchors tested did maintain the test load of 5600 pounds provided with minimal displacement for the duration of ten (10) minutes without any signs of distress and/or cracking during the testing procedure. The results of these tests are on the following chart.

FTC

December 20, 2013
MTA Arch Repairs W 168th St & W 181st St. Stations
New York City
Anchor Testing Program

ANCHOR TESTING PROGRAM RESULTS

ANCHOR NO.	DATE TESTED	ANCHOR LOCATION	TEST TYPE	TEST LOAD (LBS)	DIAL GAUGE (INCHES)	ANCHOR CONDITION
D-1	12-05-13	West 168th St. Station	Tension	5600	0.040	No Signs of Any Damage
D-2	12-05-13	West 168th St. Station	Tension	5600	0.045	No Signs of Any Damage
D-3	12-06-13	West 168th St. Station	Tension	5600	0.040	No Signs of Any Damage
D-4	12-06-13	West 168th St. Station	Tension	5600	0.030	No Signs of Any Damage
D-5	12-09-13	West 168th St. Station	Tension	5600	0.025	No Signs of Any Damage
D-6	12-09-13	West 168th St. Station	Tension	5600	0.056	No Signs of Any Damage
D-1	12-11-13	West 181st St. Station	Tension	5600	0.020	No Signs of Any Damage
D-2	12-11-13	West 181st St. Station	Tension	5600	0.015	No Signs of Any Damage
D-3	12-11-13	West 181st St. Station	Tension	5600	0.017	No Signs of Any Damage
D-4	12-11-13	West 181st St. Station	Tension	5600	0.018	No Signs of Any Damage
D-5	12-11-13	West 181st St. Station	Tension	5600	0.022	No Signs of Any Damage
D-6	12-11-13	West 181st St. Station	Tension	5600	0.014	No Signs of Any Damage

CALIBRATION CHART

EQUIPMENT CALIBRATED:
DATED: June 17, 2013
EQUIPMENT CALIBRATED
WIKA 10,000 psi Gauge
Serial No.23040
ENERPAC 20Ton Center Hole Jack
Serial No. 001

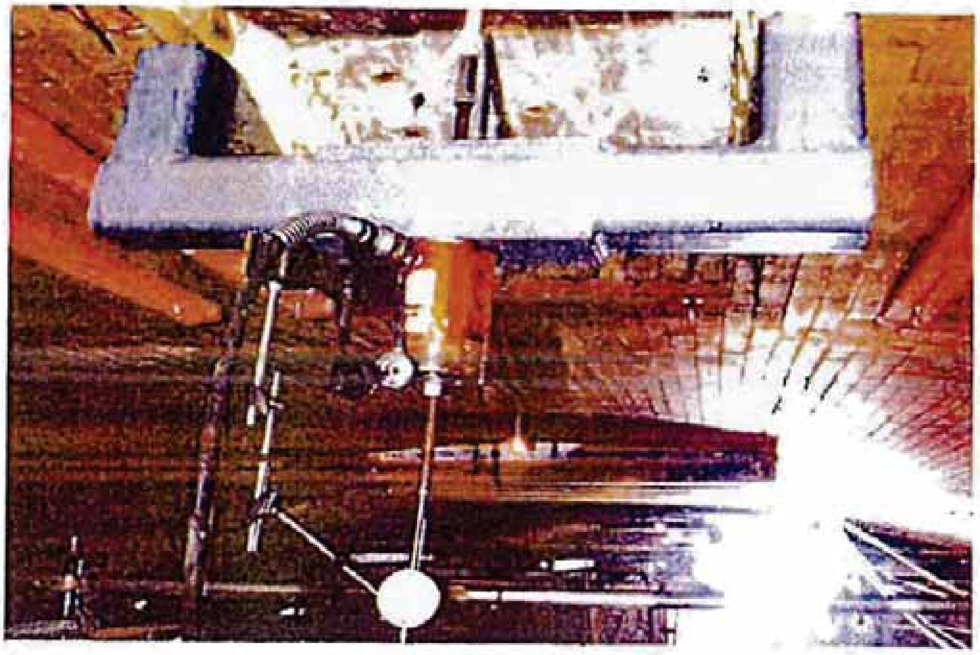
EQUIPMENT USED:
Test Mark CM-600-iD Compression Machine
Serial No. 120819 Calibrated: January 17, 2013

RESULTS

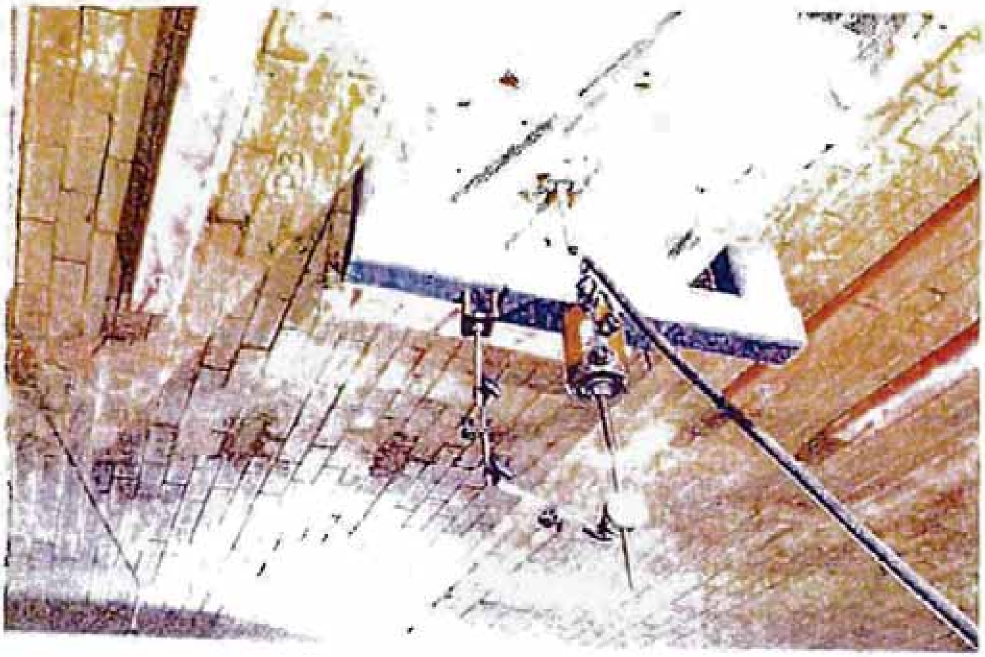
Gauge Reading (psi)	Load (lbs)
100	600
250	1200
300	1400
400	1900
500	2300
600	2500
650	2800
700	3000
800	3500
900	4300
1000	4650
1100	4800
1300	5600
1400	6400
1800	9000
2000	9500
2200	10,000
2500	11,500
2600	12,000
3000	14,100
3500	16,400
4100	19,200
4500	21,500
5000	23,500
5200	24,000
6000	28,500
6500	30,000
7000	32,500
8000	37,500
9000	42,500
10,000	47,000

Future Tech Consultants of New York, Inc.
52 East 2nd Street, Mineola, NY 11501 Tel: (516) 355-0168 Fax: (516) 355-0127

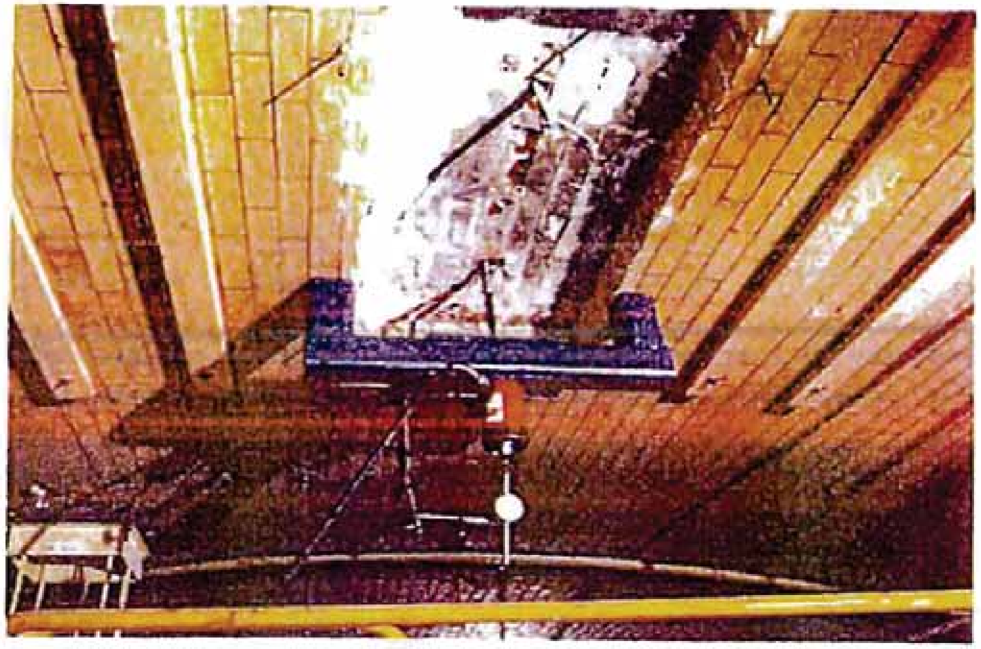
TYPICAL TEST SET UP
W168th St. STATION # D-2



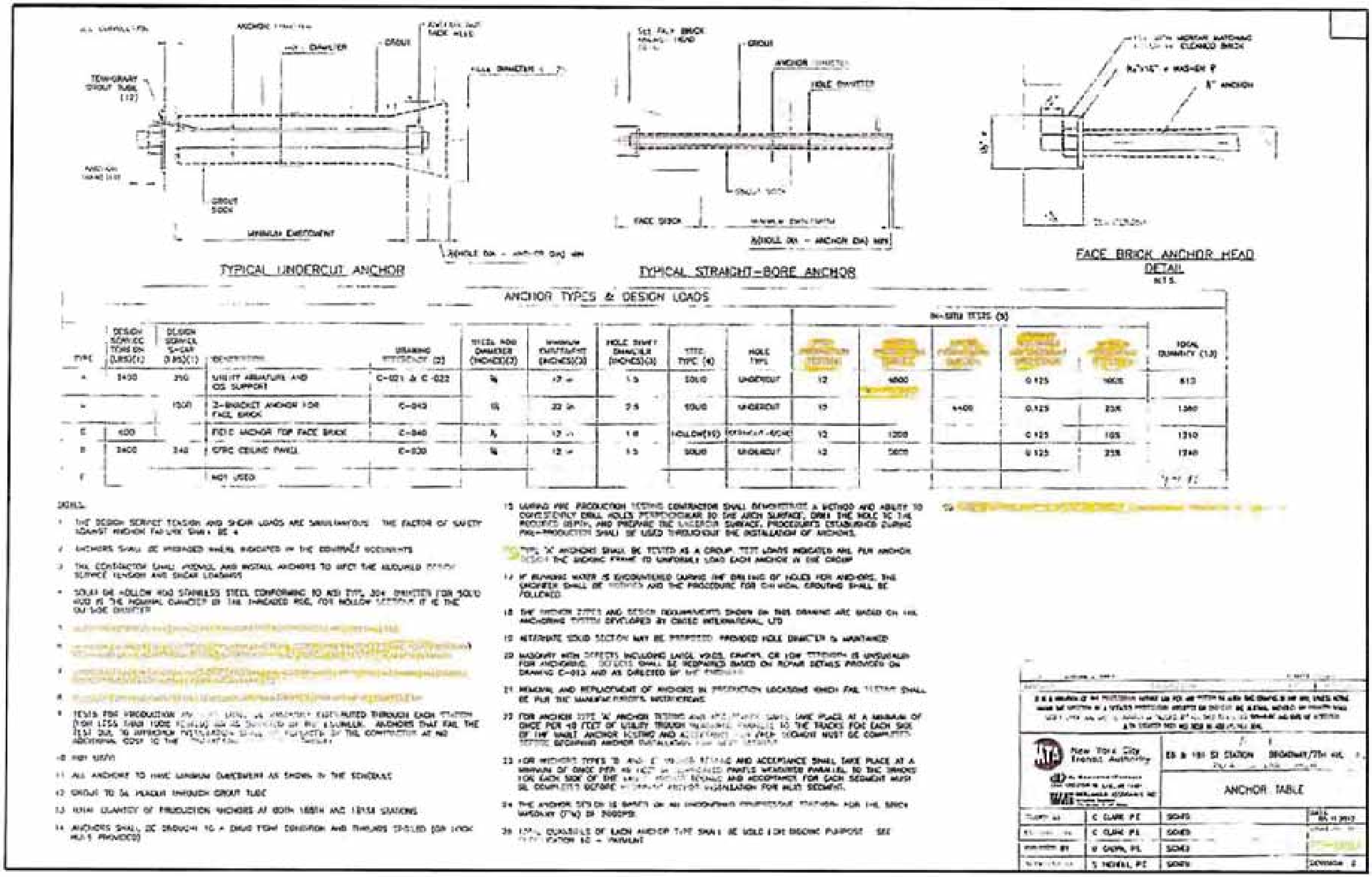
TYPICAL TEST SET UP
W168th St. STATION # D-3



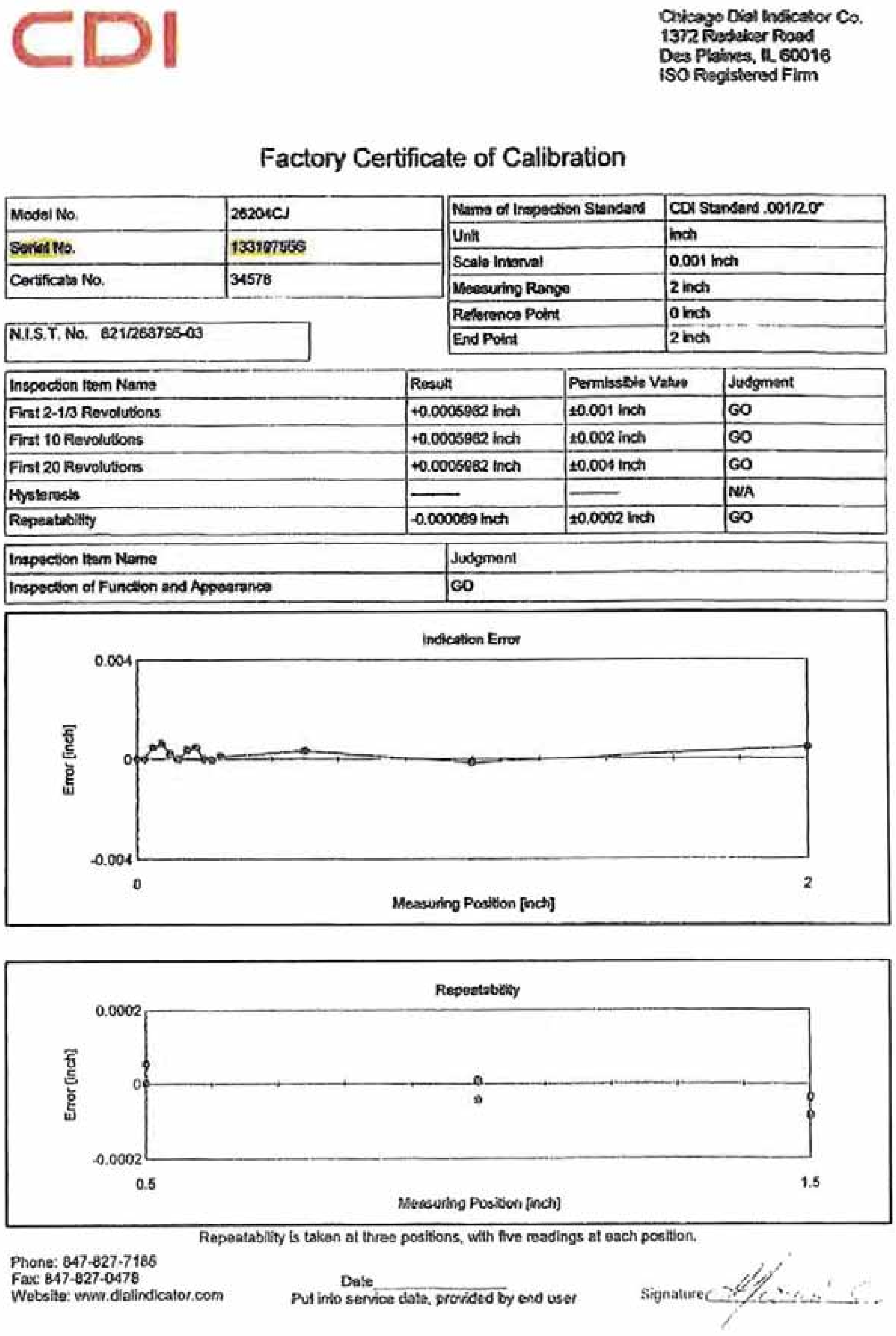
TYPICAL TEST SET UP
W181st St. STATION # D-2



TYPICAL TEST SET UP
W181st St. STATION # D-3



TYPICAL UNDERCUT ANCHOR
TYPICAL STRAIGHT-BORE ANCHOR
FACE BRICK ANCHOR HEAD DETAIL
N.T.S.
ANCHOR TYPES & DESIGN LOADS
New York City Transit Authority
ANCHOR TABLE



CDI

Chicago Dial Indicator Co.
1372 Redeker Road
Des Plaines, IL 60016
ISO Registered Firm

Factory Certificate of Calibration

Model No.	26204CJ
Serial No.	133197556
Certificate No.	34578

N.I.S.T. No. 821/268795-03

Name of Inspection Standard	CDI Standard .001/2.0"
Unit	inch
Scale Interval	0.001 inch
Measuring Range	2 inch
Reference Point	0 inch
End Point	2 inch

Inspection Item Name	Result	Permissible Value	Judgment
First 2-1/3 Revolutions	+0.0005982 inch	±0.001 inch	GO
First 10 Revolutions	+0.0005982 inch	±0.002 inch	GO
First 20 Revolutions	+0.0005982 inch	±0.004 inch	GO
Hysteresis	———	———	N/A
Repeatability	-0.000069 inch	±0.0002 inch	GO

Inspection Item Name	Judgment
Inspection of Function and Appearance	GO

Indication Error

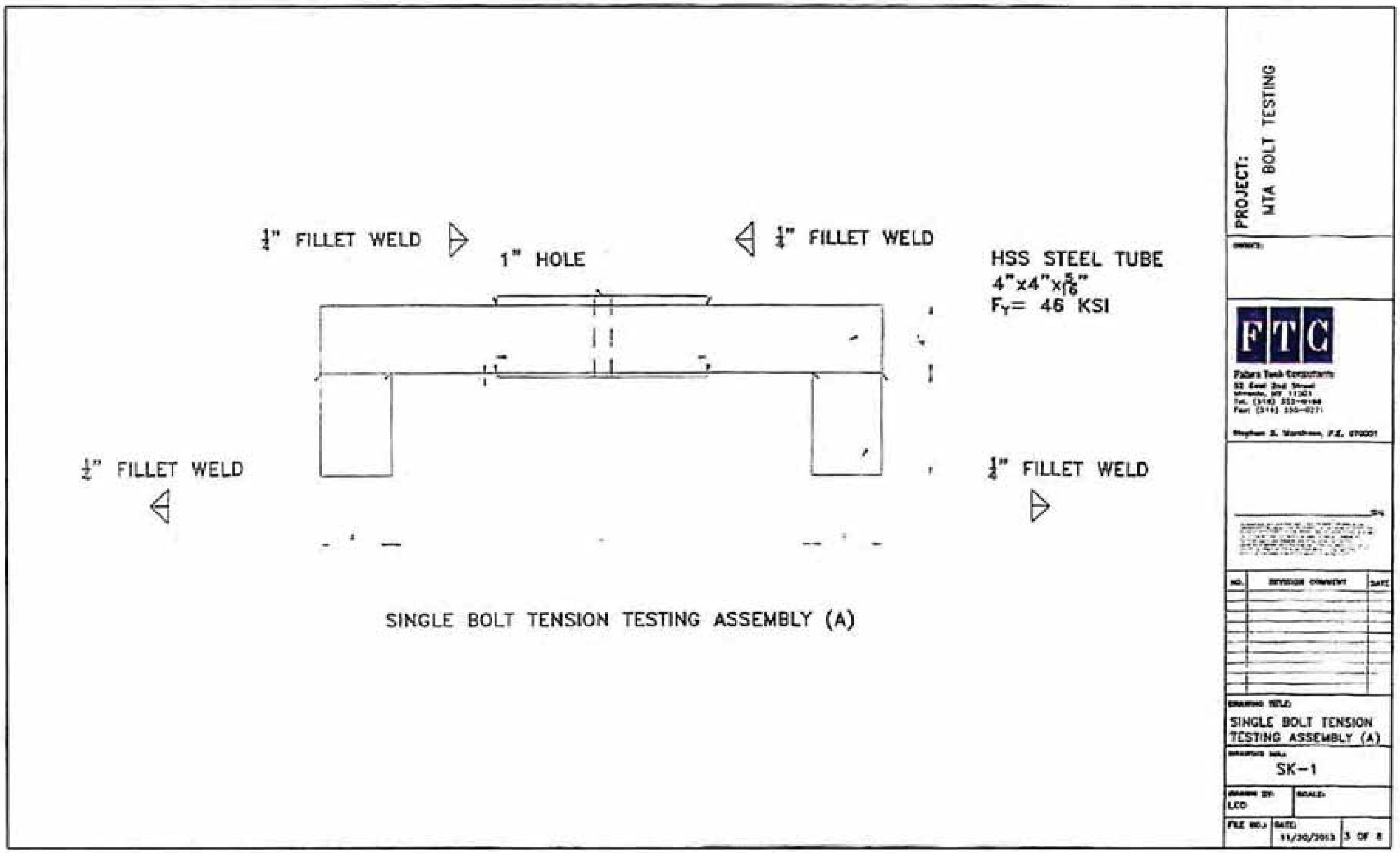
Repeatability

Repeatability is taken at three positions, with five readings at each position.

Phone: 847-827-7186
Fax: 847-827-0478
Website: www.dialindicator.com

Date ____________
Put into service date, provided by end user

Signature


½" FILLET WELD
1" HOLE
¼" FILLET WELD
HSS STEEL TUBE
4"x4"x5/16"
F_Y= 46 KSI
½" FILLET WELD
¼" FILLET WELD
SINGLE BOLT TENSION TESTING ASSEMBLY (A)
PROJECT:
MTA BOLT TESTING
OWNER:
FTC
NO.
REVISION COMMENT
DATE
DRAWING TITLE:
SINGLE BOLT TENSION TESTING ASSEMBLY (A)
DRAWING NO.:
SK-1
DRAWN BY:
LCD
SCALE:
FILE NO.:
DATE:
11/20/2013
3 OF 8

FTC

December 19, 2013

Admiral Construction LLC
92 Magnolia Avenue
Westbury, NY 11590

ATTN: Jose Caruncho **FTC#** ADMR113

RE: MTA Arch Repairs W 168th St & W181st St. Stations
New York City
Anchor Testing Program

Dear Mr. Caruncho,

As requested by Weidlinger Associates, Structural Engineers anchor tension testing was performed at the above referenced project. The purpose of the testing was to verify the structural integrity of Group Type "A" 5/8 "diameter undercut grouted stainless steel anchors embedded twelve (12") into the existing subway tunnel brick arch substrate.

The following report includes the procedures, results, calibration chart, and pictures of the testing.

If you should have any questions concerning this report, please contact our office.

Otto Garcia
Forensic Investigations Manager

Stephen S. Marchese, P.E., FACI
President

FTC

December 19, 2013
MTA Arch Repairs W168th St & W 181st St. Stations
Anchor Testing Program

ANCHOR TESTING PROGRAM

INTRODUCTON

On December 5, 11, 12, 2013, the above referenced project was visited to perform tension testing on Group Type "A" 5/8" diameter undercut grouted stainless steel anchors. The Group Type "A" 5/8" diameter undercut grouted stainless steel anchors were embedded twelve-inches (12") into the existing subway tunnel brick arch substrate. The above anchor testing was performed as indicated in Specification Section 3BB, Part 3/3.1 – Pre-Installed Anchor Testing Program.

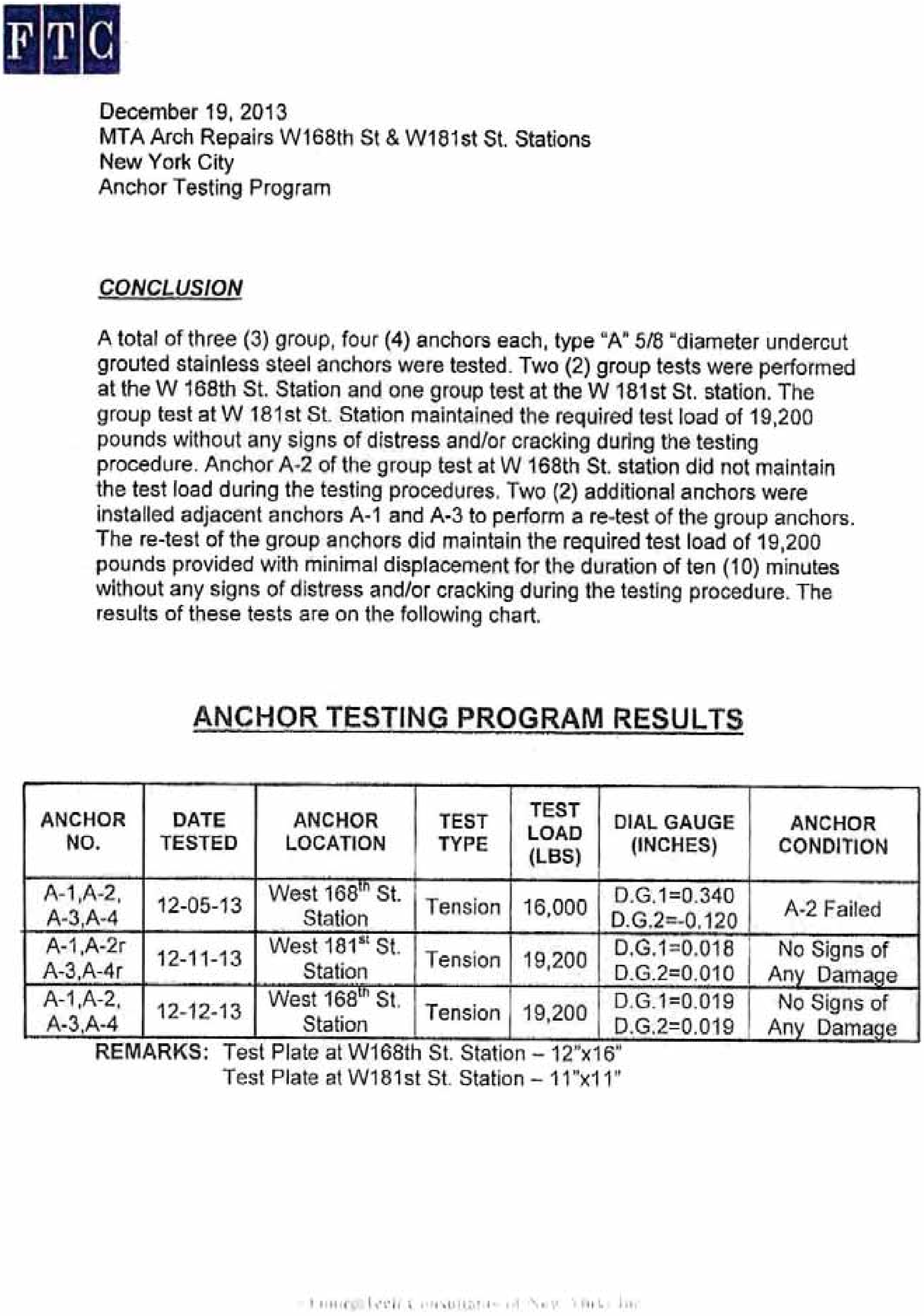
The purpose of the testing is to perform group pull tests to determine the structural integrity of the grouted anchors intention for compliance to design criteria. A test load of 19.200 pounds for Group Type "A" anchors and maximum displacement reading of 0.125 was utilized as directed by Weidlinger Associates, for testing of anchors.

Witnesses for the testing were Rehan Gulzar of Cinalta Construction, Michael Ferrell of Cintec North America, and Shahzad Hassan of Weidlinger Associates.

PROCEDURE

To perform the tests, a calibrated center hole hydraulic jack and gauge were utilized. To attach the hydraulic jack to the group anchors, a threaded rod, coupling, shackle and steel test plate were utilized, supported by a steel test fixture. To measure displacement of an anchor an extensometer (dial gauge) measuring to 0.001" was utilized.

The test began by first attaching the threaded rod and test assembly to the group anchors. The jack was attached by utilizing the threaded rod, coupling, shackle and steel test plate. The load was applied slowly until the test load was achieved or failure occurred. If the test load was achieved, the load was maintained for a duration of ten (10) minutes and at this time displacement readings are taken and then the load is released. The area surrounding the group anchors is then inspected for signs of distress and/or cracking. The above test procedure and test set up were performed as referenced in ASTM E488-96.



FTC

December 19, 2013
MTA Arch Repairs W168th St & W181st St. Stations
New York City
Anchor Testing Program

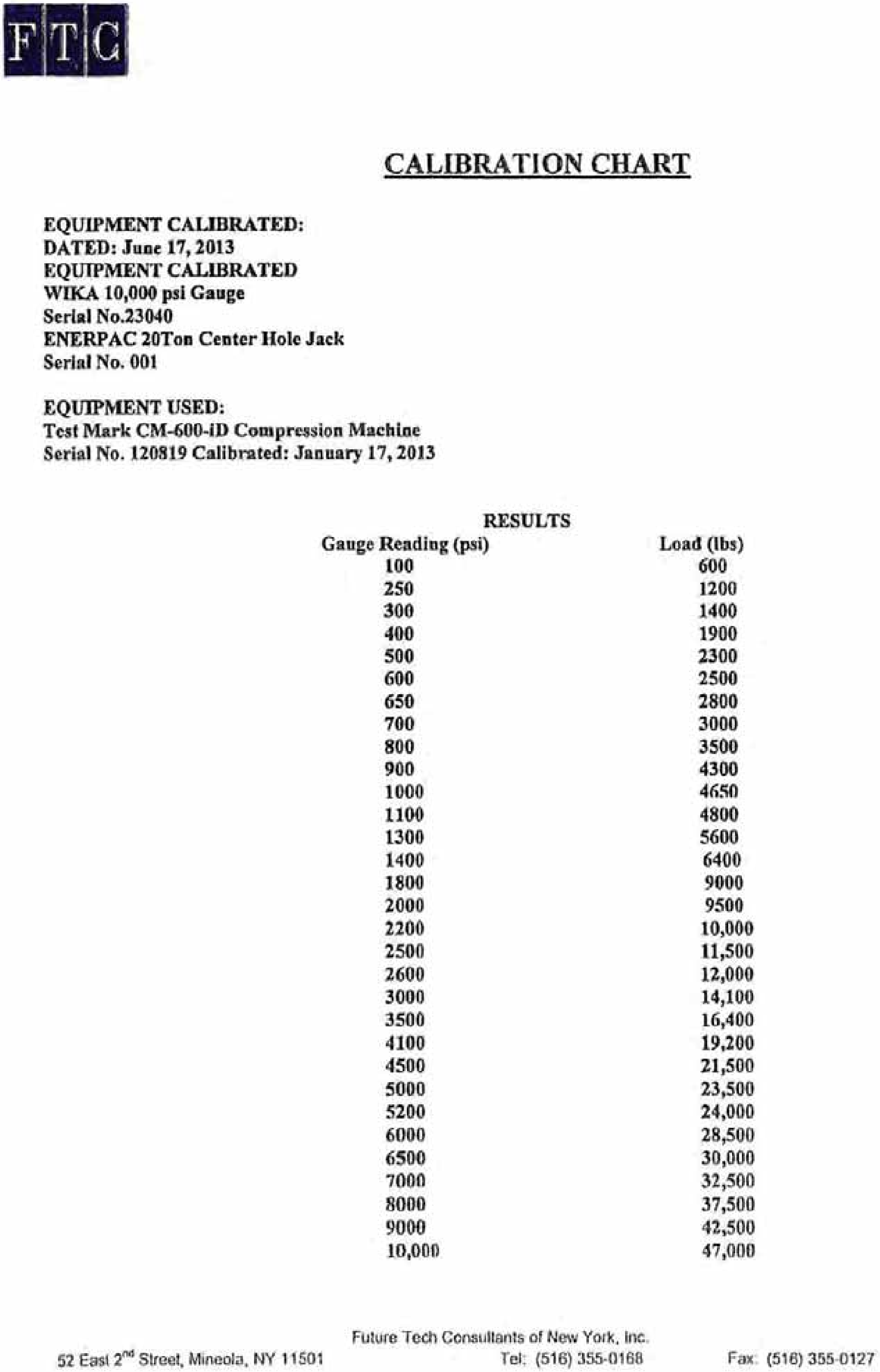
CONCLUSION

A total of three (3) group, four (4) anchors each, type "A" 5/8 "diameter undercut grouted stainless steel anchors were tested. Two (2) group tests were performed at the W 168th St. Station and one group test at the W 181st St. station. The group test at W 181st St. Station maintained the required test load of 19,200 pounds without any signs of distress and/or cracking during the testing procedure. Anchor A-2 of the group test at W 168th St. station did not maintain the test load during the testing procedures. Two (2) additional anchors were installed adjacent anchors A-1 and A-3 to perform a re-test of the group anchors. The re-test of the group anchors did maintain the required test load of 19,200 pounds provided with minimal displacement for the duration of ten (10) minutes without any signs of distress and/or cracking during the testing procedure. The results of these tests are on the following chart.

ANCHOR TESTING PROGRAM RESULTS

ANCHOR NO.	DATE TESTED	ANCHOR LOCATION	TEST TYPE	TEST LOAD (LBS)	DIAL GAUGE (INCHES)	ANCHOR CONDITION
A-1,A-2, A-3,A-4	12-05-13	West 168th St. Station	Tension	16,000	D.G.1=0.340 D.G.2=-0.120	A-2 Failed
A-1,A-2r A-3,A-4r	12-11-13	West 181st St. Station	Tension	19,200	D.G.1=0.018 D.G.2=0.010	No Signs of Any Damage
A-1,A-2, A-3,A-4	12-12-13	West 168th St. Station	Tension	19,200	D.G.1=0.019 D.G.2=0.019	No Signs of Any Damage

REMARKS: Test Plate at W168th St. Station – 12"x16"
Test Plate at W181st St. Station – 11"x11"



FTC

CALIBRATION CHART

EQUIPMENT CALIBRATED:
DATED: June 17, 2013
EQUIPMENT CALIBRATED
WIKA 10,000 psi Gauge
Serial No.23040
ENERPAC 20Ton Center Hole Jack
Serial No. 001

EQUIPMENT USED:
Test Mark CM-600-iD Compression Machine
Serial No. 120819 Calibrated: January 17, 2013

RESULTS

Gauge Reading (psi)	Load (lbs)
100	600
250	1200
300	1400
400	1900
500	2300
600	2500
650	2800
700	3000
800	3500
900	4300
1000	4650
1100	4800
1300	5600
1400	6400
1800	9000
2000	9500
2200	10,000
2500	11,500
2600	12,000
3000	14,100
3500	16,400
4100	19,200
4500	21,500
5000	23,500
5200	24,000
6000	28,500
6500	30,000
7000	32,500
8000	37,500
9000	42,500
10,000	47,000

Future Tech Consultants of New York, Inc.
52 East 2nd Street, Mineola, NY 11501 Tel: (516) 355-0168 Fax: (516) 355-0127

INSPECTION GUIDELINES

During Installation – All anchors MUST be installed by Cintec certified persons following strict guidelines as provided in the “Cintec Training Manual”. Four indicators of proper installation are:

1) End of anchor sock nearest installer must be bulbous, this assures that sock has been inflated to capacity (sufficient grout volume) to allow optimum adhesive and mechanical attachment.
2) Grout milk must be present, this assures that sock has been inflated to capacity (sufficient grout volume) to allow optimum adhesive and mechanical attachment.
3) Bulb must be firm to touch, this assures that sock has been inflated to capacity (sufficient grout volume) to allow optimum adhesive and mechanical attachment.
4) Sock must be grey in colour, this assures that grout has travelled through the sock (saturated) and that sock has been inflated to capacity (sufficient grout volume) to allow optimum adhesive and mechanical attachment.

Following installation – all anchors must have been installed to Cintec standard, by Cintec certified persons, as outlined in “Cintec Training Manual”. Visual inspection can determine that above four indicators are present.

TESTING

By design, Cintec anchors do not fail. Components used far exceed load requirements as specified by Project Engineer of Record. With Cintec anchors / reinforcement any failure will be as a result of the substrate inability to withstand applied loads (anchoring failure).

Anchor The anchor is mechanically isolated from surrounding substrate and loads applied to end of anchor. Isolation prevents reaction of wall / substrate to loads applied and reflects reaction of anchor body to load via adhesive/mechanical attachment to grout.

Wall (substrate) If failure happens, it is typically the substrate that fails and this is Anchoring Failure – not anchor failure. When the load is applied in a non-isolated manner the wall / substrate is allowed to react. The wall/substrate will provide visual (such as cracks or movement) and sometimes audible (such as a cracking sound). Use of deflection meter and load dial will give evidence of such actions as shown in “Test Reports”

Testing is usually carried out by local Independent licensed Engineers in order that Cintec can not influence the test report. Testing is normally carried out to the relevant ASTM standard Specimen test reports of a selection of New York projects follow.

Case History

NYC MTA SUBWAY STATION

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

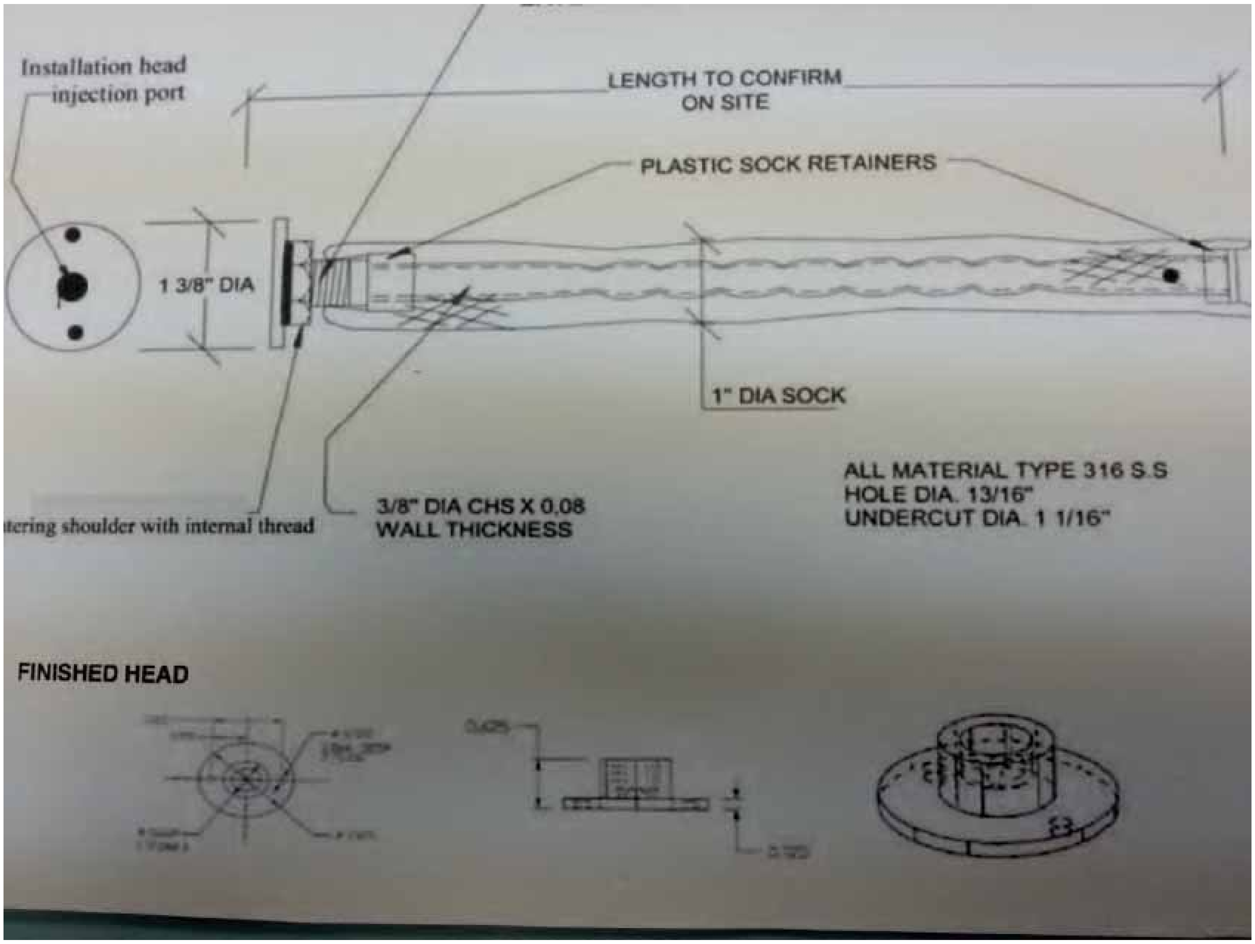
CINTEC America, a world leader in the field of structural masonry retrofit strengthening, repair, and preservation, has announced that after extensive site testing and evaluation it will supply a new anchoring system for the overhead glass fiber reinforced concrete (GFRC) panels for the NYC MTA subway 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 1-410-761- 0765 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

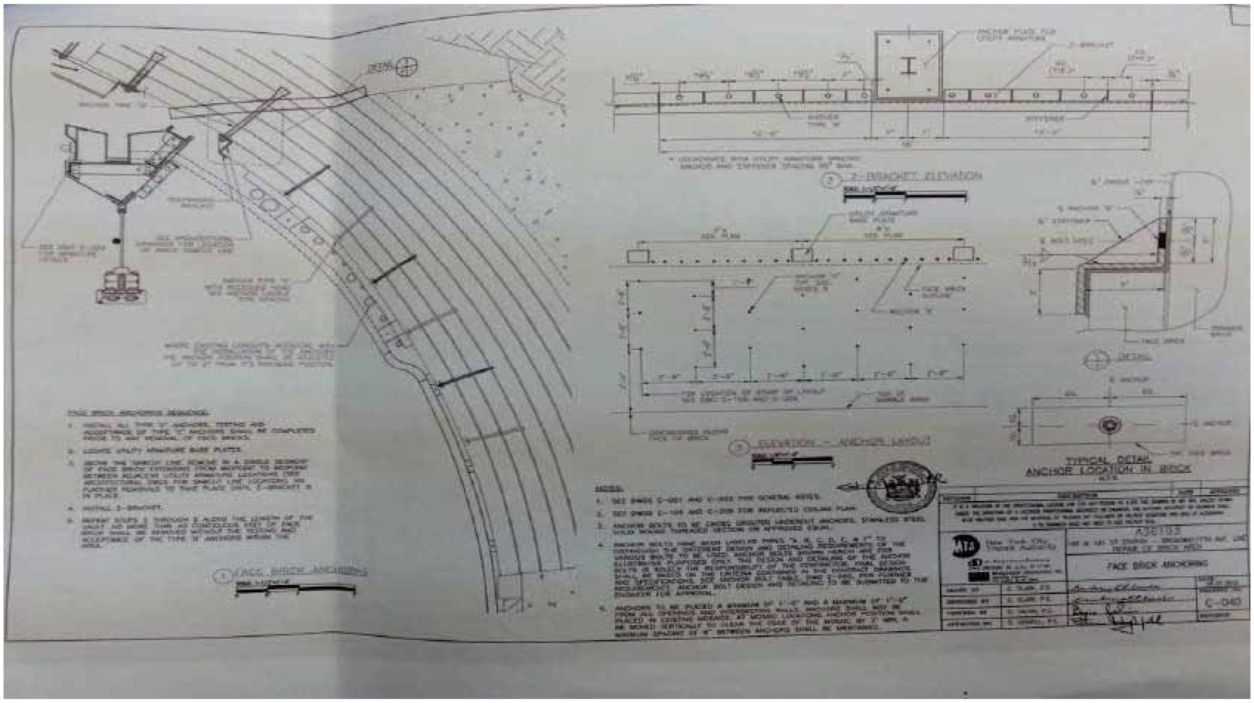
Overview

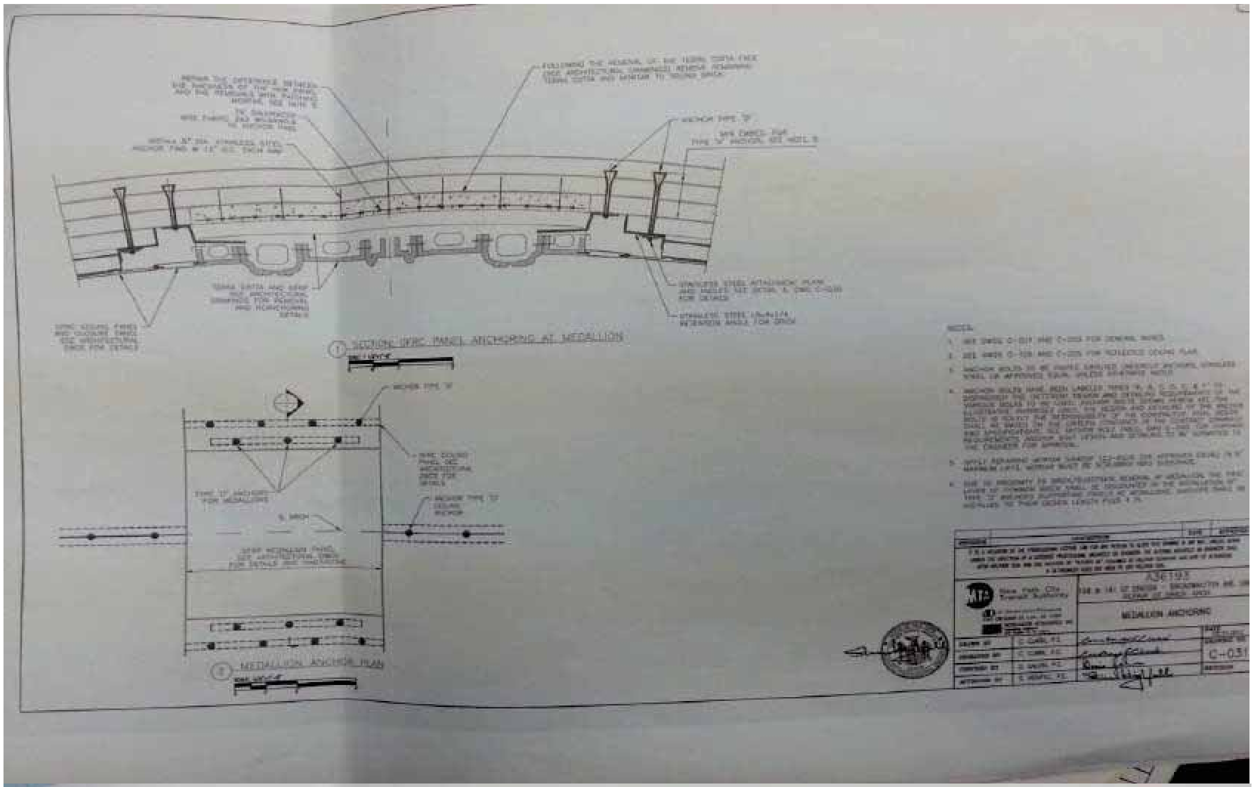
NYC Transit managers had learned in 1999 that a portion of the ceiling at 181st Street was at risk of collapse. However, it did not begin a comprehensive assessment of the ceiling's condition until June 2009. On August 16, 2009, at 10:18 p.m., a large section of the arched brick ceiling at the 181st 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.

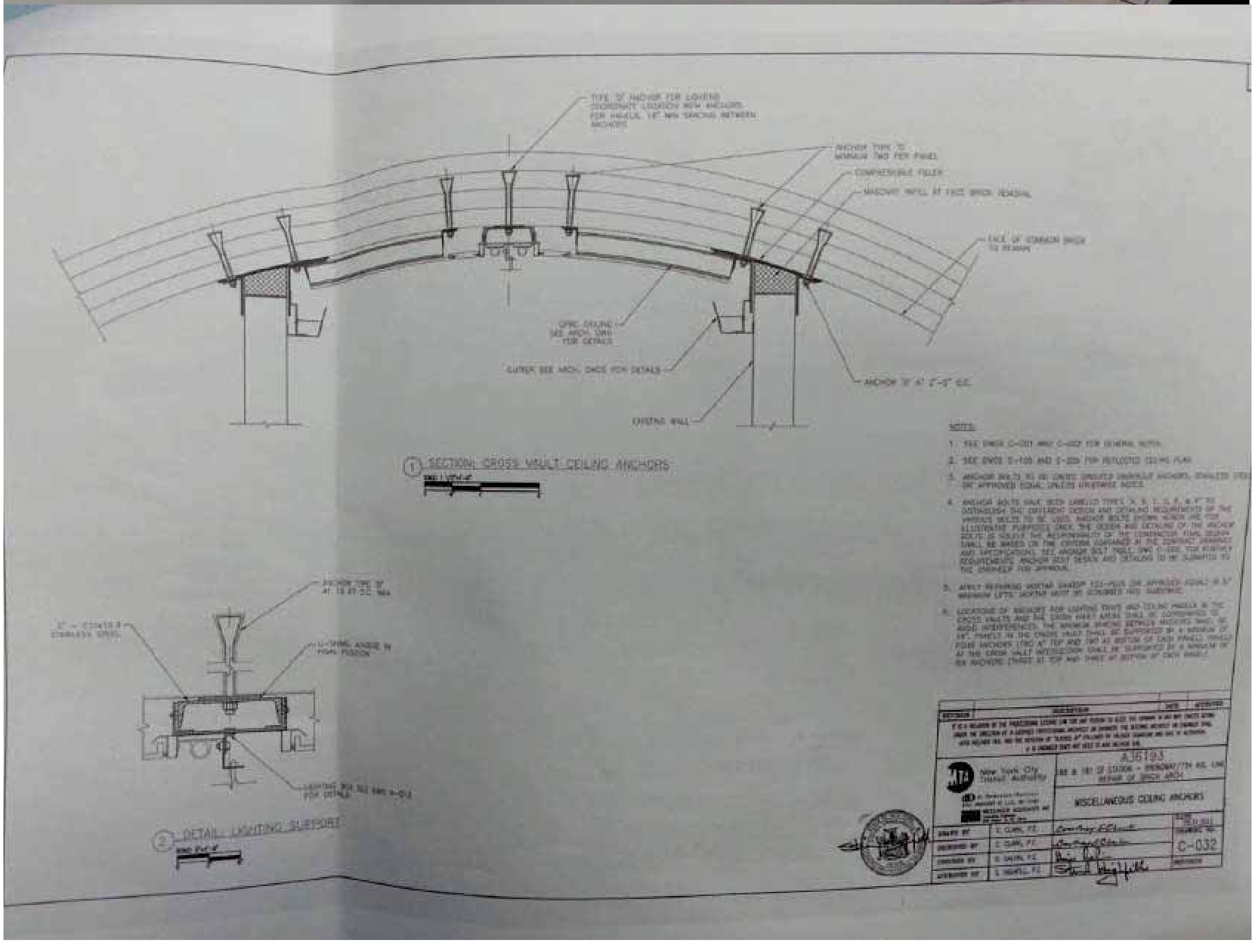
In May 2010 Robert Silman & Associates contacted Cintec requesting that we assist them in a designing a wall strengthening anchor system that could be used to hold the face brick to the backup brick. The general scope was to design anchors with an 18" embed into the ceiling masonry that would consolidate 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:




SECTION: GFRC PANEL ANCHORING AT MEDALLION
MEDALLION ANCHOR PLAN
ANCHOR TYPE 'D'
NOTES:
A36193
New York City Transit Authority
MEDALLION ANCHORING
C-031

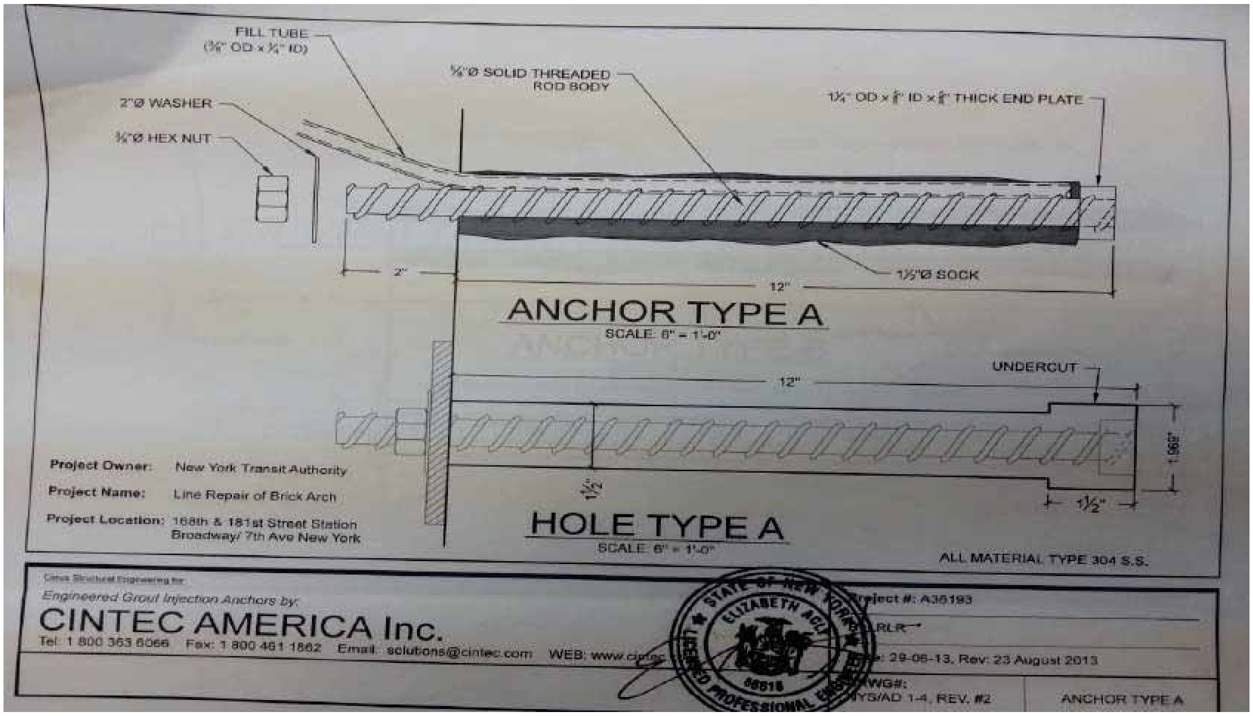

SECTION: CROSS VAULT CEILING ANCHORS
DETAIL: LIGHTING SUPPORT
EXISTING WALL
NOTES:
A36193
New York City Transit Authority
MISCELLANEOUS CEILING ANCHORS
C-032

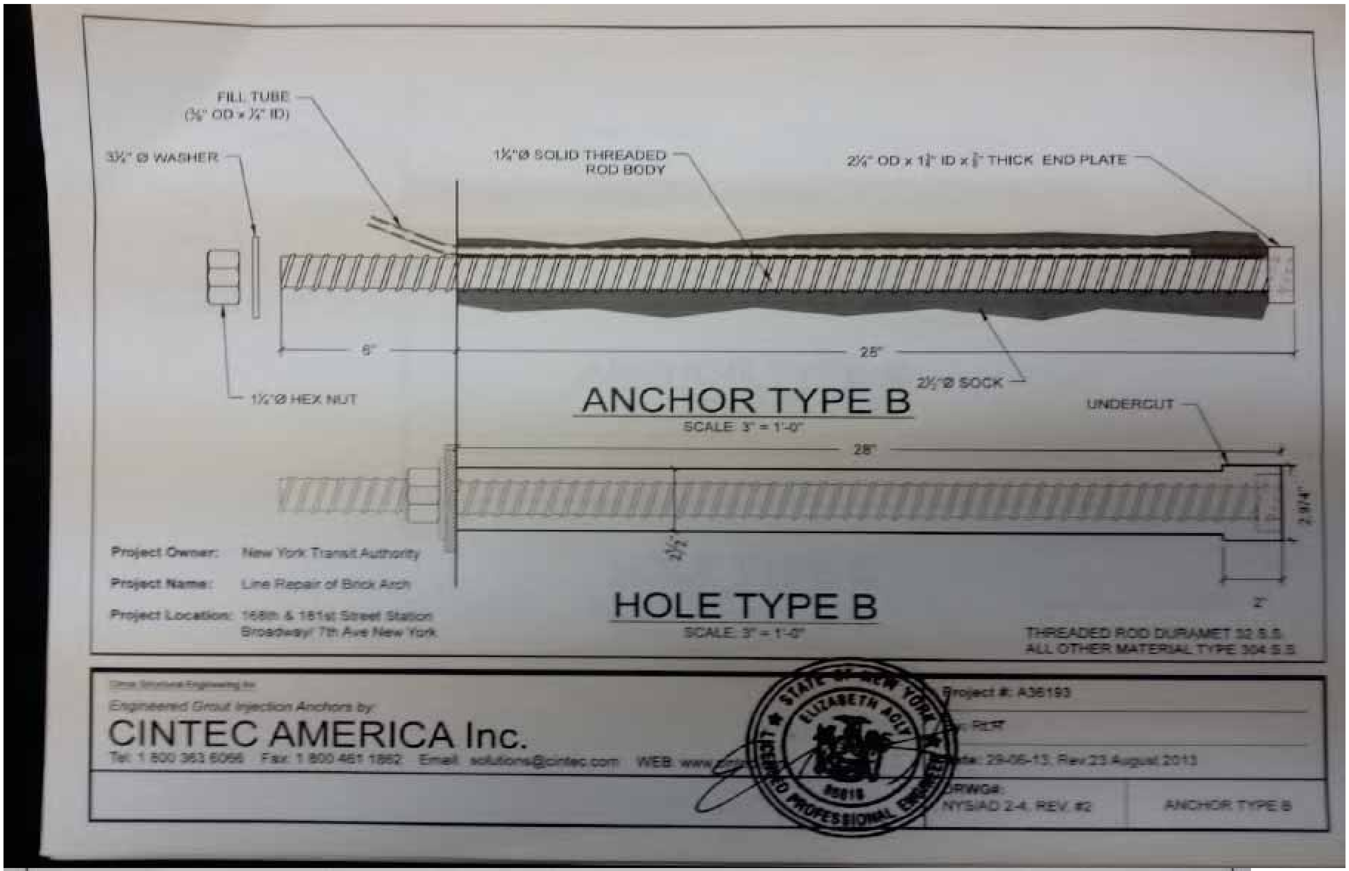
One of the challenges set worth was to design a positive lock system at the back end of the anchor drilled hole. To accomplish this Cintec developed and applied to patent an undercut cutting head that developed a square cut not a taper cut within the drilled hole. This approach to augment hole drilling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

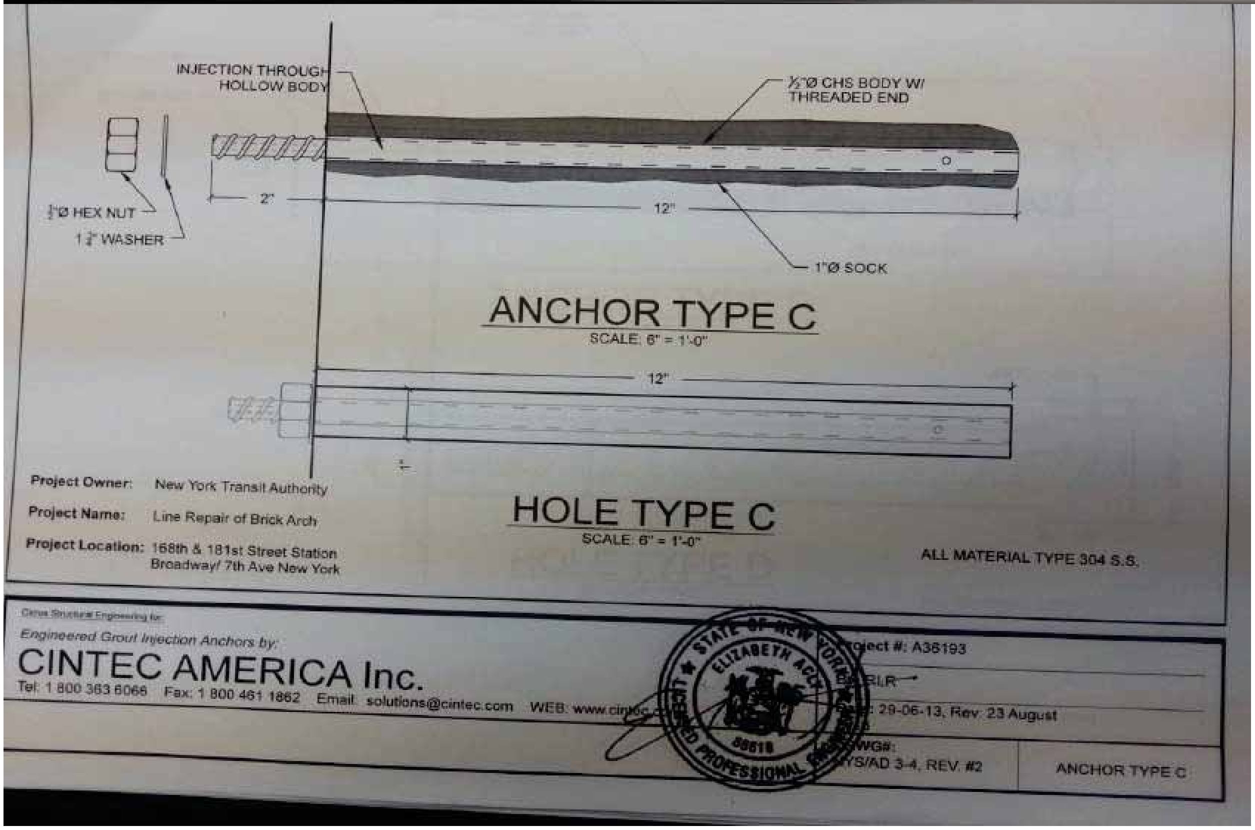
To validate the design, Cintec hired Elizabeth Acly. PE at Cirrus Structural Engineering, Hartford, CT to validate the all anchor types based on the following:

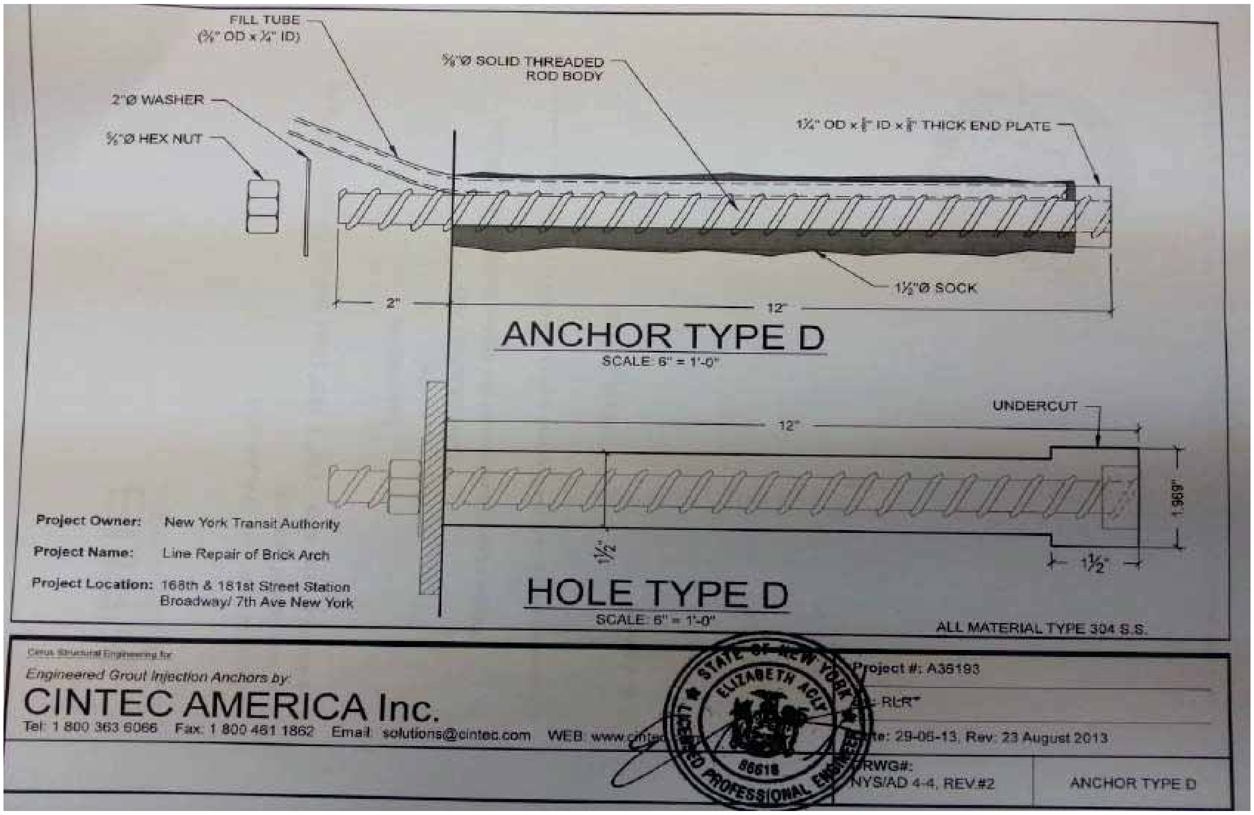
- Embed depth
- Tension load transfer from the anchor shaft to the substrate,
- Bond pull-out analysis
- Transfer of load from end plate to grout
- Transfer of load from grout bulb to substrate
- Contribution of Undercut
- Cone break-out analysis
- Steel yielding analysis
- Transfer of shear load to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

Copyrighted anchor drawings based on calculations:

- 


FILL TUBE (⅜" OD x ¼" ID)
3½" Ø WASHER
1½"Ø SOLID THREADED ROD BODY
2¾" OD x 1½" ID x ⅝" THICK END PLATE
6"
25"
2½"Ø SOCK
1½"Ø HEX NUT
ANCHOR TYPE B
SCALE: 3" = 1'-0"
UNDERCUT
28"
2 3/4"
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.
Cintec Structural Engineering Inc
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.com
Project #: A36193
RERT
Date: 29-06-13, Rev 23 August 2013
DRWG#: NYSIAD 2-4, REV. #2
ANCHOR TYPE B
ELIZABETH AOLY 85818


INJECTION THROUGH HOLLOW BODY
½"Ø CHS BODY W/ THREADED END
½"Ø HEX NUT
1 ½" WASHER
2"
12"
1"Ø SOCK
ANCHOR TYPE C
SCALE: 6" = 1'-0"
12"
HOLE TYPE C
SCALE: 6" = 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
ALL MATERIAL TYPE 304 S.S.
Cintec Structural Engineering Inc
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.com
Project #: A36193
BLR
Date: 29-06-13, Rev: 23 August
DRWG#: NYSIAD 3-4, REV. #2
ANCHOR TYPE C
ELIZABETH AOLY 85818

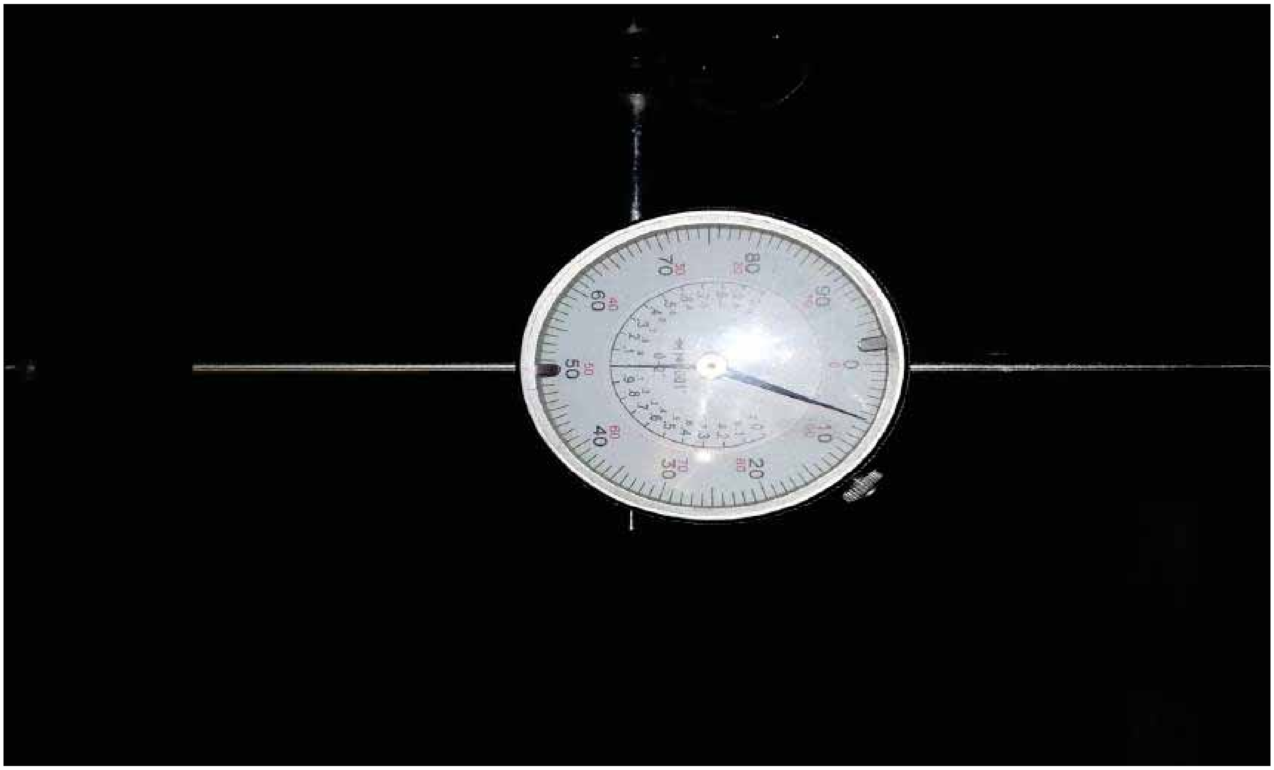


To validate the required proof load tension and shear values, NYC Transit under contract A36193 hired Future Testing Corporation to conduct on site field testing at [to the equivalent of ASTM E488-9696] at both subway stations. All specifications for testing were designed by Weidlinger Associates, Inc. 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.

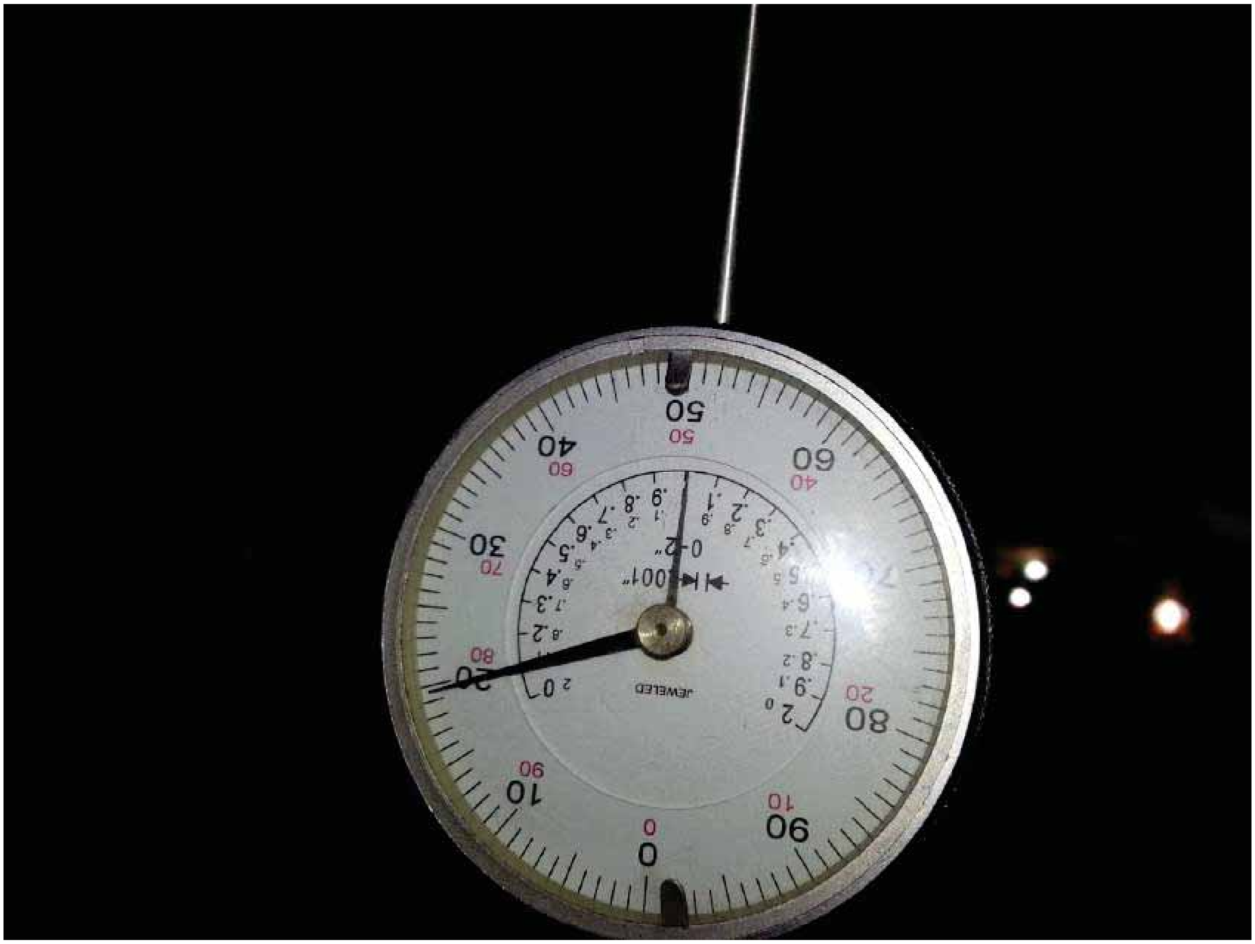


Type A Overhead Anchor

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

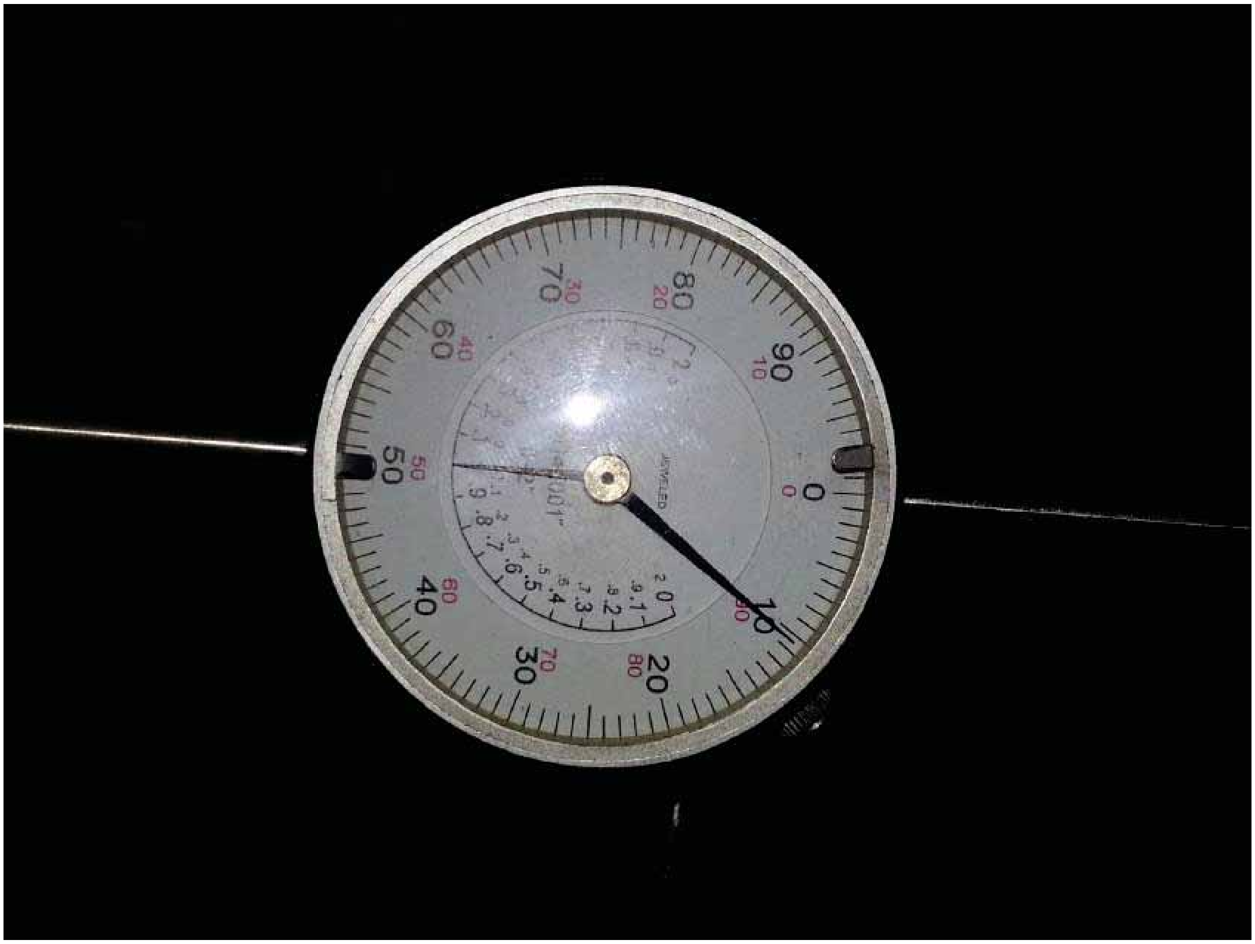
Dial Gauge actual reading after 10 minutes at rest. .049

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

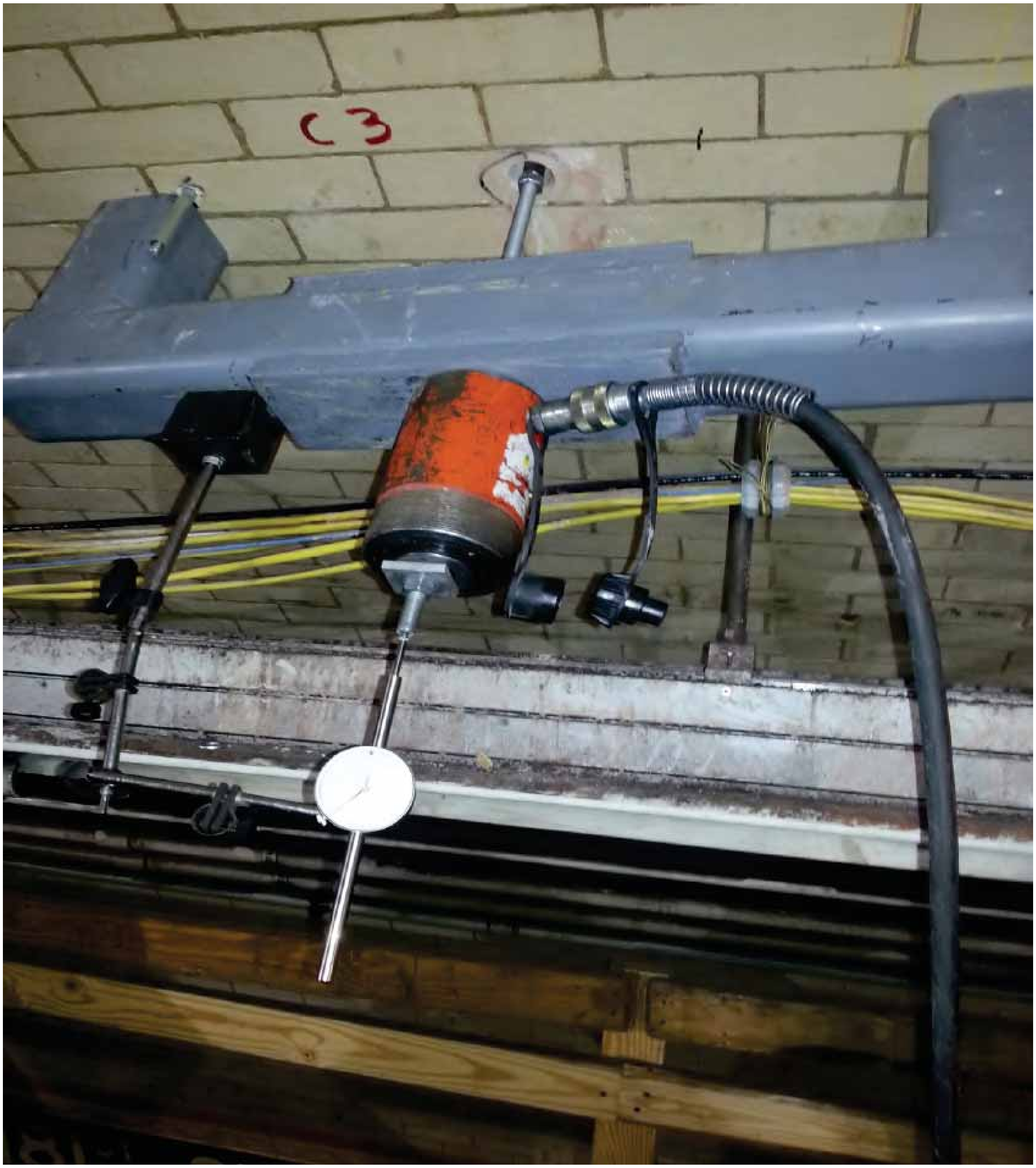


The panel were lifted to the ceiling on a custom designed lifting rig which allowed the finished panel to be aligned with the guide panel installed in the ceiling and side wall. This pictures show the ceiling guide panels.

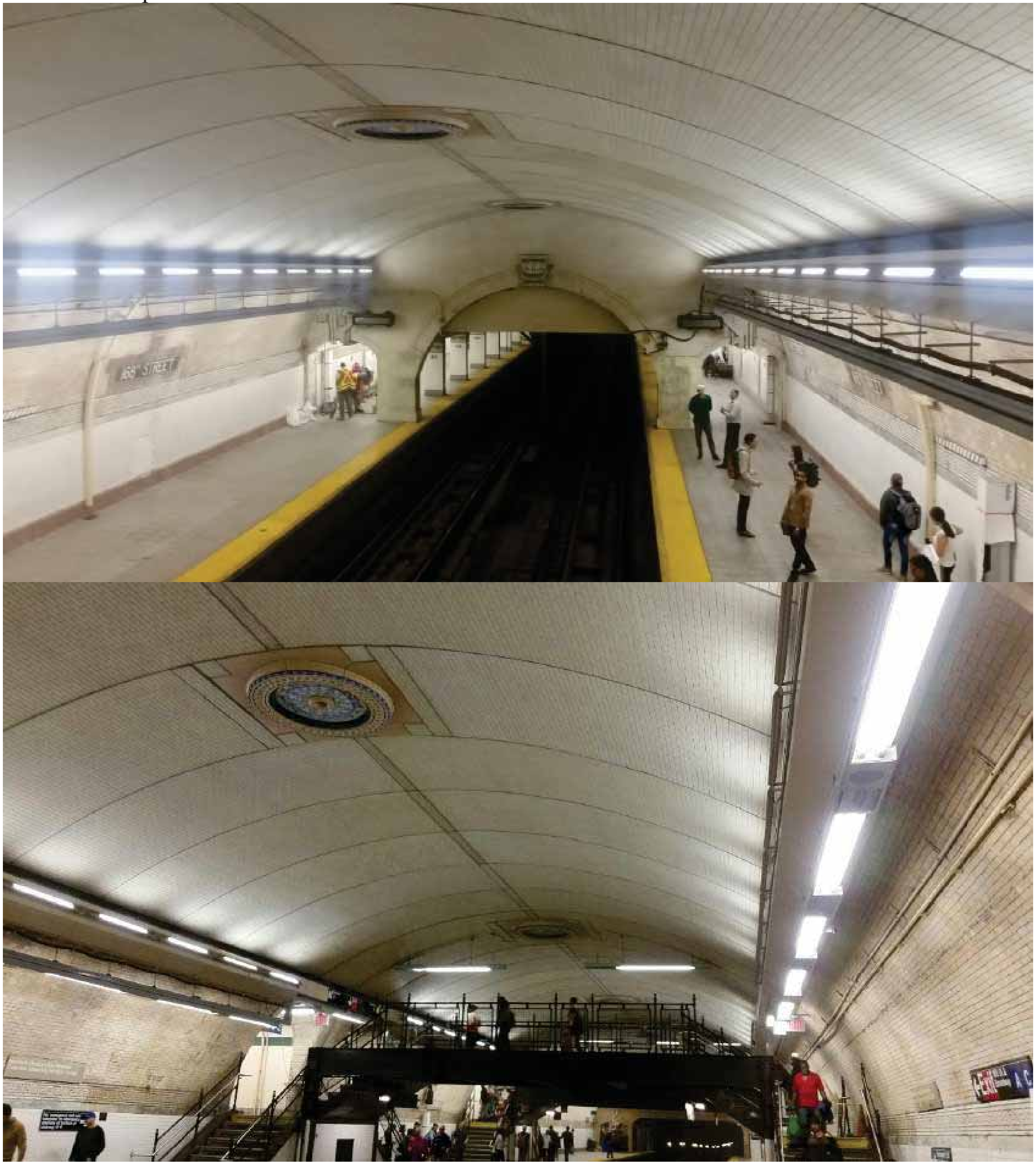
The yellow and gray lift in foreground is used to lift the panels in place.

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.



CASE HISTORY

TEST DATA

CINTEC
NORTH AMERICA

Pull Out Tests for Cintec Anchors carried out on the

EMPIRE STATE BUILDING, NEW YORK

The Cintec Anchors were installed on December 8th, 1994 at the 6th floor elevation by David Aston from CLS Cintec America in the presence of Mr. R. Wagner LZA Technology and Mr. A. Destefano of Empire National. ½" OD RAC anchors were used being of different lengths.

Type 1 overall length 3 ¾" socked 2 ¾" for testing in 4" thick limestone panels.

Type 2 overall length 7 ¾" socked 6 ¾" for testing in 8" thick limestone panels.

Type 3 overall length 11 ¾" socked from the rear for testing the brick back up wall.

Testing was carried out 8 days after installation by David Aston, in the presence of Mr. R. Wagner using a Mark 1V Hilti Test Meter Serial No. 01632.

The loads achieved are set out on the test date result sheet overleaf. It should be noted at the achieved loads there were no failures or any visible damage to the areas surrounding the test anchors.

COMPANY ADDRESS
LZA TECHNOLOGY 641 AVENUE OF THE AMERICAS NEW YORK NY 10011

TEST ANCHORS & RESULTS

Date: 16/12/94

SITE ADDRESS
EMPIRE STATE BUILDING 5^{TH} AVENUE NEW YORK

TEST REQUIRED	TEST NO	INSTALL TIME	TYPE OF ANCHOR	LOAD REQUIRED	LOAD ACHEIVED	BASE MATERIAL	STOCK IMBEDMENT	STOCK DIAMETER	PULLOUT TIME
1) To Test Brick Facade	1	20 mm	¾" Solid Bar	1000lbs	3200lbs	STONE	2 ¾"	1"	10 MINS
	2	20 mm	¾" Solid Bar	1000lbs	2800lbs	STONE	2 ¾"	1"	10 MINS
2) To Secure Brick Facade on 6th Floor	3	20 mm	¾" Solid Bar	1000lbs	3200lbs	STONE	6 ¾"	1"	15 MINS
	4	20 mm	¾" Solid Bar	1000lbs	3150lbs	BRICK	6"	1"	10 MINS
	5	20 mm	¾" Solid Bar	1000lbs	3000lbs	BRICK	6"	1"	10 MINS

PERSONS PRESENT ON TEST / DEMONSTRATION

PRINT NAME	COMPANY	POSITION	PHONE NUMBER
MR ROBERT WAGNER	LZA TECHNOLOGY	SENIOR PROJECT DIRECTOR	212 741 1300

COMMENTS

It should be noted that at the achieved loads no failure of the anchors was observed, in addition there was no visible damage to the areas surrounding the test anchors.

SIGNED Robert Lloyd. Keen.
FOR & ON BEHALF OF CAVITY LOCK SYSTEMS LTD
POSITION:- *CLS NORTH AMERICA*

CLS CINTEC CANADA LTD.
38 Auriga Drive, Suite 200
Nepean, Ont. K2E 8A5
613-225-3381

SIGNED
FOR & ON BEHALF OF LZA TECHNOLOGY
POSITION:- *SENIOR PROJECT DIRECTOR*

CINTEC ANCHOR TESTING

Union County Court House
Elizabeth New Jersey USA

TYPE:

SHEAR LOAD TESTS FOR MASONRY AND TERRA-COTTA

BY:

TESTWELL LABORATORIES
AND
SIMPSON GUMBERTZ AND HEGER
(JULY 1999)

STWELL
ORATORIES INC

Corporate Headqua
47 Hudson S
Ossining N Y 1(

Tel (914) 762-
Fax (914) 762-
Environmental Fax. (914) 941-

ENGINEER'S REPORT

Client: CINTEC AMERICA INC.
Project: Union Country Courthouse
2 Broad St. Elizabeth, NJ
Engineer: K. R. Thumma, P.E.
Technicians: G. Ramkaran, A. Uzhca,
C. Suarez, C. Clark

Lab #: MIA-001
Report#: MC-01
Date Of Testing: 7/21/99

Page 1 of 12

Re: Load Tests on Wall Anchors.

INTRODUCTION

This report presents results of load tests wall anchors performed by Testwell Laboratories, Inc. on 7/21/99 at the above referred project site. Eight anchors, six of type HSS 15mm X 15mm and two of type RACCHS 10mm, 3/8" dia., were tested. These anchors were installed by the client in a brick masonry wall prior to arrival of personnel of Testwell Laboratories, Inc., at the job site Mr Robert Lloyd-Rees of CLS CINTEC AMERICA INC. and Mr. Mark Berman (part of the tests) of Michael Zemsky Architects witnessed the tests. The locations of anchors tested are shown in Figure 1.

TEST PROCEDURE

Two types of tests were performed. (1) Sheer Load Test and (2) Pull out load tests.

Sheer load tests were performed by hanging 50 lb. weights as shown in Figure 2 and Photos 1 and 2. Each weight of 50 lbs. was added slowly one by one to the trolley hung from the anchor with a steel strand. Shear tests were performed on anchors A, B and C.

Pull out load tests on anchors D, E and F were performed by using a hydraulic jack setup shown in Figure 3 and Photos 3 and 4. This setup includes a hydraulic pump, a hydraulic jack, a pressure gauge, a valve, hoses and a threaded rod. The jack is supported on steel frame resting on the brick wall and around the anchor. The anchor is connected to the jack with a box coupling and threaded bar. When the pump is operated, the pressure of hydraulic fluid increases and load is applied on the piston of the jack. The pressure of the hydraulic fluid is measured by the pressure gauge. The gauge pressure indication in psi is calibrated to the load applied on jack and consequently on the anchor.

Pullout tests on the anchors G and H were performed by using a HILTI Mark V tester shown in Photo 5. This equipment was furnished by the client.

CINTEC AMERICA, INC.
LAB# MIA-001, Report # MC-01,
Page 2 of 12

TEST RESULTS

Table 1 shows all the results of load tests performed on the anchors indicating type of anchor, test apparatus used and the load applied along with observations on the behavior of anchors as the load is applied to different levels. The locations of the anchors on the brick wall are shown in Figure 1.

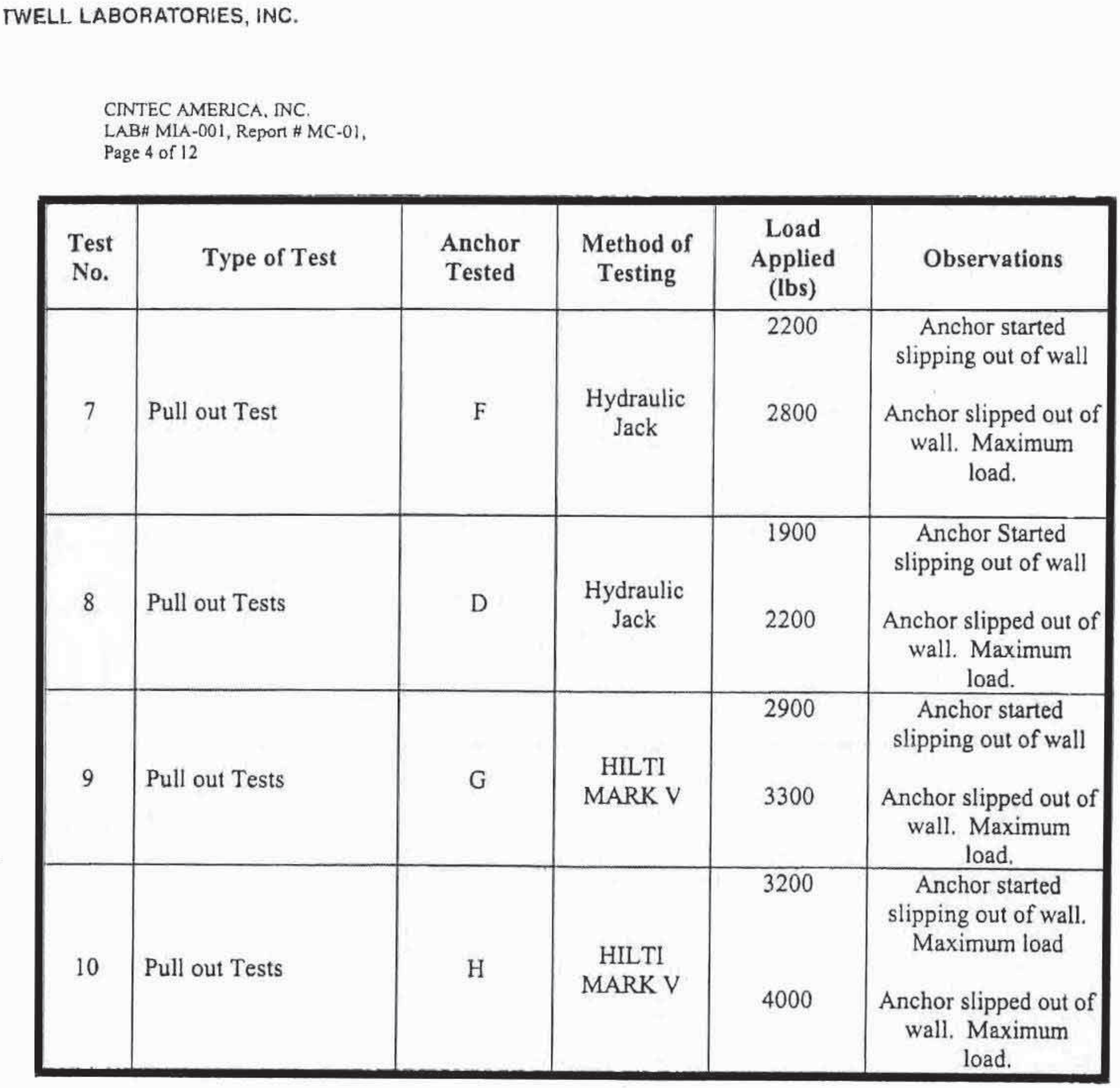
TESTWELL LABORATORIES, INC.

KASPAL REDDY THU
074264

Kaspal R. Thumma, Eng. Sc. D, P.E.
Vice President
KRT/SK

Table 1: Results of Load Tests Performed on CINTEC Anchors

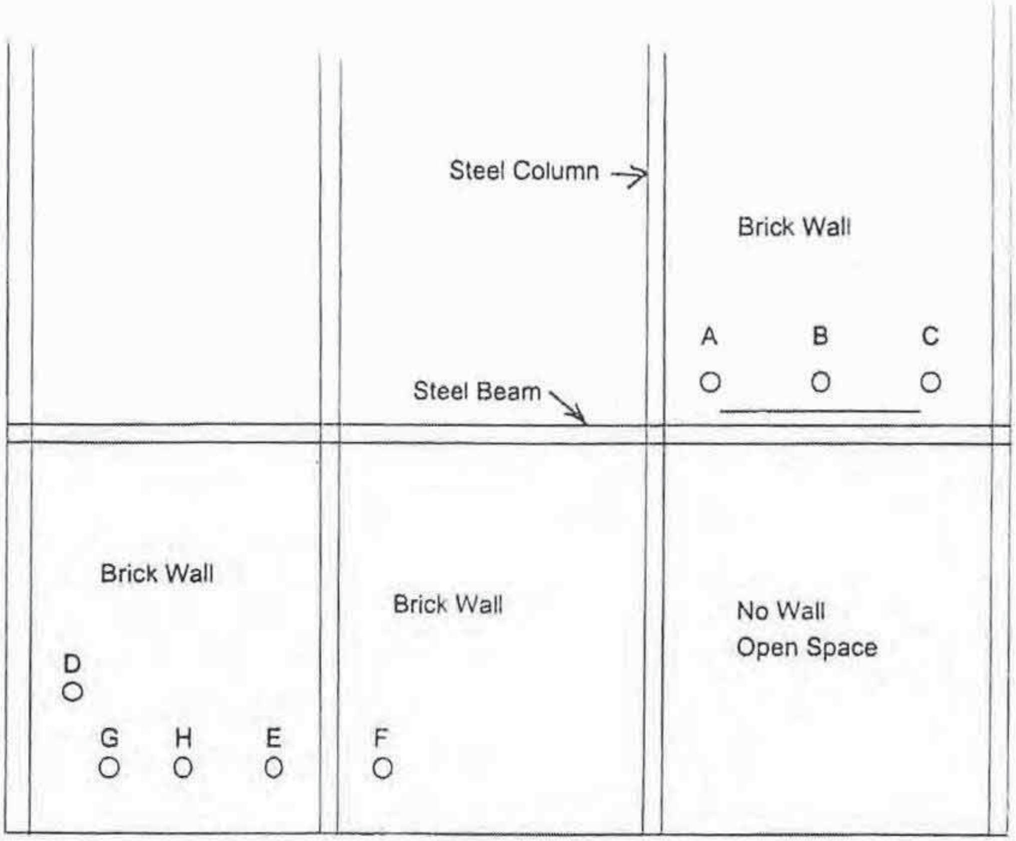
Test No.	Type of Test	Anchor Tested	Method of Testing	Load Applied (lbs)	Observations
1	Shear Load at 2" away from wall	C	Hanging Weights	900	Loading tackle slipped bending lever arm
2	Shear Load at 2" away from wall	B	Hanging weights	1000 1150	Started deflection of lever arm Deflection increased. Test stopped
3	Shear Load at 2" away from wall	A & B together	Hanging weights	2050	No signs of failure or bending. Test stopped
4	Shear Load at 2" away from wall	A	Hanging weights	1700	Started bending Test stopped.
5	Shear Load at 2" away from wall	B	Hanging weights	1500 2050	Started bending. Bent by 1" at load line. Test stopped.
6	Pull out Test	E	Hydraulic Jack	1900 2500	Anchor started slipping out of wall Anchor slipped out of wall chipping brick around it. Maximum load.



TWELL LABORATORIES, INC.

CINTEC AMERICA, INC.
LAB# MIA-001, Report # MC-01,
Page 4 of 12

Test No.	Type of Test	Anchor Tested	Method of Testing	Load Applied (lbs)	Observations
7	Pull out Test	F	Hydraulic Jack	2200 2800	Anchor started slipping out of wall Anchor slipped out of wall. Maximum load.
8	Pull out Tests	D	Hydraulic Jack	1900 2200	Anchor Started slipping out of wall Anchor slipped out of wall. Maximum load.
9	Pull out Tests	G	HILTI MARK V	2900 3300	Anchor started slipping out of wall Anchor slipped out of wall. Maximum load.
10	Pull out Tests	H	HILTI MARK V	3200 4000	Anchor started slipping out of wall. Maximum load Anchor slipped out of wall. Maximum load.



Anchor Types: A, B, C, D, E, F - HSS 15mmX15mm, 6" embedment
G, H - RAC CHS 10mm, 3/8" Dia, 7" embedment

Figure 1: Locations of Test Anchors

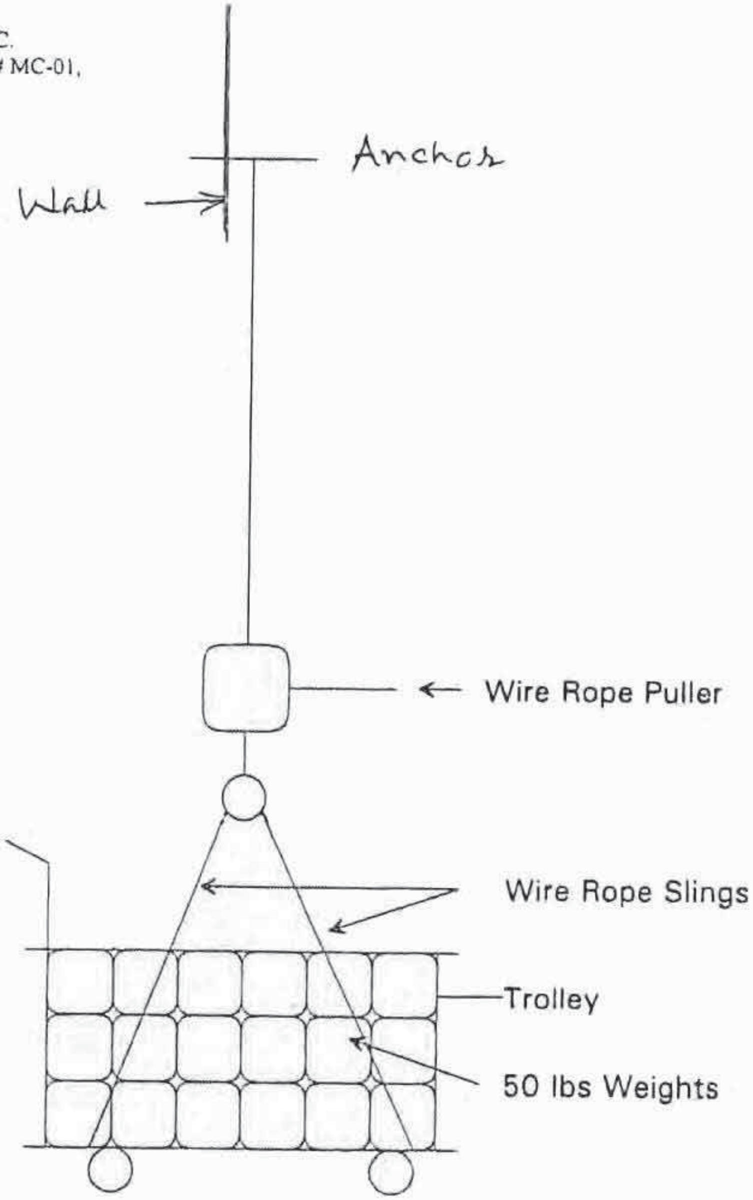


Figure 2: Setup For Shear Load Tests

ᴦWELL LABORATORIES, INC.

CINTEC AMERICA, INC.
LAB# MIA-001, Report # MC-01,
Page 7 of 12

HYDRAULIC EQUIPMENT SETUP

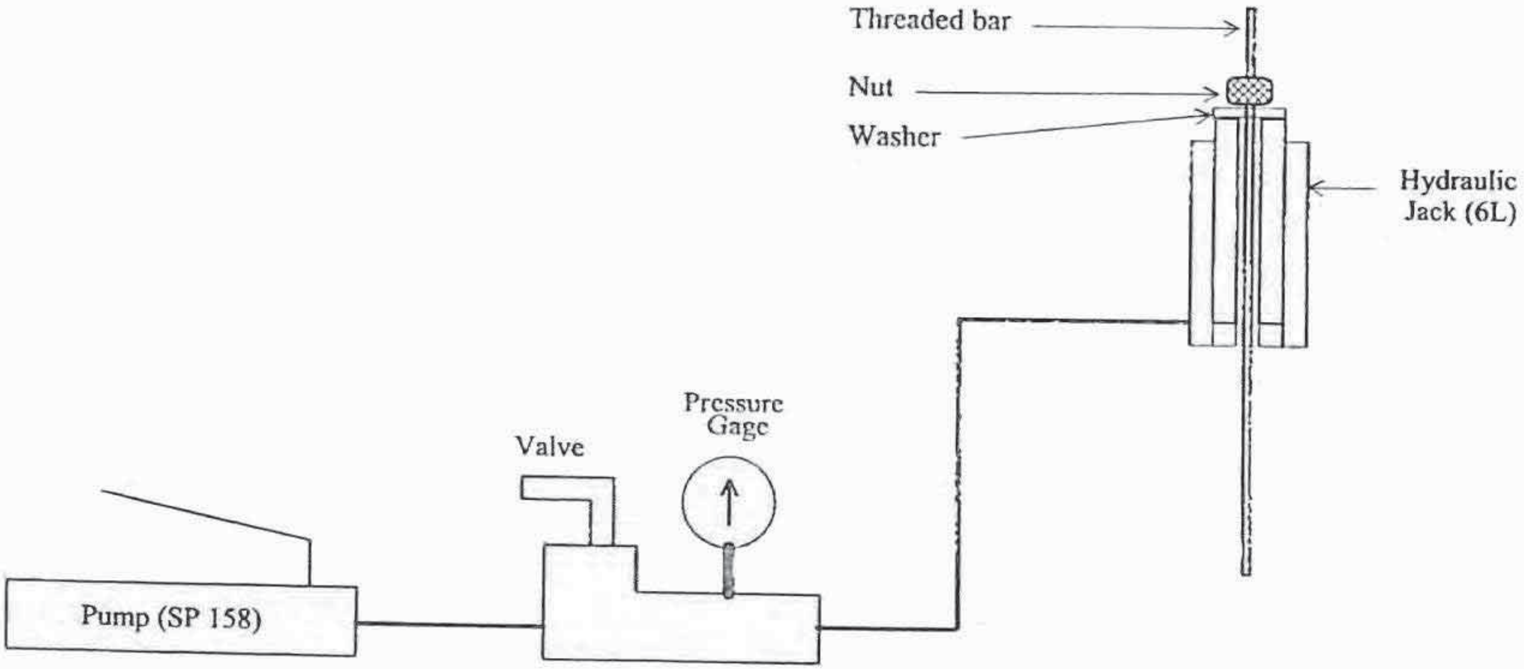


Figure 3

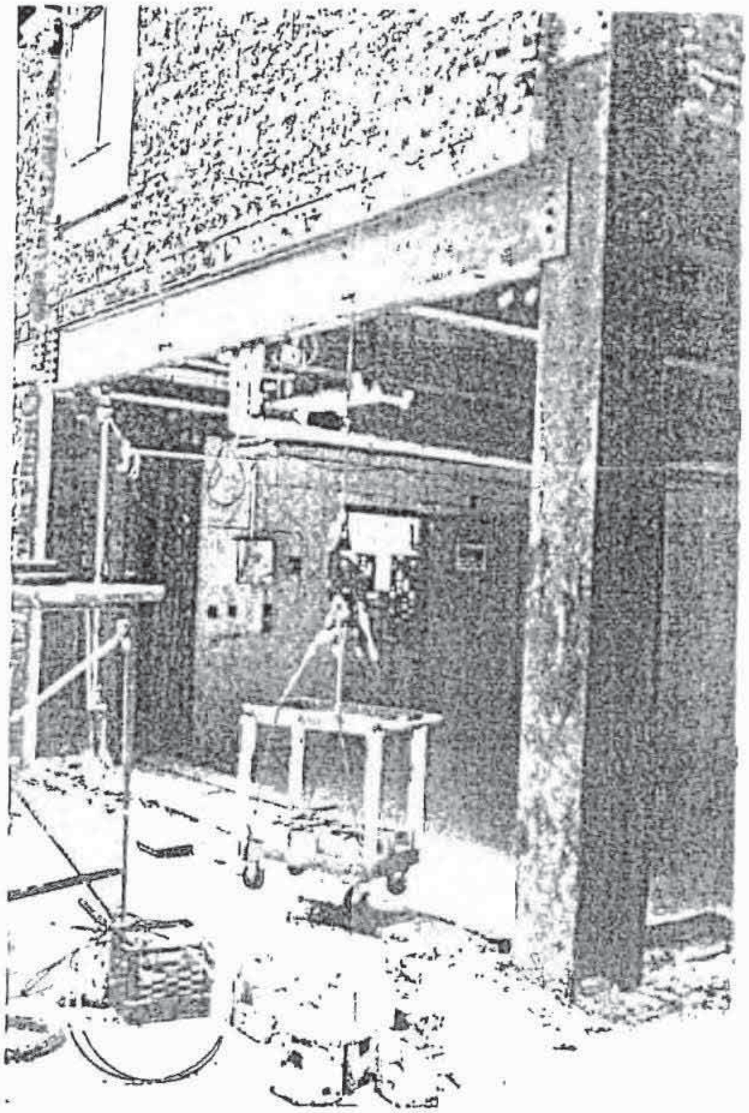


PHOTO 1

Setup for Shear Load Testing a Single Anchor

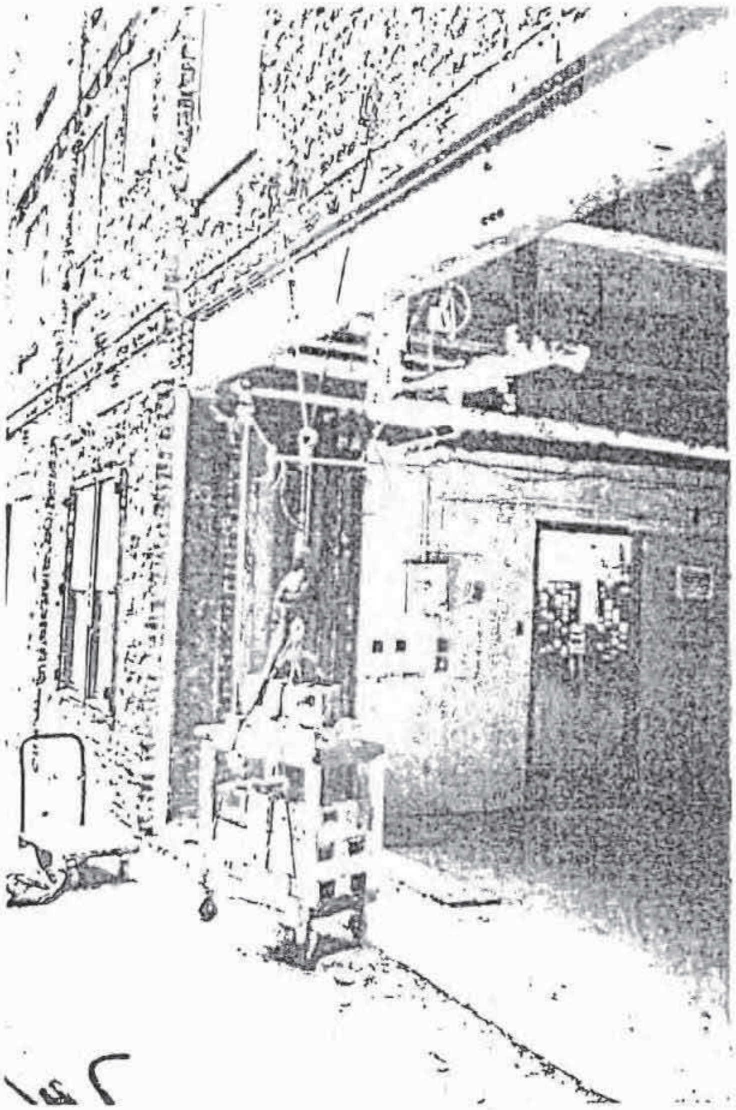


PHOTO 2

Setup for Shear Load Testing of Two Anchors Together

SGH
Simpson Gumpertz & Heger Inc.
Consulting Engineers

Arlington MA / San Francisco CA

Mr. Robert Lloyd-Rees
Cintec
38 Auriga Drive, Suite 200
Nepean, Ontario K2E8A5
CANADA

Comm. 99331 - Testing of Anchors in Terra Cotta, Union County Courthouse, NJ

Dear Mr. Lloyd-Rees:

This letter report summarizes the results of our tests of the Cintec anchors in two terra-cotta blocks you submitted for the Union County Courthouse

1. Pull-out Tests

We tested four anchors in pull-out. We loaded the anchors with a pull-out testing machine with supports located outside of the expected failure cone of the anchor The following are the results of the pull-out tests.

Test 1

Nearly simultaneous cone failure and flexural failure of the block at a load of 4047 pounds. Deflection was not measured.

Test 2

Flexural failure of the block at a load of 3035 pounds and a deflection of 0.0646 inches.

Test 3

Cone failure of the block at a load of 4384 pounds and a deflection of 0.0787 inches.

Test 4

Pull-out failure of the anchor in the grout bulb in the block at a load of 3878 pounds and a deflection of 0.0882 inches.

2. Shear Test

We tested one set of anchors in shear. We set the two anchors in the bottom cell of the block into grout filled core holes in a concrete substrate. The block was separated from the concrete substrate by a 1 inch cavity. We loaded the top of the block with a hydraulic jack through a wide flange beam to spread the jack load across the entire width of the block. We restrained the top of the block against rotation with a 3/16 in. x 1 ½ in. x 1 ½ in. angle spanning across the exterior face of the block. We stopped the test at a load of 6144 pounds and deflection of 0.116 inches at the bottom of the block because the top of the block had rotated approximately ½ in.

Sincerely yours,

Michael L. Brainerd, Principal
MLB69-99.ras

CINTEC ANCHOR TESTING

The Mission San Juan Capistrano

Sanctuary Walls

California

ENGINEER:

THE ROSELUND ENGINEERING COMPANY

ROSEMEAD, CALIFORNIA

TESTING ENGINEERS:

TWINING LABORATORIES OF SOUTHERN CALIFORNIA


ENERPAC

Twining Laboratories *of Southern California, Inc.*

ENGINEERING INSPECTION TESTING
www.twininglabs.com

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San Diego: 9235 Chesapeake Drive, Suite D, San Diego, CA 92121-1085 • Phone: (858) 974-3750 • Fax: (858) 974-3752

LOAD TEST REPORT ON CINTEC GROUTED ANCHORS

DATE:	**FEBRUARY 7, 2001**
PROJECT NO:	**2001-5037**
TLSC NO:	
CLIENT:	**MISSION SAN JUAN CAPISTRANO** **ATTN: GERALD MILLER, ADMINISTRATOR** **PO BOX 697** **SAN JUAN CAPISTRANO, CA 92693**
PROJECT:	**STABILIZATION OF THE STONE WALLS** **OF THE GREAT STONE CHURCH** **MISSION SAN JUAN CAPISTRANO, CA**
DATE OF TEST:	**FEBRUARY 5, 2001**
PERFORMED BY:	**EUGENE RAYMUNDO, STAFF ENGINEER** **OSCAR SANCHEZ & KENT GRAY, TECHNICIANS**

Transmitted herewith is the Load Test Program for Cintec Grouted Anchors of the Old Stone Church at Mission San Juan Capistrano. This test program is in accordance to the Roselund Engineering Company Test Program of Cintec Grouted Anchors. This report contains Testing Requirements, Calibration Chart (Aluminum Dual Ram), Load Deformation Curves, and Photographs.

SUBMITTED BY: TWINING LABORATORIES OF SOUTHERN CALIFORNIA , INC

Prepared by:	Reviewed by:
Raymundo	
Eugene Raymundo Staff Engineer	Elmer D. Marapao, PE Civil Engineer

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Created on 02/06/01 15:39

Nels Roselund 6265732572

TEST REPORT ON CINTEC GROUTED ANCHORS
OLD STONE CHURCH, MISSION SAN JUAN CAPISTRANO

Purpose of Test

Twining Laboratories conducted a pull test program of the Cintec Grouted Anchors in the walls of the Old Stone Church, San Juan Capistrano to observe, evaluate, and tension-test of the anchors in order to establish the suitability of the anchors for bonding of the inner and outer wythes of the stone walls to prevent internal separation in the walls.

Location of Tests & Test Setup.

A total of thirteen (13) anchors were installed by Cintec by drilling with a 1 ¼" diameter dry-diamond core drill and inserting a Stainless steel pins with a fabric grout sock, then a Presstec cementitious grout was applied by Cintec. Grout was allowed to cure undisturbed for a minimum of 64 hours prior to testing.

Two test assembly were used during the test program: 1). Hilti Mark V Tester Kit or 2). Aluminum Dual Piston Ram by Twining Laboratories with calibrated Pump and Gauge. A digital strain gauge (0.0001") Mitutuyo displacement gauge was installed into the 5/16" threaded adapter to record displacement of the stainless steel pins. Each test location was marked and selected by Mr. Nel Roselund of Roselund Engineering Company. A preload of 200 lbs. was applied prior to actual load testing at 200 lbs. increments. Visual observation was performed at each 200 lbs. increments to observe any pin movement, or mortar crumbling.

Test Results and Photographs

(Individual Test Data, Load Deformation Curves, and Photographs are enclosed)

Modification

During the actual testing, weld failure at the coupler were encountered on Test #2 (3000 lbs.) and Test # 4 (1800 lbs.), we recommended to remove the displacement gauge at a load of 3000 lbs. or any sign of weld failure to avoid any damage of the electronic displacement gauge. Further visual observation will be performed as we continue applying the load to a maximum of 3400 lbs.

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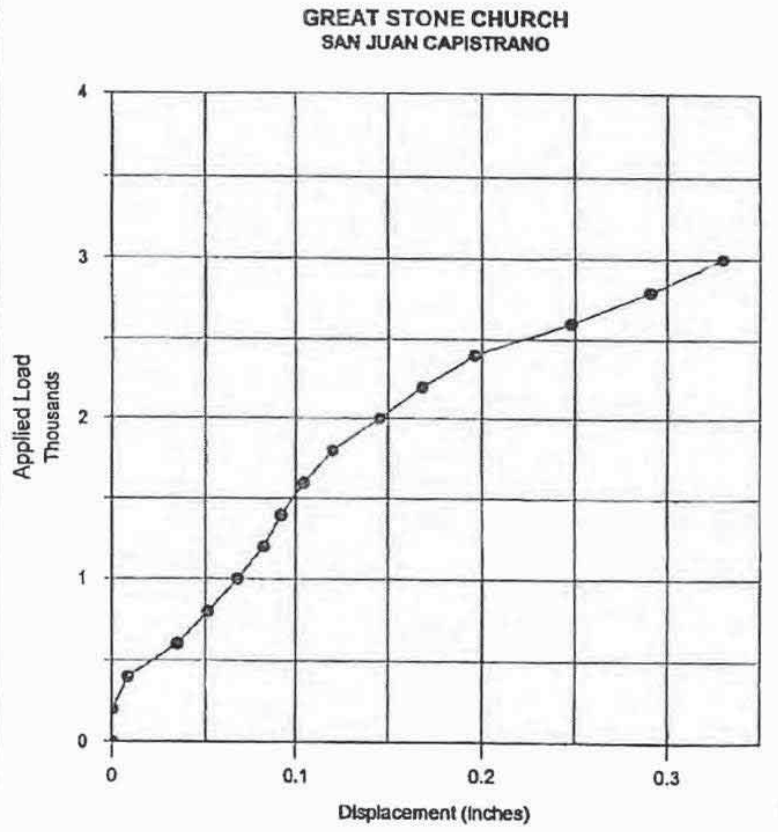
PROJECT: GREAT STONE CHURCH, SAN JUAN CAPISTRANO

TEST DATA FOR CINTEC GROUTED ANCHORS

TEST LOCATION No.	1	No. of Anchors	1
TEST SET UP:	DUAL RAM-TLSC	Max. Spec. Load	1900 lbs
DATE	02/05/01	D. GAUGE	MITUTUYO

Applied Load, lbs.	Measured* Displacement	OBSERVATION
0	0.0000	Displacement sensor mounted on track.
200	0.0000	Preload, release load and zero the displacement gauge
400	0.0085	
600	0.0350	
800	0.0515	
1000	0.0675	
1200	0.0820	
1400	0.0915	
1600	0.1045	sleeve anchor beginning to slip from grout sock
1800	0.1200	
2000	0.1455	
2200	0.1680	
2400	0.1960	
2600	0.2480	
2800	0.2910	
3000	0.3305	displacement gauge removed prior to weld failure.
3200		
3400		maximum load, prior to release of load

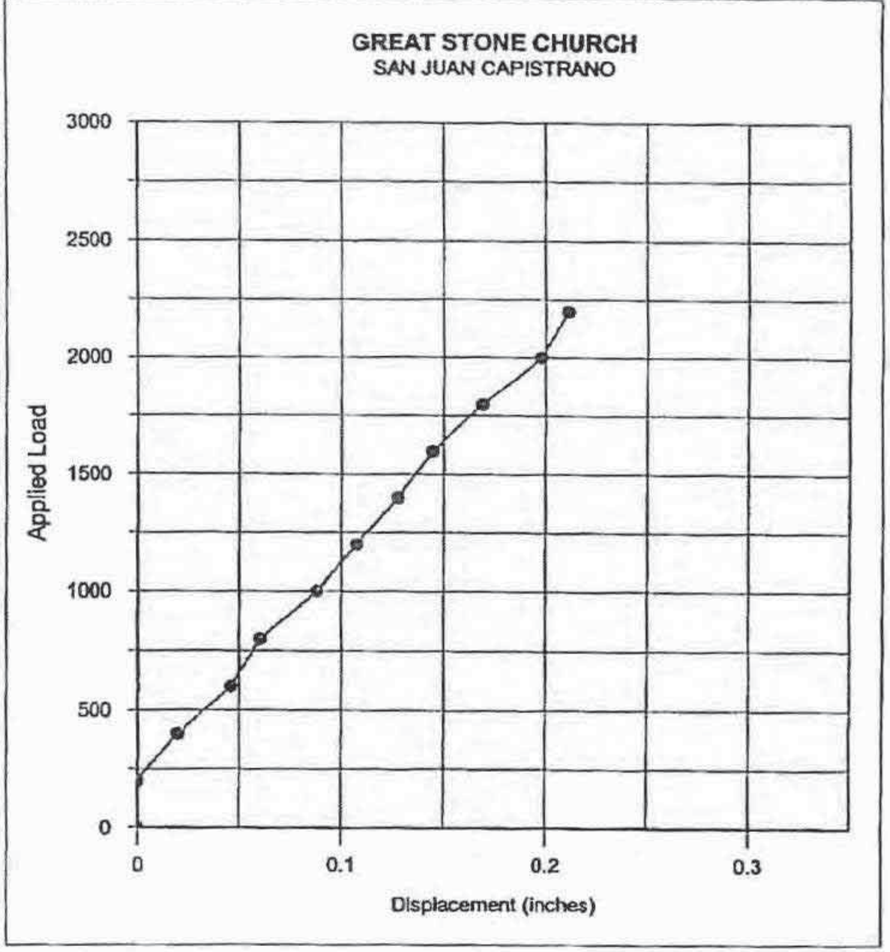


PROJECT: **GREAT STONE CHURCH, SAN JUAN CAPISTRANO**

TEST DATA FOR CINTEC GROUTED ANCHORS

TEST LOCATION No. 6 No. of Anchors 1
TEST SET UP: DUAL RAM-TLSC Max. Spec. Load 1900 lbs
DATE 02/05/01 Disp. Gauge MITUTUYO

Applied Load, lbs.	Measured* Displacement	OBSERVATION
0	0.0000	Displacement sensor mounted on track.
200	0.0000	Preload, release load and zero the displacement gauge
400	0.0195	
600	0.0455	
800	0.0600	
1000	0.0880	
1200	0.1075	
1400	0.1275	sleeve anchor beginning to slip from grout sock
1600	0.1445	
1800	0.1690	
2000	0.1980	
2200	0.2110	displacement gauge removed prior to weld failure.
2400		
2600		
2800		maximum load, prior to release of load



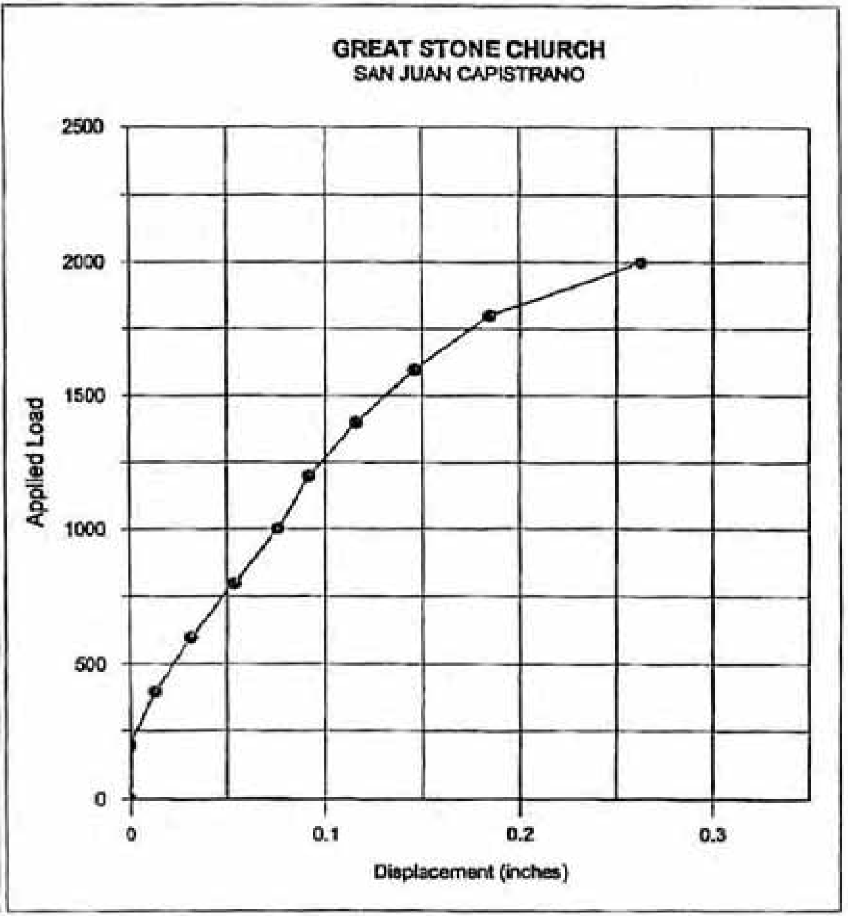
Nels Roselund 6265732572

PROJECT: GREAT STONE CHURCH, SAN JUAN CAPISTRANO

TEST DATA FOR CINTEC GROUTED ANCHORS

TEST LOCATION No. 7 No. of Anchors 1
TEST SET UP: DUAL RAM-TLSC Max. Spec. Load 1900 lbs
DATE 02/05/01 Disp. Gauge MITUTUYO

Applied Load, lbs.	Measured* Displacement	OBSERVATION
0	0.0000	Displacement sensor mounted on track.
200	0.0000	Preload, release load and zero the displacement gauge
400	0.0130	
600	0.0315	
800	0.0535	
1000	0.0755	
1200	0.0915	
1400	0.1160	sleeve anchor beginning to slip from grout sock
1600	0.1460	
1800	0.1845	
2000	0.2630	displacement gauge removed prior to weld failure.
2200		maximum load, prior to release of load



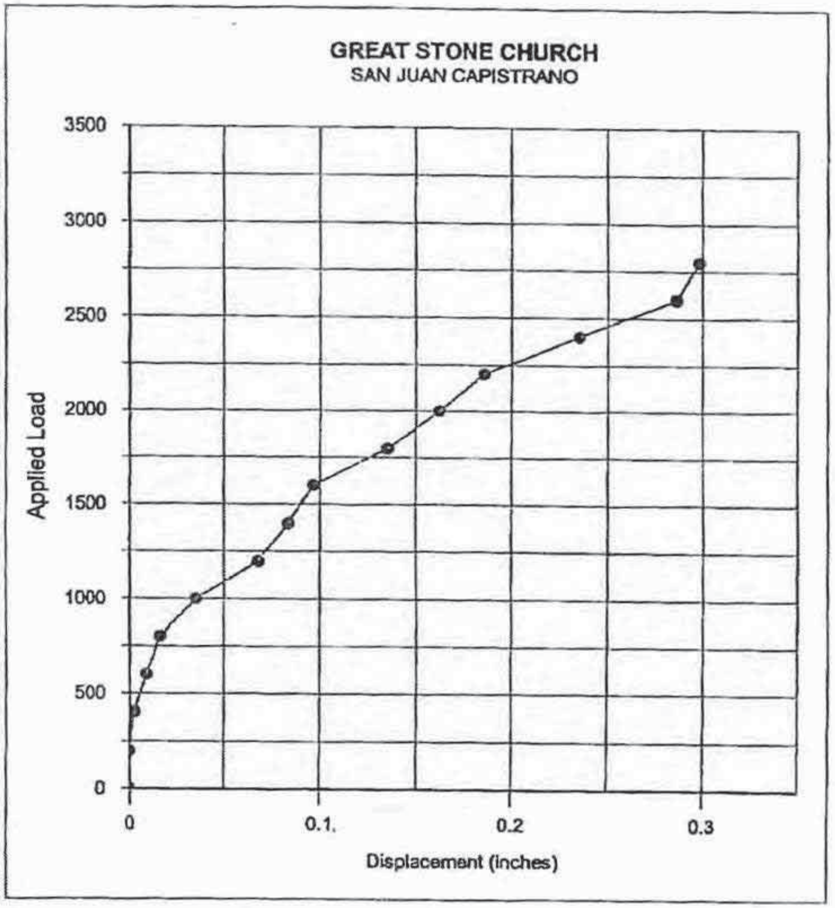
Nels Roselund 6265732572

PROJECT: **GREAT STONE CHURCH, SAN JUAN CAPISTRANO**

TEST DATA FOR CINTEC GROUTED ANCHORS

TEST LOCATION No. 8 No. of Anchors 1
TEST SET UP: HILTI Max. Spec. Load 1900 lbs
DATE 02/05/01 Disp. Gauge MITUTUYO

Applied Load, lbs.	Measured* Displacement	OBSERVATION
0	0.0000	Displacement sensor mounted on track.
200	0.0000	Preload, release load and zero the displacement gauge
400	0.0025	
600	0.0090	
800	0.0160	
1000	0.0350	
1200	0.0680	
1400	0.0835	
1600	0.0965	sleeve anchor beginning to slip from grout sock
1800	0.1350	
2000	0.1620	
2200	0.1855	
2400	0.2350	
2600	0.2860	
2800	0.2980	displacement gauge removed prior to weld failure.
3000		
3200		maximum load, prior to release of load

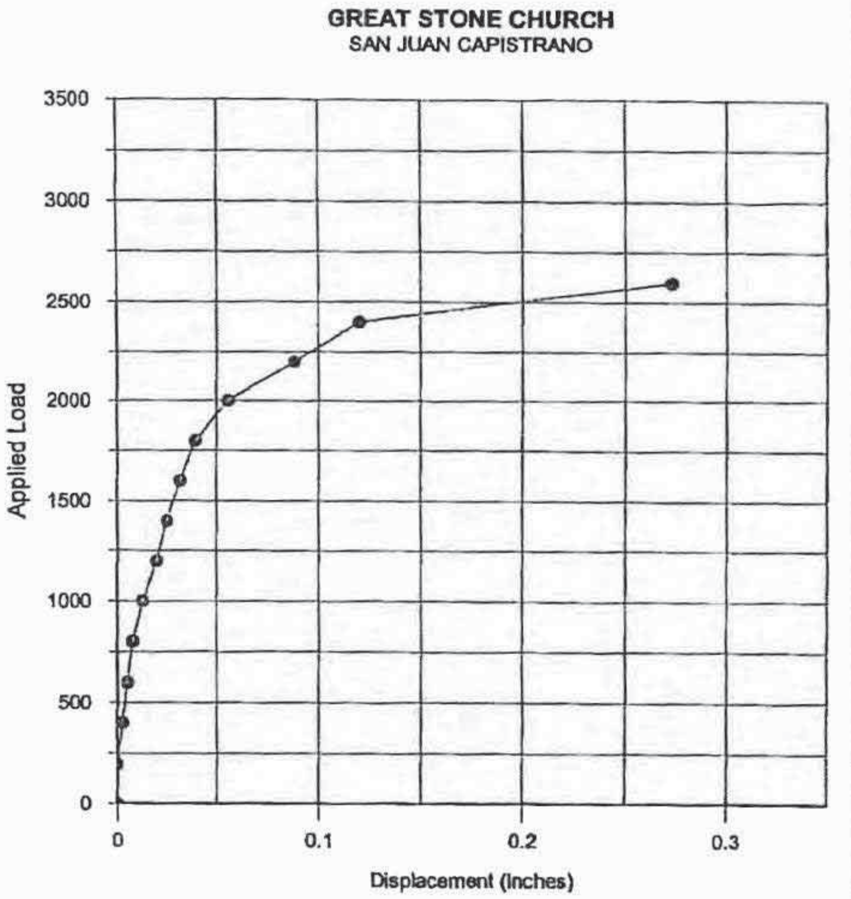


PROJECT: GREAT STONE CHURCH, SAN JUAN CAPISTRANO

TEST DATA FOR CINTEC GROUTED ANCHORS

TEST LOCATION No.	9	No. of Anchors	1
TEST SET UP:	HILTI	Max. Spec. Load	1900 lbs
DATE	02/05/01	Disp. Gauge	MITUTUYO

Applied Load, lbs.	Measured* Displacement	OBSERVATION
0	0.0000	Displacement sensor mounted on track.
200	0.0000	Preload, release load and zero the displacement gauge
400	0.0030	
600	0.0055	
800	0.0080	
1000	0.0130	
1200	0.0195	
1400	0.0250	
1600	0.0315	
1800	0.0390	
2000	0.0555	
2200	0.0880	
2400	0.1200	sleeve anchor beginning to slip from grout sock
2600	0.2730	
2800		displacement gauge removed prior to weld failure.
3000		
3200		maximum load, prior to release of load

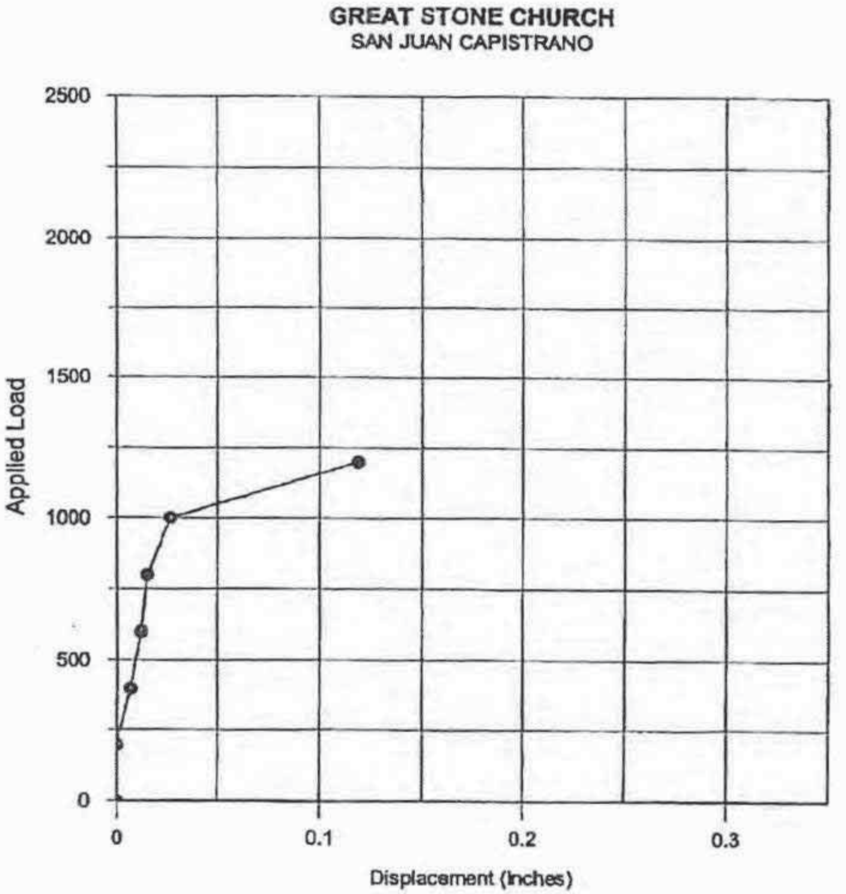


PROJECT: GREAT STONE CHURCH, SAN JUAN CAPISTRANO

TEST DATA FOR CINTEC GROUTED ANCHORS

TEST LOCATION No. 10 No. of Anchors 1
TEST SET UP: HILTI Max. Spec. Load 1900 lbs
DATE 02/05/01 Disp. Gauge MITUTUYO

Applied Load, lbs.	Measured* Displacement	OBSERVATION
0	0.0000	Displacement sensor mounted on track.
200	0.0000	Preload, release load and zero the displacement gauge
400	0.0070	
600	0.0120	
800	0.0150	
1000	0.0265	
1200	0.1190	sleeve anchor beginning to slip from grout sock
1400		displacement gauge removed prior to weld failure.
1600		
1800		
2000		
2200		maximum load, prior to release of load

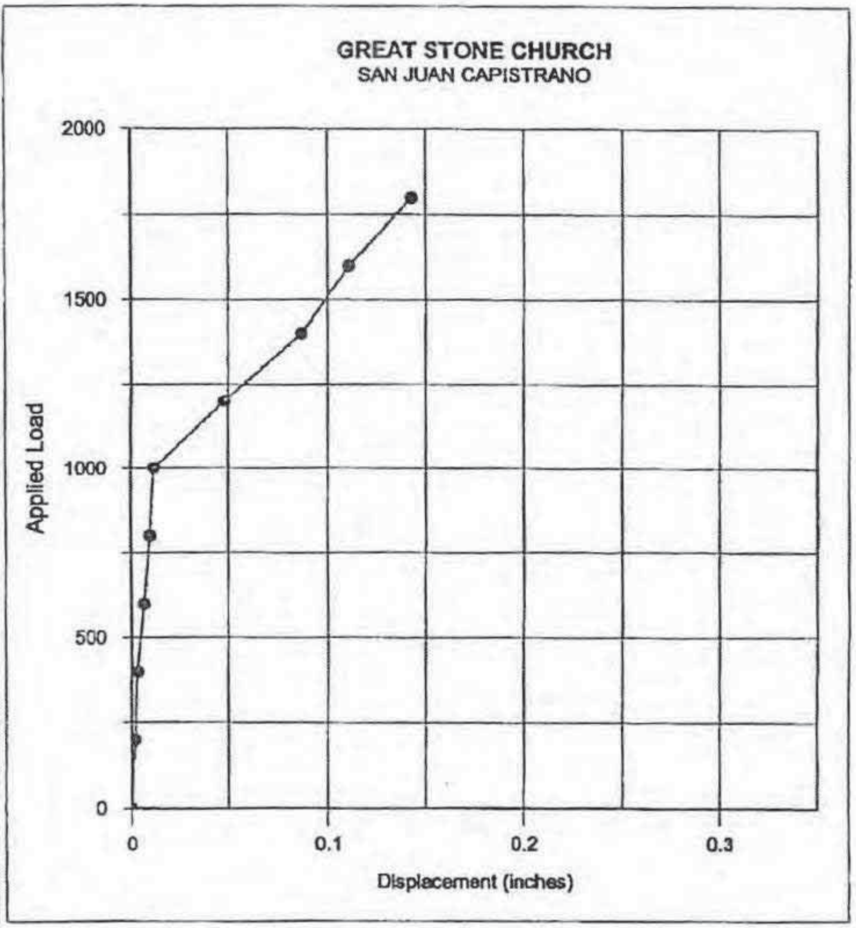


PROJECT: **GREAT STONE CHURCH, SAN JUAN CAPISTRANO**

TEST DATA FOR CINTEC GROUTED ANCHORS

TEST LOCATION No.	11	No. of Anchors	1
TEST SET UP:	HILTI	Max. Spec. Load	1900 lbs
DATE	02/05/01	Disp. Gauge	MITUTUYO

Applied Load, lbs.	Measured* Displacement	OBSERVATION
0	0.0000	Displacement sensor mounted on track.
200	0.0020	Preload, release load and zero the displacement gauge
400	0.0035	
600	0.0070	
800	0.0100	
1000	0.0120	
1200	0.0480	
1400	0.0865	sleeve anchor beginning to slip from grout sock
1600	0.1105	
1800	0.1430	maximum load, prior to release of load

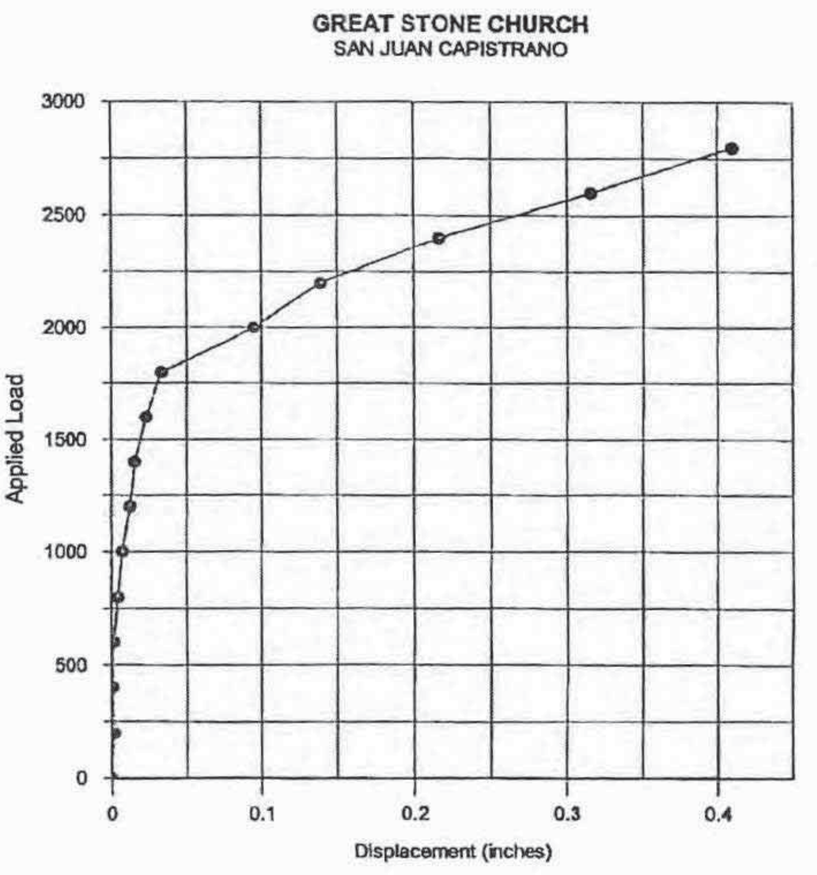


PROJECT: **GREAT STONE CHURCH, SAN JUAN CAPISTRANO**

TEST DATA FOR CINTEC GROUTED ANCHORS

TEST LOCATION No.	12	No. of Anchors	1
TEST SET UP:	HILTI	Max. Spec. Load	1900 lbs
DATE	02/05/01	Disp. Gauge	MITUTUYO

Applied Load, lbs.	Measured* Displacement	OBSERVATION
0	0.0000	Displacement sensor mounted on track.
200	0.0020	Preload, release load and zero the displacement gauge
400	0.0010	
600	0.0015	
800	0.0045	
1000	0.0075	
1200	0.0125	
1400	0.0155	
1600	0.0230	
1800	0.0335	
2000	0.0950	sleeve anchor beginning to slip from grout sock
2200	0.1390	
2400	0.2160	
2600	0.3155	
2800	0.4095	maximum load, prior to release of load

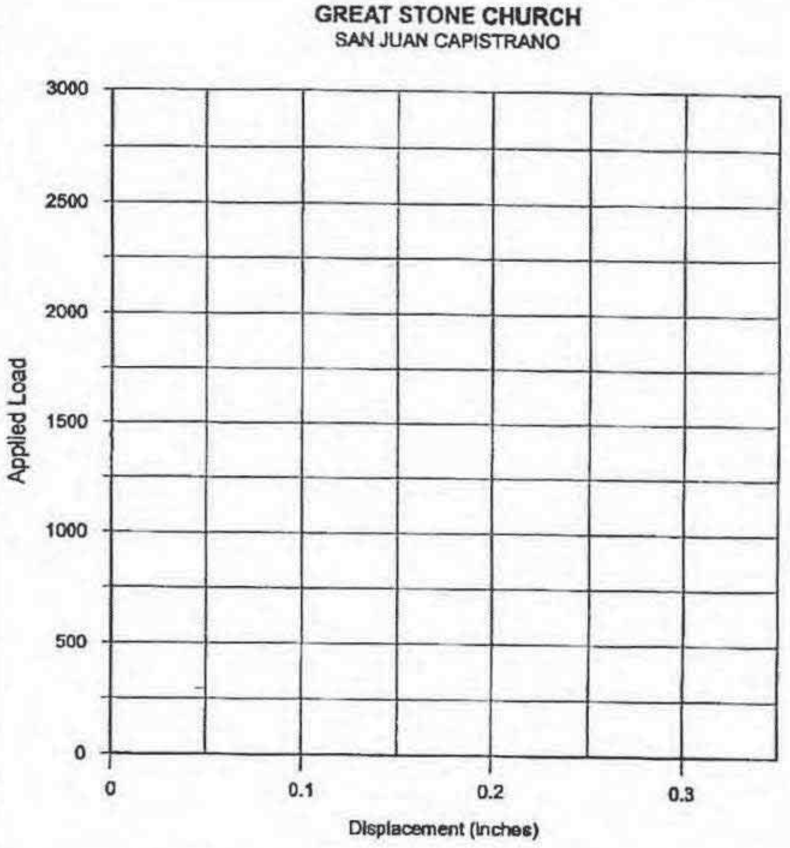


PROJECT: GREAT STONE CHURCH, SAN JUAN CAPISTRANO

TEST DATA FOR CINTEC GROUTED ANCHORS

TEST LOCATION No.	14	No. of Anchors	1
TEST SET UP:	HILTI	Max. Spec. Loac	1900 lbs
DATE	02/05/01	Disp. Gauge	MITUTUYO

Applied Load, lbs.	Measured* Displacement	OBSERVATION
0		
200		Preload
400		
600		
800		
1000		
1200		
1400		
1600		
1800		sleeve anchors appears to slip at this load.
2000		
2200		crumbling of mortar at this load
2400		
2600		
2800		
3000		maximum load, prior to release of load



Note:

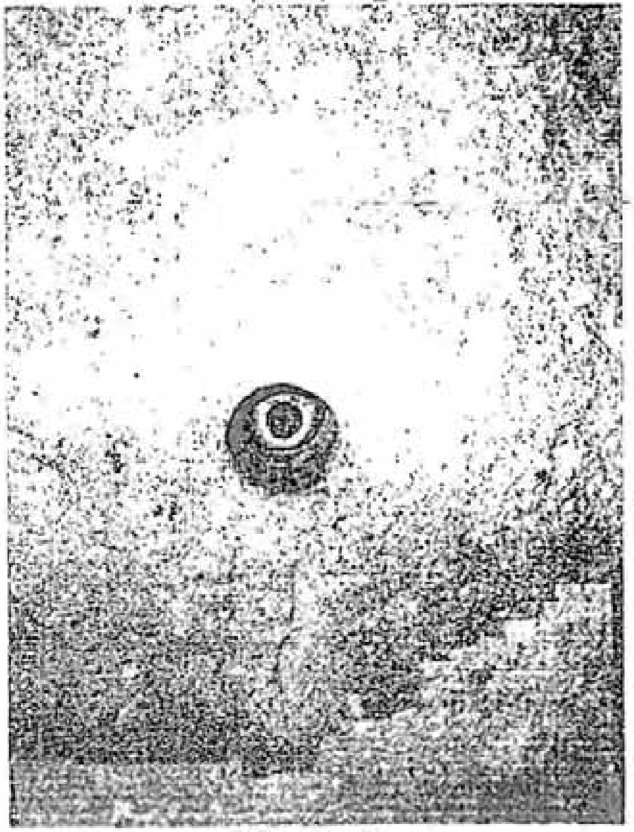
1. No displacement gauge was set up at this test location. Mortar around the test anchor cannot hold the magnetic displacement gauge bracket.
2. Visual observation only, first movement of the sleeve anchor was observed at 1800 lbs., when mortar around the grout sock begins to crack and crumble to pieces.

TEST 1

TEST 2

TEST 3

TEST 4



TEST 5

TEST 6

TEST 7

TEST 8

TEST 9

TEST 10

TEST 11

TEST 12

TEST 14

the ROSELUND
ENGINEERING COMPANY
626-573-2441

Client: Mission San Juan Capistrano
Project: Stabilization of the Stone Walls
of the Great Stone Church
Inner and Outer Stone Wythe Bonding by Pinning

Sheet 1 of 2
4/11/01by Nels
Job 00-107

Sequence and Procedure - Test Program of Cintec Grouted All-Thread Anchors

A. Objective

The objective of this Test Program is to observe, evaluate and tension-test Cintec Grouted Anchors in the walls of the Old Stone Church in order to establish the suitability of the Anchors for bonding of the inner and outer wythes of the stone walls to prevent internal separation in the walls. Internal separations may occur due to:

1. Internal shear stresses as the wall rocks on the base of a wythe, its edge acting as a fulcrum so that the weight of the wall is supported by internal vertical shear stresses.
2. Seismic horizontal acceleration of an inner or outer wythe normal to the plane of the wall.

The Anchors will be judged suitable provided

1. They can be demonstrated to be reliably installed,
2. Anchors with a 12 " embedment in stone, in mortar, or in a combination of stone and mortar have tension Anchor capacity with a design strength of 1,900 pounds as determined in Section H., below.
3. No unanticipated disadvantages are observed during the Test Program.

B. Materials

1. Grout: Presstec Cementitious Injection Grout supplied by Cintec in 25kg bags.
2. Stainless steel pins: ½" diameter 316 stainless steel with fabric grout-confinement sock, by Cintec.
3. Water: Clean, potable water from domestic supply.

C. Equipment

1. Drill: 1½" diameter dry-diamond core-drill bit - no impact or vibratory force shall be used on bit.
2. Grouting Equipment: Comply with Equipment Required for the Installation of the Cintec Anchoring System, a Cintec document.
3. Test equipment:
   Jack: center-pull hydraulic jack with hand-operated hydraulic pump, and digital-reading pressure gauge. The jack/pump/gauge apparatus shall have been calibrated within the preceding 180 days and shall be provided with a chart or other means to allow on-site determination of test loads during the test procedure (submit calibration record).
   Bridge: tripod bridge that applies the jack reactions to the wall at 3 spots, a minimum of 12" from the center of the Anchor.
   Strain gauge: dial or digital-reading strain gage capable of registering increments of 0.001 inch.
   Adapter: coupling nut or other device to connect Anchors to the center-pull jack.

D. Anchor Locations for Tension Test

Tension-test Anchors. Layout locations of 12" depth Anchor installations at convenient locations about 24" to 30" above ground in a wall of the Old Stone Church. Six Anchors shall be installed in holes that enter the wall through a mortar joint; six shall be installed in holes that enter the wall in a stone. The anchors were installed on March 6, 2001.

E. Testing

1. Install a strain gauge to measure the deflection of the Anchor. The strain gage shall be positioned to measure directly the displacement on the anchor along its centerline axis.

2. Install the center-pull jack and bridge to apply a direct tension load to the Anchor and that is

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Twining Laboratories *of Southern California, Inc.*

ENGINEERING INSPECTION TESTING

www.twininglabs.com

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San Diego: 9235 Chesapeake Drive, Suite D, San Diego, CA 92121-1085 • Phone: (858) 974-3750 • Fax: (858) 974-3752

REPORT OF TEST

30th Street Architect

2821 Newport Beach
Newport Beach, CA 92660
Attn: Accounts Payable

TENSION TESTS FOR CINTEC WALL ANCHORS "STABILIZATION OF THE STONE"

Job Name: Mission San Juan Capistrano

REPORT DATE: May 2, 2001

TWINING LABORATORIES OF SOUTHERN CALIFORNIA, INC.

TEST REPORT NO. 01-9025

mike fattal

MIKE FATTAL
DIVISION MANAGER
SPECIAL PRODUCT TESTING DIVISION

Twining Laboratories of Southern California, Inc.
ENGINEERING INSPECTION TESTING
www.twininglabs.com
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San Diego: 9235 Chesapeake Drive, Suite D, San Diego, CA 92121-1085 • Phone: (858) 974-3750 • Fax: (858) 974-3752

MAY 2, 2001

PROJECT 98-9025

Test Results

Anchor # 3 (stone)

Load (lbs)	Deflection (in)	Mode of Failure
0	0	No sign of failure
200	0	No sign of failure
400	0	No sign of failure
600	0	No sign of failure
800	0	No sign of failure
1,000	0	No sign of failure
1,200	0	No sign of failure
1,400	0	No sign of failure
1,600	0	No sign of failure
1,800	0	No sign of failure
2,000	0	No sign of failure
2,200	0	No sign of failure
2,400	0	No sign of failure
2,600	0	No sign of failure
2,800	0	No sign of failure
3,000	0	No sign of failure
3,000 (30 seconds)	0.0036	No sign of failure

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MAY 2, 2001

PROJECT 98-9025

Test Results

Anchor # 4 (stone)

Load (lbs)	Deflection (in)	Mode of Failure
0	0	No sign of failure
200	0	No sign of failure
400	0	No sign of failure
600	0	No sign of failure
800	0	No sign of failure
1,000	0	No sign of failure
1,200	0	No sign of failure
1,400	0	No sign of failure
1,600	0	No sign of failure
1,800	0.0035	No sign of failure
2,000	0.0035	No sign of failure
2,200	0.0070	No sign of failure
2,400	0.0070	No sign of failure
2,600	0.0070	No sign of failure
2,800	0.0106	No sign of failure
3,000	0.0106	No sign of failure
3,000 (30 seconds)	0.0141	No sign of failure

Twining Laboratories of Southern California, Inc.
ENGINEERING INSPECTION TESTING
www.twininglabs.com
Corporate Office: 3310 Airport Way, Long Beach, CA 90806 Mail: P.O. Box 47, 90801 • Phone: (562) 426-3355 • Fax: (562) 426-6424
Orange County: 5942 Edinger Ave., Suite 113, P.M.B. 313, Huntington Beach, CA 92649 • Phone: (714) 960-0830 • Fax: (714) 960-0860
San Diego: 9235 Chesapeake Drive, Suite D, San Diego, CA 92121-1085 • Phone: (858) 974-3750 • Fax: (858) 974-3752

MAY 2, 2001

PROJECT 98-9025

Test Results

Anchor # 5 (Mortar)

Load (lbs)	Deflection (in)	Mode of Failure
0	0	No sign of failure
200	0	No sign of failure
400	0	No sign of failure
600	0	No sign of failure
800	0	No sign of failure
1,000	0	No sign of failure
1,200	0	No sign of failure
1,400	0	No sign of failure
1,600	0	No sign of failure
1,800	0	No sign of failure
2,000	0	No sign of failure
2,200	0	No sign of failure
2,400	0.0036	No sign of failure
2,600	0.0036	No sign of failure
2,800	0.00071	No sign of failure
3,000	0.0071	No sign of failure
3,000 (30 seconds)	0.0106	No sign of failure

ENGINEERING INSPECTION TESTING
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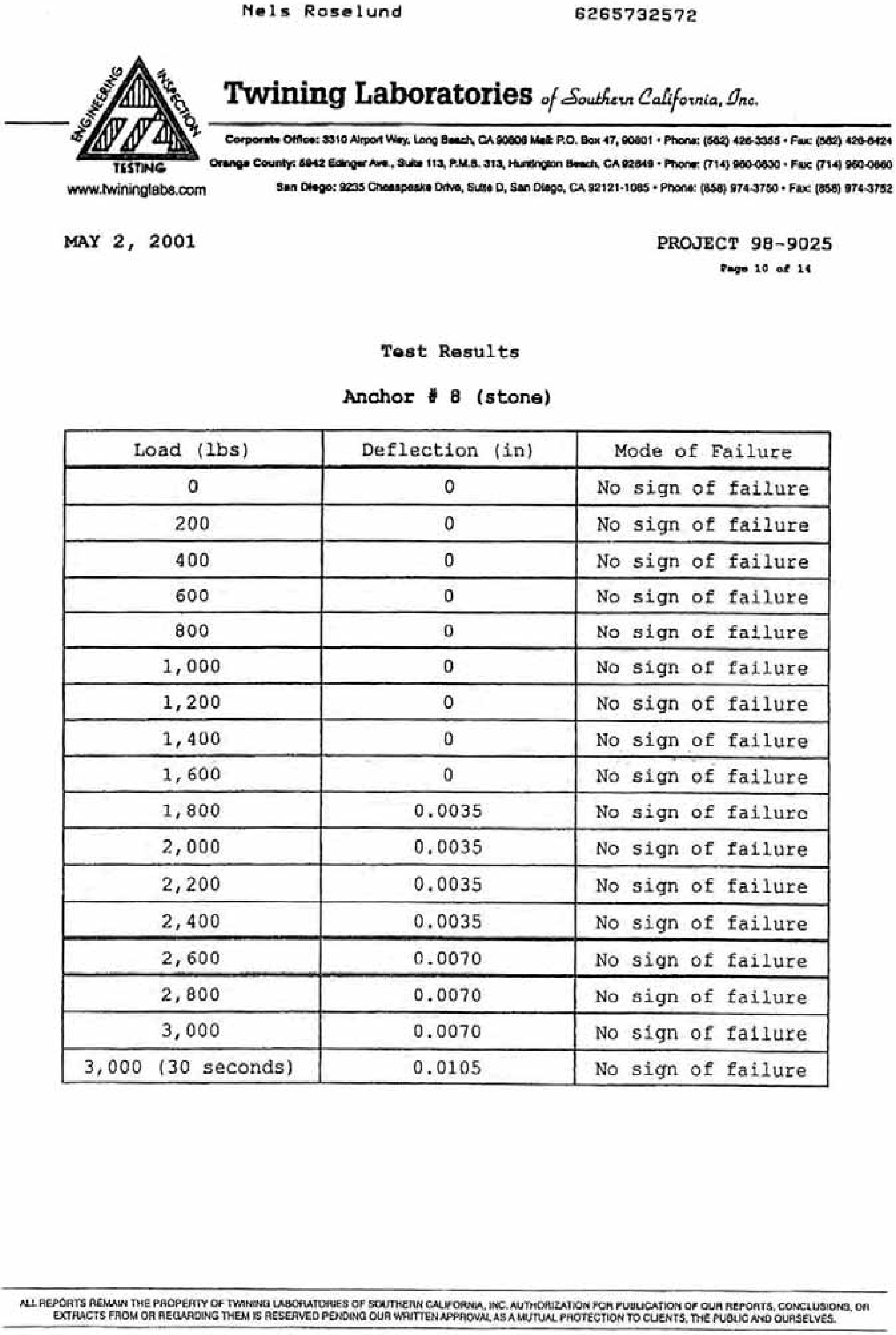
www.twininglabs.com

MAY 2, 2001

Test Results

Anchor # 7 (Mortar)

Load (lbs)	Deflection (in)	Mode of Failure
0	0	No sign of failure
200	0	No sign of failure
400	0	No sign of failure
600	0	No sign of failure
800	0	No sign of failure
1,000	0	No sign of failure
1,200	0	No sign of failure
1,400	0	No sign of failure
1,600	0	No sign of failure
1,800	0.0035	No sign of failure
2,000	0.0035	No sign of failure
2,200	0.0035	No sign of failure
2,400	0.0035	No sign of failure
2,600	0.0070	No sign of failure
2,800	0.0070	No sign of failure
3,000	0.0070	No sign of failure
3,000 (30 seconds)	0.0105	No sign of failure



Nels Roselund 6265732572

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ENGINEERING INSPECTION TESTING

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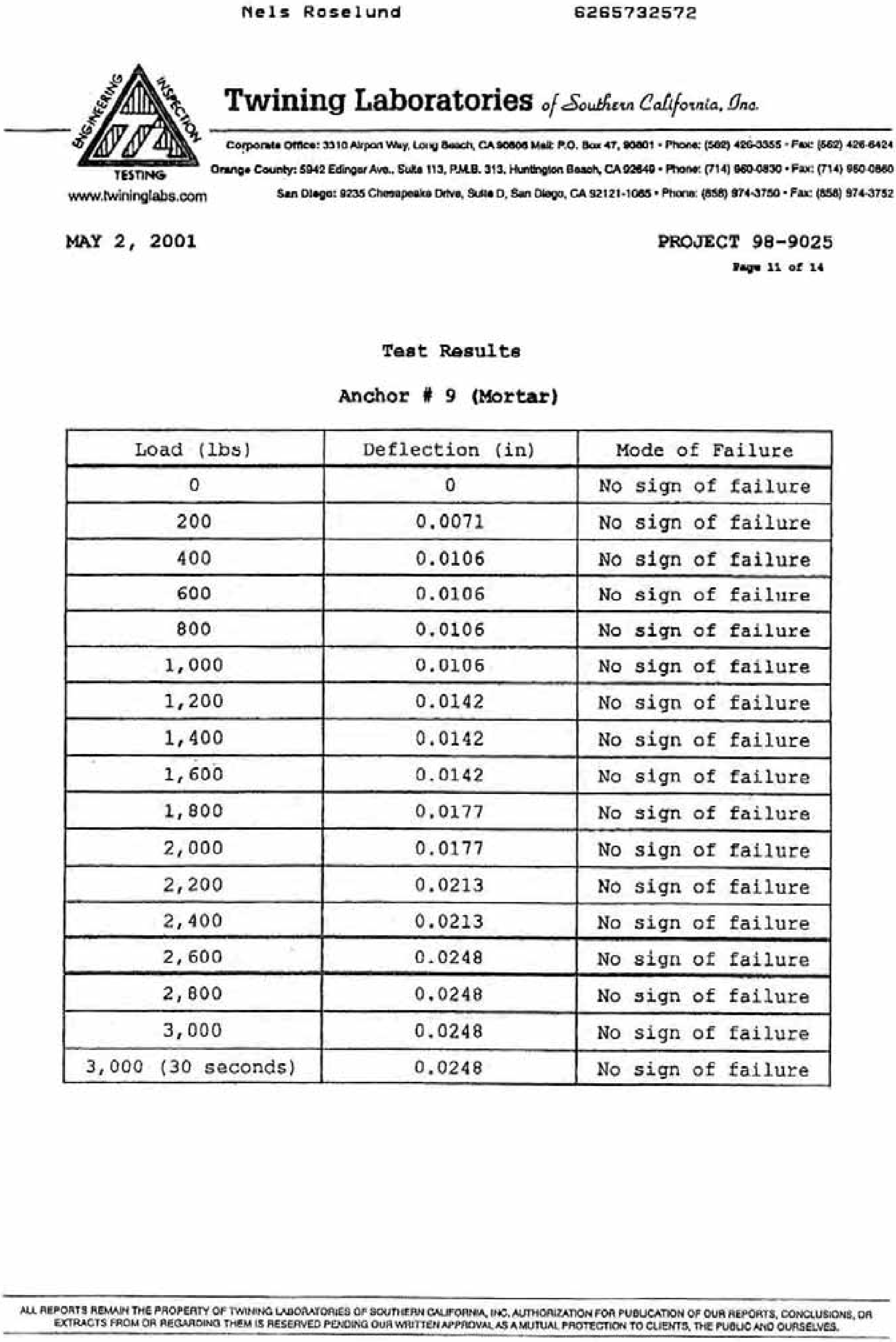
MAY 2, 2001

PROJECT 98-9025
Page 10 of 14

Test Results

Anchor # 8 (stone)

Load (lbs)	Deflection (in)	Mode of Failure
0	0	No sign of failure
200	0	No sign of failure
400	0	No sign of failure
600	0	No sign of failure
800	0	No sign of failure
1,000	0	No sign of failure
1,200	0	No sign of failure
1,400	0	No sign of failure
1,600	0	No sign of failure
1,800	0.0035	No sign of failure
2,000	0.0035	No sign of failure
2,200	0.0035	No sign of failure
2,400	0.0035	No sign of failure
2,600	0.0070	No sign of failure
2,800	0.0070	No sign of failure
3,000	0.0070	No sign of failure
3,000 (30 seconds)	0.0105	No sign of failure



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MAY 2, 2001

PROJECT 98-9025

Test Results

Anchor # 9 (Mortar)

Load (lbs)	Deflection (in)	Mode of Failure
0	0	No sign of failure
200	0.0071	No sign of failure
400	0.0106	No sign of failure
600	0.0106	No sign of failure
800	0.0106	No sign of failure
1,000	0.0106	No sign of failure
1,200	0.0142	No sign of failure
1,400	0.0142	No sign of failure
1,600	0.0142	No sign of failure
1,800	0.0177	No sign of failure
2,000	0.0177	No sign of failure
2,200	0.0213	No sign of failure
2,400	0.0213	No sign of failure
2,600	0.0248	No sign of failure
2,800	0.0248	No sign of failure
3,000	0.0248	No sign of failure
3,000 (30 seconds)	0.0248	No sign of failure

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ENGINEERING INSPECTION TESTING
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MAY 2, 2001

PROJECT 98-9025

Test Results

Anchor # 10 (stone)

Load (lbs)	Deflection (in)	Mode of Failure
0	0	No sign of failure
200	0	No sign of failure
400	0	No sign of failure
600	0	No sign of failure
800	0	No sign of failure
1,000	0.0071	No sign of failure
1,200	0.0071	No sign of failure
1,400	0.0071	No sign of failure
1,600	0.0071	No sign of failure
1,800	0.0071	No sign of failure
2,000	0.0071	No sign of failure
2,200	0.0071	No sign of failure
2,400	0.0071	No sign of failure
2,600	0.0071	No sign of failure
2,800	0.0071	No sign of failure
3,000	0.0071	No sign of failure
3,000 (30 seconds)	0.0106	No sign of failure

ENGINEERING INSPECTION TESTING
www.twininglabs.com

Twining Laboratories *of Southern California, Inc.*

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MAY 2, 2001

PROJECT 98-9025

Page 13 of 14

Test Results

Anchor # 11 (stone)

Load (lbs)	Deflection (in)	Mode of Failure
0	0	No sign of failure
200	0	No sign of failure
400	0	No sign of failure
600	0	No sign of failure
800	0	No sign of failure
1,000	0	No sign of failure
1,200	0	No sign of failure
1,400	0	No sign of failure
1,600	0	No sign of failure
1,800	0	No sign of failure
2,000	0	No sign of failure
2,200	0	No sign of failure
2,400	0	No sign of failure
2,600	0	No sign of failure
2,800	0	No sign of failure
3,000	0	No sign of failure
3,000 (30 seconds)	0.0035	No sign of failure

CINTEC ANCHOR TESTING

New York Schools Construction Authority

TESTING AT:

PS230K

1 ALBERMARLE ROAD, BROOKLYN

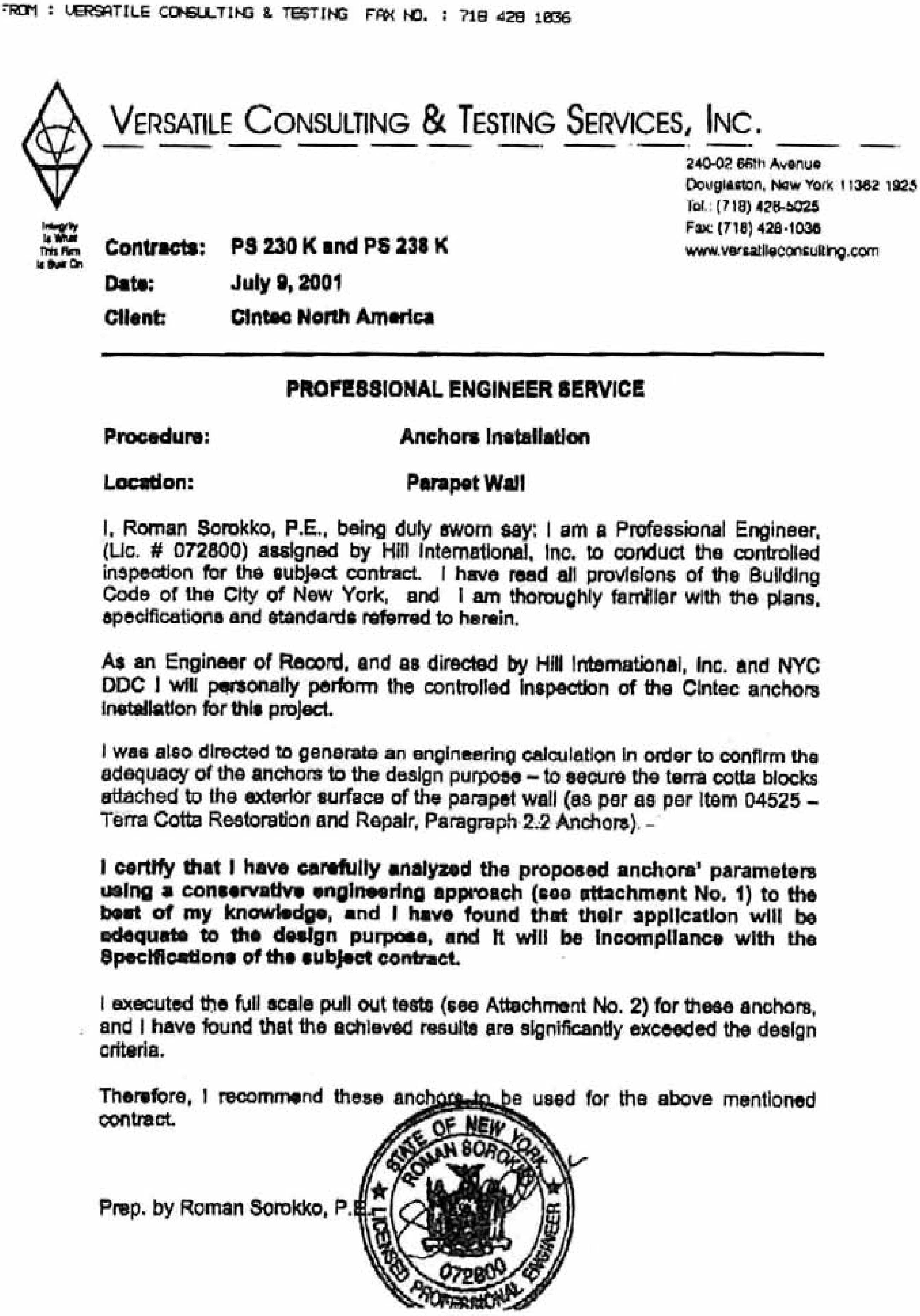
AND

PS238K

1633 EAST 8TH, BROOKLYN, NEW YORK

TESTING ENGINEERS:

VERSATILE CONSULTING AND TESTING SERVICES (JULY 2001)



FROM : VERSATILE CONSULTING & TESTING FAX NO. : 718 428 1036

VERSATILE CONSULTING & TESTING SERVICES, INC.

Integrity Is What This Firm Is Built On

240-02 65th Avenue
Douglaston, New York 11362 1925
Tel.: (718) 428-5025
Fax: (718) 428-1036
www.versatileconsulting.com

Contracts: **PS 230 K and PS 238 K**

Date: **July 9, 2001**

Client: **Cintec North America**

PROFESSIONAL ENGINEER SERVICE

Procedure: **Anchors Installation**

Location: **Parapet Wall**

I, Roman Sorokko, P.E., being duly sworn say: I am a Professional Engineer, (Lic. # 072800) assigned by Hill International, Inc. to conduct the controlled inspection for the subject contract. I have read all provisions of the Building Code of the City of New York, and I am thoroughly familiar with the plans, specifications and standards referred to herein.

As an Engineer of Record, and as directed by Hill International, Inc. and NYC DDC I will personally perform the controlled inspection of the Cintec anchors installation for this project.

I was also directed to generate an engineering calculation in order to confirm the adequacy of the anchors to the design purpose – to secure the terra cotta blocks attached to the exterior surface of the parapet wall (as per as per Item 04525 – Terra Cotta Restoration and Repair, Paragraph 2.2 Anchors).

I certify that I have carefully analyzed the proposed anchors' parameters using a conservative engineering approach (see attachment No. 1) to the best of my knowledge, and I have found that their application will be adequate to the design purpose, and it will be incompliance with the Specifications of the subject contract.

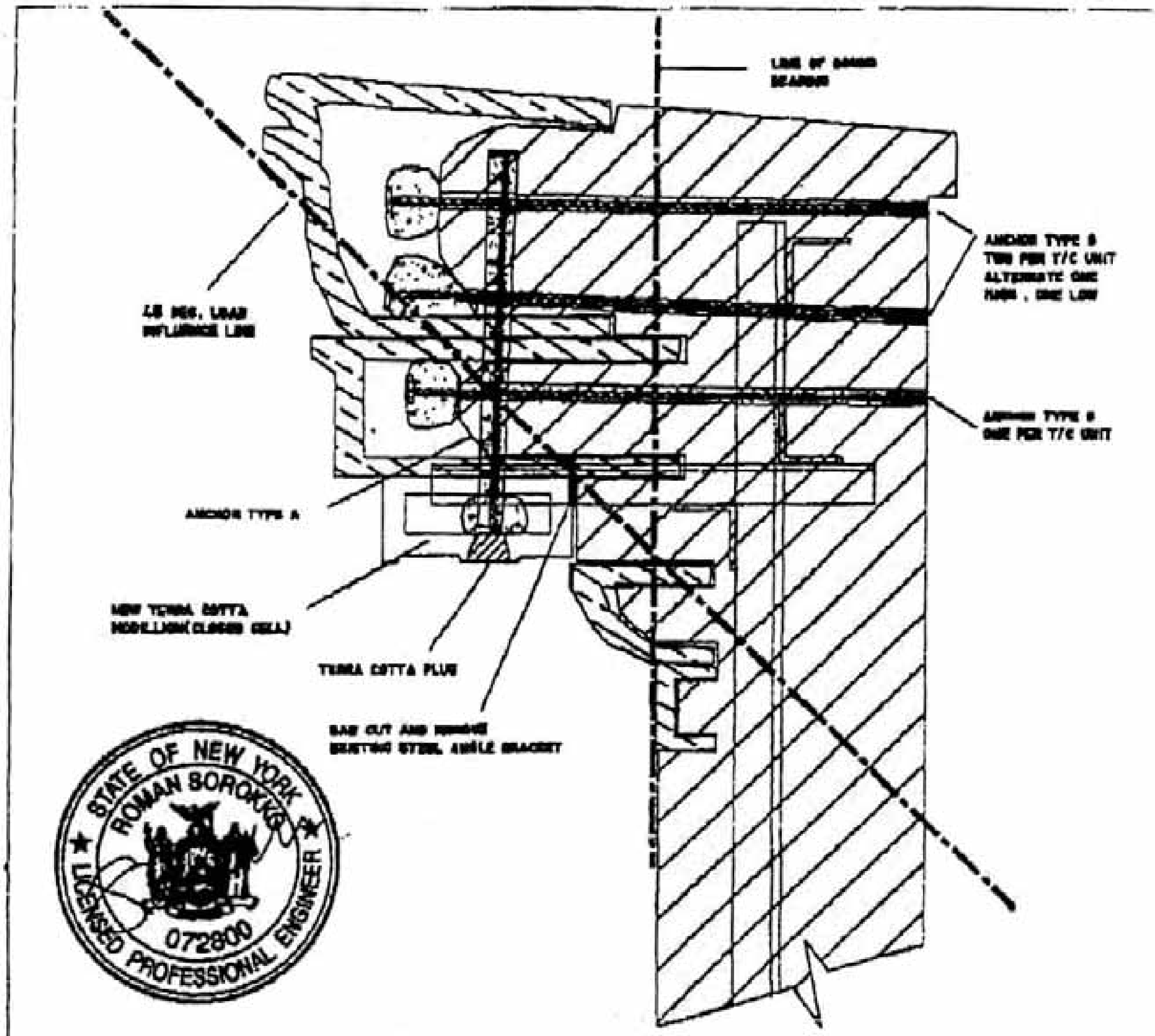
I executed the full scale pull out tests (see Attachment No. 2) for these anchors, and I have found that the achieved results are significantly exceeded the design criteria.

Therefore, I recommend these anchors to be used for the above mentioned contract.

Prep. by Roman Sorokko, P.E.

ROMAN SOROKKO
072800

FROM : VERSATILE CONSULTING & TESTING FAX NO. : 718 428 1836 Aug. 05 2001 09:58PM P4



ROMAN BOROKKS
072800

Project Name 230 & PS 238
Location BROOKLYN, NEW YORK
Consultant: TAMS CONSULTANTS, INC.

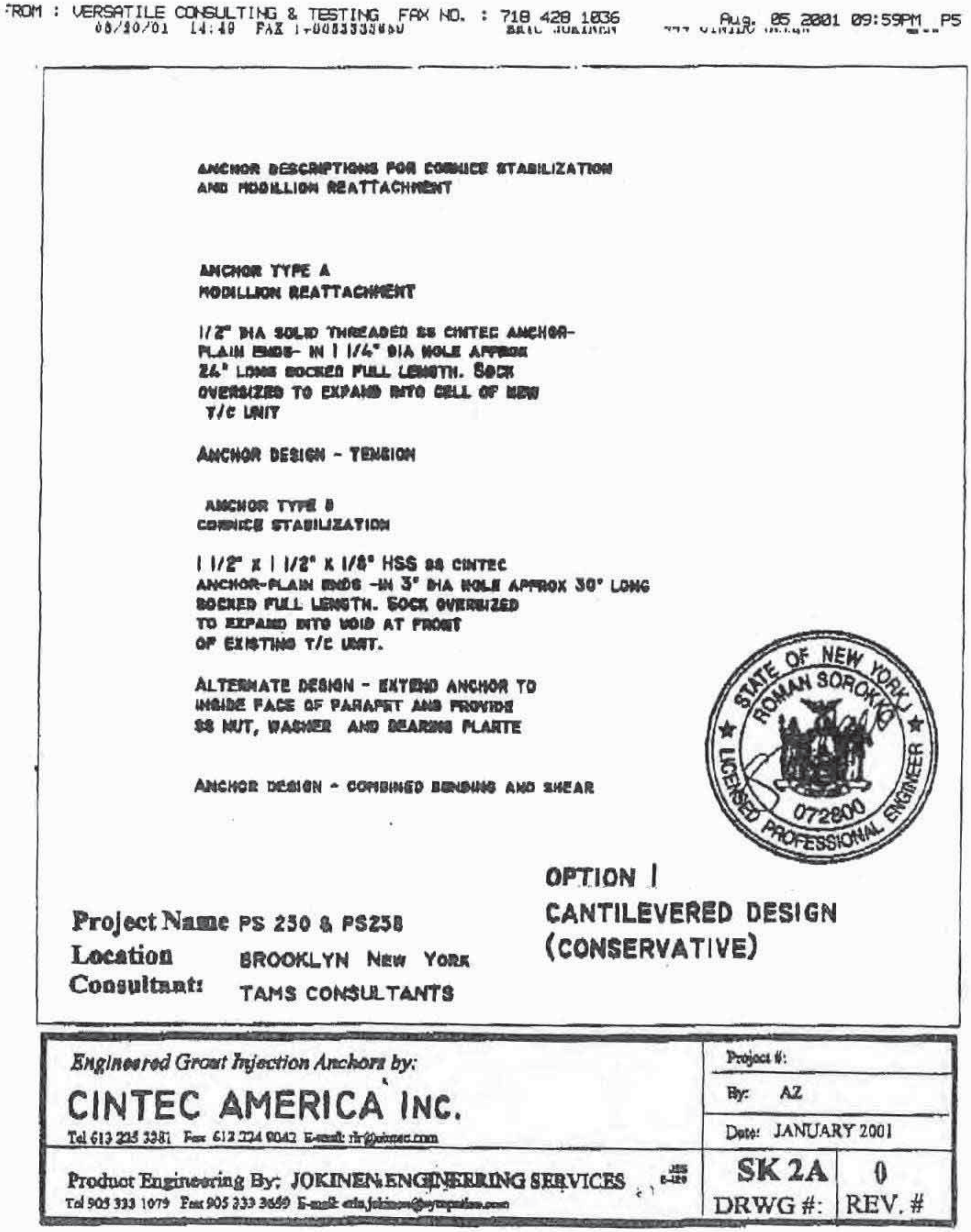
CORNICE STABILIZATION
MODILLION REPLACEMENT ONLY

Engineered Grout Injection Anchors by:
CINTEC AMERICA INC.
Tel 613 225 3381 Fax 613 234 9042 E-mail: [illegible]

Project #:
By: AZ
Date: Dec 14/2000

Product Engineering By: JOKINEN ENGINEERING SERVICES JES C129
Tel 905 333 1079 Fax 905 333 3659 E-mail: eric.jokinen@sympatico.com

SK 1 DRWG #:
1 REV. #



FROM : VERSATILE CONSULTING & TESTING FAX NO. : 718 428 1036 Aug. 05 2001 09:59PM P5
08/20/01 14:49 FAX [illegible]

ANCHOR DESCRIPTIONS FOR CORNICE STABILIZATION
AND MODILLION REATTACHMENT

ANCHOR TYPE A
MODILLION REATTACHMENT

1/2" DIA SOLID THREADED SS CINTEC ANCHOR-
PLAIN ENDS- IN 1 1/4" DIA HOLE APPROX
24" LONG SOCKED FULL LENGTH. SOCK
OVERSIZED TO EXPAND INTO CELL OF NEW
T/C UNIT

ANCHOR DESIGN - TENSION

ANCHOR TYPE B
CORNICE STABILIZATION

1 1/2" x 1 1/2" x 1/8" HSS SS CINTEC
ANCHOR-PLAIN ENDS -IN 3" DIA HOLE APPROX 30" LONG
SOCKED FULL LENGTH. SOCK OVERSIZED
TO EXPAND INTO VOID AT FRONT
OF EXISTING T/C UNIT.

ALTERNATE DESIGN - EXTEND ANCHOR TO
INSIDE FACE OF PARAPET AND PROVIDE
SS NUT, WASHER AND BEARING PLARTE

ANCHOR DESIGN - COMBINED BENDING AND SHEAR

STATE OF NEW YORK
ROMAN SOROKKO
072800
LICENSED PROFESSIONAL ENGINEER

OPTION 1
CANTILEVERED DESIGN
(CONSERVATIVE)

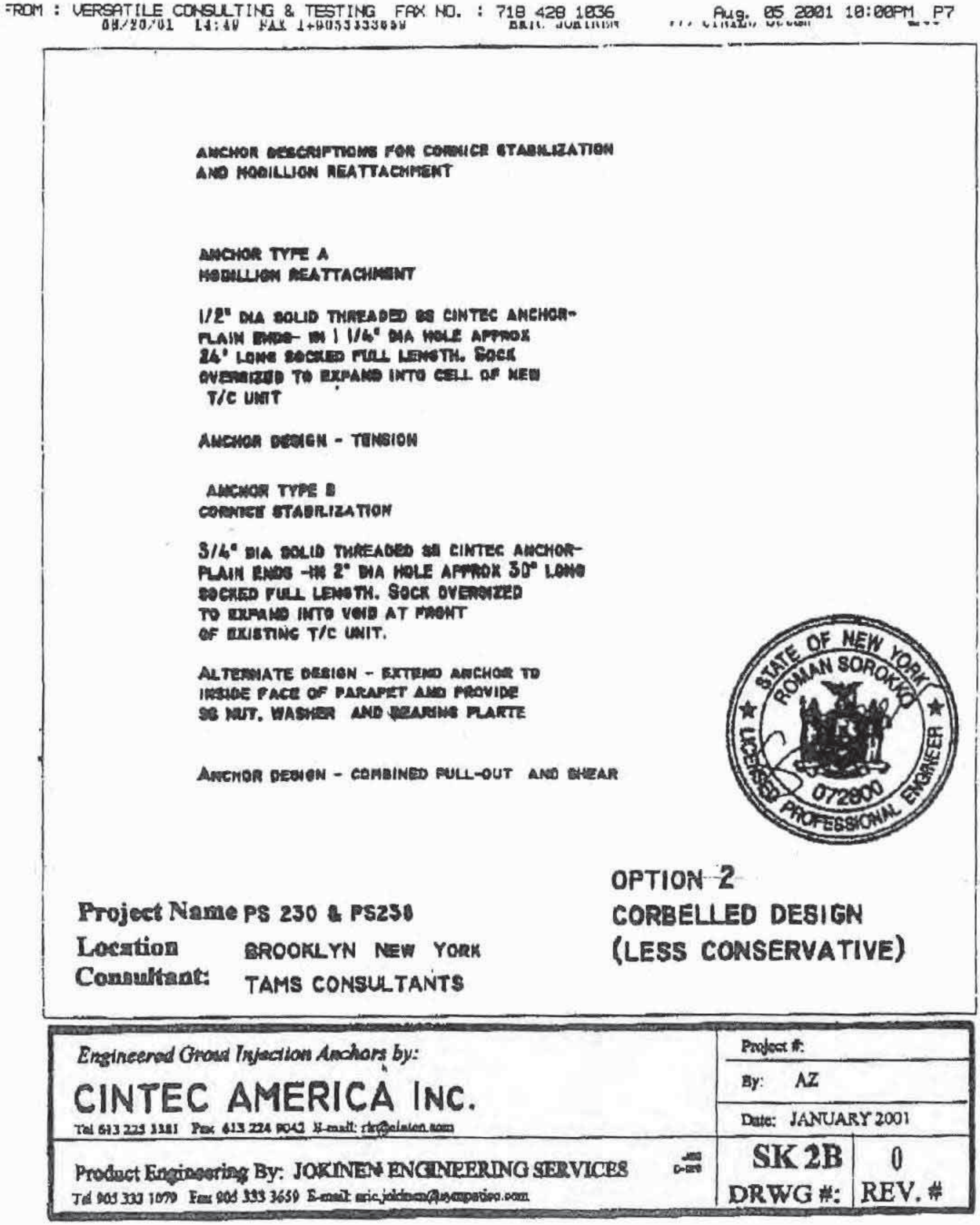
Project Name PS 230 & PS238
Location BROOKLYN New York
Consultant: TAMS CONSULTANTS

Engineered Grout Injection Anchors by:
CINTEC AMERICA INC.
Tel 613 225 3381 Fax 613 224 9042 E-mail: [illegible]

Project #:
By: AZ
Date: JANUARY 2001

Product Engineering By: JOKINEN ENGINEERING SERVICES
Tel 905 333 1079 Fax 905 333 3659 E-mail: [illegible]

SK 2A DRWG #:
0 REV. #



FROM : VERSATILE CONSULTING & TESTING FAX NO. : 718 428 1036 Aug. 05 2001 10:00PM P7
08/20/01 14:40 FAX 1+9053333659 ERIC JOKINEN

ANCHOR DESCRIPTIONS FOR CORNICE STABILIZATION AND MODILLION REATTACHMENT

ANCHOR TYPE A
MODILLION REATTACHMENT

1/2" DIA SOLID THREADED SS CINTEC ANCHOR- PLAIN ENDS- IN 1 1/4" DIA HOLE APPROX 24" LONG SOCKED FULL LENGTH. SOCK OVERSIZED TO EXPAND INTO CELL OF NEW T/C UNIT

ANCHOR DESIGN - TENSION

ANCHOR TYPE B
CORNICE STABILIZATION

3/4" DIA SOLID THREADED SS CINTEC ANCHOR- PLAIN ENDS -IN 2" DIA HOLE APPROX 30" LONG SOCKED FULL LENGTH. SOCK OVERSIZED TO EXPAND INTO VOID AT FRONT OF EXISTING T/C UNIT.

ALTERNATE DESIGN - EXTEND ANCHOR TO INSIDE FACE OF PARAPET AND PROVIDE SS NUT, WASHER AND BEARING PLARTE

ANCHOR DESIGN - COMBINED PULL-OUT AND SHEAR

ROMAN SOROKKO
072800

OPTION 2
CORBELLED DESIGN
(LESS CONSERVATIVE)

Project Name PS 230 & PS250
Location BROOKLYN NEW YORK
Consultant: TAMS CONSULTANTS

Engineered Grout Injection Anchors by:
CINTEC AMERICA INC.
Tel 613 225 1181 Fax 613 224 9042 E-mail: rk@cintec.com

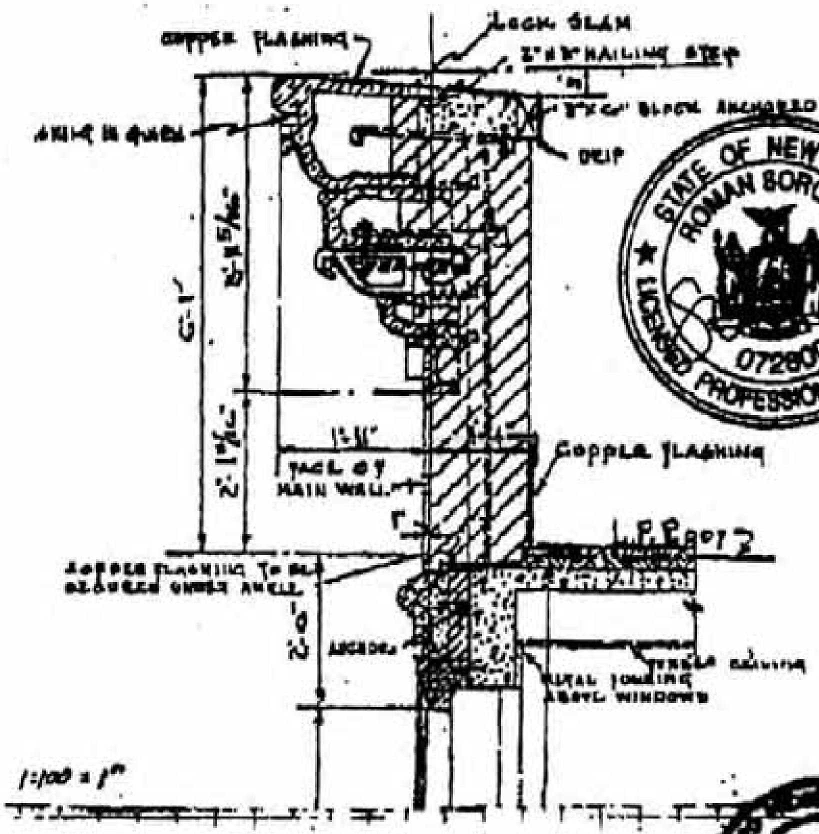
Product Engineering By: JOKINEN ENGINEERING SERVICES
Tel 905 333 1079 Fax 905 333 3659 E-mail: eric.jokinen@sympatico.com

Project #:
By: AZ
Date: JANUARY 2001

SK 2B	0
DRWG #:	REV. #

FROM : VERSATILE CONSULTING & TESTING FAX NO. : 718 428 1036 Aug. 05 2001 10:00PM P8

08/20/01 14:49 FAX 1-9053335650 ERIC JOKINEN



ROMAN BOROKKO 072800

EXISTING CONDITION

ERIC F. JOKINEN

Project Name PS 230 & PS 238

Location BROOKLYN, NEW YORK

Consultant: TAMS CONSULTANTS, INC.

DESIGN CALCULATIONS

CORNICE / PARAPET

Engineered Grout Injection Anchors by:

CINTEC AMERICA Inc.

613 225 3381 Fax 613 224 9042 Email: [illegible]

Product Engineering By: JOKINEN ENGINEERING SERVICES

Tel 905 333 1079 Fax 905 333 5650 E-mail: eric.jokinen@sympatico.com

JES C129

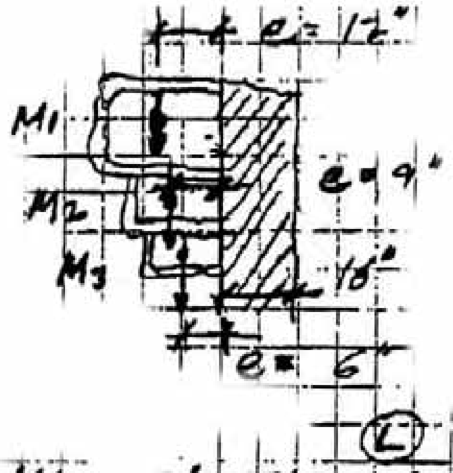
Project #:

By: AZ

Date: Dec 14/2000

DRWG #: DE 1

REV. # 0



ROMAN BOROKKO 072800

M1: 2' x 1.5' x 2.5 @ 100PCF = 750#

M2: 1' x 1.5' x 3.0 @ 100PCF = 450#

M3: 1' x 0.67' x 2.0 @ 50PCF = 100#

MAT'L: AISI 304 SS

f_y = 29,000 PSI STEEL

f'_c = 5000 PSI GROUT

f_b = 300 PSI BRICK SUBSTRATE

ERIC P.

Project Name: PS 230 & PS 238

Location BROOKLYN, NEW YORK

Consultant: TAMS CONSULTANTS, INC.

DESIGN CALCULATIONS

CORNICE & PARAPET

Engineered Grout Injection Anchors by:

CINTEC AMERICA INC

613 225 3391 Fax 613 224 9042 E-mail: rh@cintec.com

Product Engineering By: JOKINEN ENGINEERING SERVICES

Tel 905 333 1079 Fax 905 333 3659 E-mail: eric.jokinen@sympatico.com

JES C129

Project #:

By: AZ

Date: Dec 14/2000

DE 2 DRWG #:

0 REV. #

OPTION 1: CANTILEVER DESIGN (CONSERVATIVE)

BLOCK M1: 750# / 2 ANCHORS

2 Anchors / block

$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{8}$ Anchor body HSS $A_v = 0.531 \text{ in}^2$

$S_6 = 0.266 \text{ in}^3$

Shear

$V = \frac{750}{2} = 375\#$

$F_v = \frac{V \times 2.0}{0.531} = 1412 \text{ PSI} < 0.4 F_y$

$M = \frac{750}{2} \times 12" = 4500 \text{ in-lb}$

$f_b = M/S = \frac{4500}{0.266} = 16917 < 0.66 F_y$

ROMAN BOROKKO 072800

FEB 21 2001 ERIC P. JOKINEN

Project Name: PS 230 & PS 238

Location: BROOKLYN, NEW YORK

Consultant: TAMS CONSULTANTS, INC.

DESIGN CALCULATIONS

Engineered Grout Injection Anchors by:

CINTEC AMERICA INC.

~~613 225 5981 Fax 613 224 9042 E-mail: rlr@cintec.com~~

Product Engineering By: JOKINEN ENGINEERING SERVICES

Tel 905 335 1079 Fax 905 335 3655 E-mail: eric.jokinen@sympatico.com

JES C129

Project #:

By: AZ

Date: Dec 14/2000

DE 3 DRWG #:

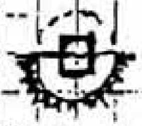
0 REV. #

OPTION 1: CANTILEVER (CONSERVATIVE)

BLOCK M1 (CONT'D)

CHECK BRG ON BRICK

ASSUME 3"φ DIA HOLE



BRG ON ½ CIRCUMF.

EMBEDMENT = 1'-2" = 16" - 2" = 14"

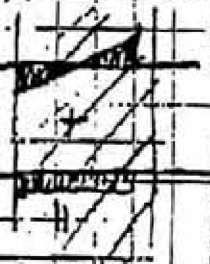
$S_b = \frac{3 \times 3.14}{2} \times \frac{14^2}{6} = 154$ in^3

$A_b = \frac{3 \times 3.14}{2} \times 14 = 66$ in^2

Moment about centroid of brick brg area

$M = 12'' + \frac{14}{2} = 19'' \times 375^{\#} = 7125$ in-lb

$f_{bend} = \frac{7125}{154} = 46$ psi



$f_{brg} = \frac{375}{66} = 6$ psi

$\Sigma = 52$ psi < 300 psi ALLOWABLE

ROMAN SOROKKO 072800

Project Name: PS 230 & PS 238

Location: BROOKLYN, NEW YORK

Consultant: TAMS CONSULTANTS, INC.

DESIGN CALCULATIONS

FEB 26 2001
ERIC P. JOKINEN

Engineered Grout Injection Anchors by:

CINTEC AMERICA INC.

613 225 3381 Fax 613 224 9042 E-mail: [illegible]

Product Engineering By: JOKINEN ENGINEERING SERVICES

Tel 905 333 1079 Fax 905 333 3659 E-mail: eric.jokinen@[illegible].com

JES C129

Project #:

By: AZ

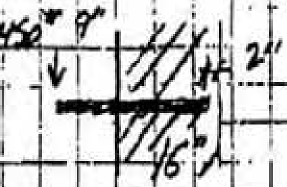
Date: Dec 14/2000

DRWG #: DE 4

REV. #: 0

OPTION 1 - CANTILEVER

BLOCK M2:



ROMAN BOROKHO 072800

TRY 1 ANCHOR/BLOCK

1½ x 1½ x ⅛ in 3" HOLE - EMBED 14"

$M_c = 450 \times 9 = 4050 < M_c$ (BLOCK 1) ∴ OK

$M_{BRG} = 450 \times (9+7) = 7200$ in-lb $\approx M_{bg}$ (BLOCK 1) ∴ OK

USE SAME DESIGN AS BLOCK 1 EXCEPT 1 ANCHOR/BLOCK

BLOCK M3 IN TENSION

$P = 100$#/blk ½"⌀ THREADED ROD $A_{net} = 0.11$ in²

$P_{allow} = 0.11 \times 29000 \times 0.6 = 1900$# OK

Pull out 1⅝⌀ HOLE x 12" EMBED @ 55 PSI BOND

$P = 3060$# OK

END OPTION (1)

Project Name PS 230 & PS 238

Location BROOKLYN, NEW YORK

Consultant: TAMS CONSULTANTS, INC.

DESIGN CALCULATIONS

FEB 2 0 2001 ERIC A. JOKINEN

Engineered Grout Injection Anchors by:

CINTEC AMERICA INC.

613 225 3381 Fax 613 224 9042 E-mail: rlr@cintec.com

Product Engineering By: JOKINEN ENGINEERING SERVICES

Tel 905 333 1079 FAX 905 333 7657 E-Mail: eric.jokinen@sympatico.com

JES C129

Project #:

By: AZ

Date: Dec 14/2000

DRWG #: DE 5

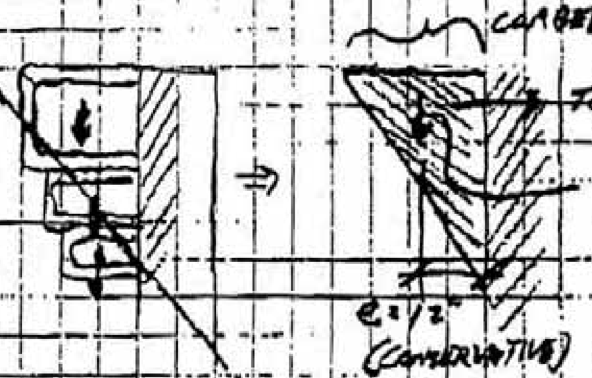
REV. #: 0

FROM : VERSATILE CONSULTING & TESTING FAX NO. : 718 420 1836 Aug. 05 2001 10:05PM P13

08/29/01 14:49 FAX [illegible] ERIC JOKINEN [illegible]

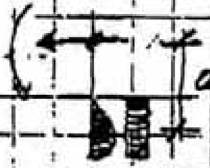
OPTION 2: CORBELLED

ROMAN SOROKKO 072880



$P = M1 + M2 + M3$
$= 750 + 450 + 100^{\#}$
$= 1300^{\#}$

$M_c = 12 \times 1300 = 15600$ in-lb



$P = \frac{M}{d} = \frac{15600}{16} = 975^{\#}$ PULLOUT ON 1 ANCHOR

TRY 3/4"⌀ in 1 1/4"⌀ HOLE - 14" EMBED

STEEL: $P_a = 0.25 \times 29000 \times 0.6 = 4350^{\#} < 975^{\#}$

BOND: $P_a = 1.5\pi \times 12" \times 65\,PSI = 3673^{\#} < 975^{\#}$

$\therefore$ OK

BLOCK M3 HANGER (AS OPTION 1 DESIGN)

Project Name PS 230 & PS 238

Location BROOKLYN, NEW YORK DESIGN CALCULATIONS

Consultant: TAMS CONSULTANTS, INC.

FEB 20 2001
ERIC JOKINEN

Engineered Grout Injection Anchors by:

CINTEC AMERICA INC.

613 225 3381 Fax 613 224 9042 E-mail: [illegible]

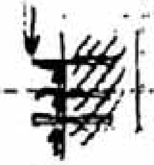
Product Engineering By: JOKINEN ENGINEERING SERVICES
Tel 905 333 1079 Fax 905 333 3659 E-mail: [illegible]

JES C129

Project [illegible]
By: AZ
Date: Dec 14/2000

DE 6 DRWG #: 0 REV. #

OPTION 2: CORBELLED



CHECK SHEAR IN ANCHORS @ PARAPET EXT. FACE

3 - 3/4"φ THRD ROD DOWELS

$$V_{allow} = \frac{0.25 \times 29000 \times 0.4}{1.33} = 2180^{\#}/\text{anchor}$$

$> 1300^{\#}$ TOTAL REQ'D

∴ OK

END OPTION ②

ROMAN BOROKKO 072800

FEB 20 2001 ERIC P. JOKINEN

Project Name PS 230 & PS 238

Location BROOKLYN, NEW YORK

Consultant: TAMS CONSULTANTS, INC.

DESIGN CALCULATIONS

Engineered Grout Injection Anchors by: CINTEC AMERICA INC.	Project #: By: AZ Date: Dec 14/2000
Product Engineering By: JOKINEN ENGINEERING SERVICES JES C129	DRWG #: DE 7 REV. #: 0

TESTING OF CINTEC WALL ANCHORS

[To resist a seismic event]

For

BRITICH NUCLEAR FUELS

Magnox Generation

Wylfa Power Station

By

Cetlest Ltd

And

Cintec International

November – December 2001

Wylfa power station Anglesey Wales

WS/Atkins

RSO

TAYWOOD ENGINEERING

NNC

MOTHERWELL BRIDGE

BNFL
Magnox Generation

Project – Wylfa LTSR

Document Type – Report

Document Number –14392/30/REP/1003

Trial installation and testing of Cintec wall anchors.

Revision	Date	Originator	Checked by	Reviewed for the Consortium
A	10/1/02	D Castree	T. Kirlew	

Approved for LTSR by:	Name Ron A Alasin	Signature Ronald A Alasin	Date 17.1.02

DOCUMENT REVISION RECORD

Revision	Date	Reason for Revision	Approval Reference
0	22/12/01	Issue for approval purposes	
A	14/1/02	Incorporation of internal LTSR team comments	

INDEX

1 INTRODUCTION

As part of the LTSR project, over 400 stretcher-bond cavity brick walls at Wylfa are to be modified in order for them to meet the design requirements for strengthening. Currently the designs from W S Atkins and Babtie require the strengthened walls' leaves to behave in a composite manner under loading from either seismic, hot gas or steam release events. The design from Babtie specifies the use of Cintec steel anchors embedded in grout in an array over the wall panel to tie the two leaves together. Babtie have produced a substantiation report on the use of Cintec anchors based on these test results (document reference 1). It applies only to walls to be strengthened to resist a seismic event. The W S Atkins' design incorporating Cintec is currently being developed.

2 PURPOSE

It is clear from the nature and history of the use of Cintec anchors that they are specifically designed to be used as retro-fitted anchors in brickwork. The purpose of the in-situ testing at Wylfa is therefore simply confirmatory not defining.

The objectives of the installation and the testing were:
- To check the ease of installation
- To check the speed of the installation procedures
- To assess the grout-to-brickwork bond strength (if critical)
- To assess the grout-to-bar bond strength (if critical)
- To assess the brickwork's crushing strength (if critical)
- To assess the grout's crushing strength (if critical)
- To measure bar deflections under shear load (vertical and horizontal)
- To measure bar displacements under pull-out load
- To assess the effect of frog up or down orientation on Cintec anchors
- To note the modes of failure

3. THE TRIALS

3.1 The choice of wall:

A North East loading bay wall was chosen for the trial as it had no safety significance, provided easy access to both sides and was a representative example of the majority of the reactor building's stretcher bond cavity brickwork which will require strengthening.

3.2 Wall description:

The trial wall extends 5.1 metres vertically between two concrete beams/slabs and 3.7 metres horizontally between two concrete columns.

Each leaf is built in stretcher bond from clay brickwork. Evidence (i.e. size, appearance and testing (ref 2)) suggests that generally London clay brickwork has been used for wall construction at Wylfa although evidence of use of Butterleys brick was revealed in earlier cores taken from the trial wall. The wall has been painted. Details of the brickwork were assumed to be similar to those tested and reported in the design philosophy document (ref 1).

3.3 Anchor choice:

Cintec anchor bars of the type and size selected by Babtie were adopted for the tests with the exception of the anchors' length. In the Babtie design for the seismically loaded walls the anchor will be grouted fully in the near leaf and partially in the far leaf. For the tests, in order to more accurately assess the 'real' anchor's capacities, the test anchor chosen was only long enough to be embedded 80mm into one leaf. A typical hole/sock/bar configuration is shown in Appendix A sheet 1. The anchor pattern on the wall is shown in Appendix A sheet 2.

The single leaf approach simplifies the post-test mathematical modelling to calculate characteristic strengths.

3.4 Anchor description:

The test anchors were specially manufactured for the test program by Cintec. They consist of a 10 mm diameter x 125 long steel bar with a plastic centring washer at the end in the wall. A polypropylene 'sock' with relatively open weave is clamped to the washer and extends for 90 mm along the length of the bar. Inside the sock there is a plastic tube extending along the bar to deliver grout to the back of the sock first. The tube is taped to the bar. At the front end the sock is gathered into both the bar and tube and tied off, leaving approximately 25 mm of bar and 50mm of grout tube projecting. The projecting bar is threaded (10 diameter metric thread). After the grout has hardened the projecting grout-filled tube is cut off and discarded.

3.5 Anchor action:

The grout is a mixture of a German equivalent of Ordinary Portland Cement and a volcanic sand (finely milled volcanic trass). These are pre-mixed at the factory. Water is added at site and the mixture is thoroughly stirred with a mechanical agitator. The grout is injected under pressure into the sock, which expands to the limits of its containment or to approximately 40 mm diameter – whichever is the smaller. See photograph of grout-inflated sock in Appendix G. The pressure is held for a few seconds, and grout 'milk' – largely cementitious water - seeps out of the weave of the sock, effectively reducing the percentage of water in the grout still retained by the sock. At this point the retained grout loses its liquid-like properties and becomes a pressurised solid. The sock becomes rigid. When the pressure is disconnected from the grout tube, leakage of grout is negligible.

4 DESCRIPTION OF THE INSTALLATION AND TESTING.

4.1 Documentation:

A method statement reference 14392/30/GMS/1005 rev B, quality plan reference 14392/30/GQP/1005 rev B and risk assessment reference 14392/30/GMS/1005 rev B were prepared for the in-situ installation and testing and they were approved before work on the installation began.

4.2 Cintec anchors' installation:

On 25 and 26/11/01 twenty-five 10mm diameter Cintec anchors were installed – generally at 460mm centres (see Appendix A Sheet 2) - and grouted into 30 mm diameter holes 85 mm deep into one leaf of the brickwork. The holes were formed by dry, rotary-percussive drilling to a depth of 70 mm, then rotary drilling to the final depth of 85 mm. The holes were then purged of debris by vacuum cleaning. All drilling took place on 26/11/01.

The bars were made from high yield reinforcement (fy = 460 N/sq mm) and the projecting ends were threaded. All anchor installation and grouting took place on 27/11/01. The holes' bores were wetted with an unused anchor's wet sock. Prestec cementitious grout with a projected mean compressive stress of 51.5 N/sq mm at 28 days was used for all anchors. Two batches of grout (designated #1 and #2 – see Appendix B Sheets 1 and 2) were used to fill the anchors' socks and to make twelve 100mm test cubes (see 4.3 below). The anchors were inserted into the holes and the grout injected into the sock using compressed air at 3.0~3.5 bar as the propellant. Each sock was 90 mm long – 80 mm of which was embedded in the hole. The installation log is attached as Appendix F

The total drilling time for all 25 holes - including set-up time - was approximately four hours (x two men); installation and grouting took two hours (x two men). These figures give approximately 15 minutes x two men per anchor.

The drilling revealed a random laying pattern of frog-up and frog-down bricks (see Appendix A sheet 2).

4.3 Grout test cubes:

12 grout test cubes were made using the same grout and delivery method as for the anchors. Celtest Limited carried out the cube storage and testing. Celtest's facilities are UKAS approved. The cubes were stored under moist hessian in out-door conditions in Bangor. Pairs of cubes were laboratory tested at 3 days, 7 days, 10 days, and 14 days, using Celtest's 2000 kN in-house compressive testing machine (last calibrated on 8/2/01); a final pair were tested at 27 days (24/12/01). The test results are attached as Appendix B.

4.4 Anchor load tests:

On the thirteenth and fourteenth day after grouting - i.e. 10 & 11/12/01, ten anchors were tested in vertical shear, ten were tested in horizontal shear and five were tested in pull-out. All anchor load tests were carried out in-situ. Anchor V2 which had already been tested in vertical shear was also tested in pull-out (see Certificate numbers 0190 and 0197 in Appendix C). The total number of tests was therefore twenty-six.

4.5 Test equipment:

The shear loads were applied to the subject anchor using a hydraulic jack which delivered its force via a length of 20 diameter steel studding to a steel channel with a hole in its web. The hole fitted over the projecting part of the subject anchor, and was secured by a nut and washer. An adjacent anchor with a loosely fitted nut was used in a longitudinal slot-hole in the web of the channel to act as a guide – (see Appendix A sheet 3). The web of the channel was 10 mm thick; the back of the web was in contact with the outer end of the grouted sock, which projected 10 mm from the wall face. The centre of the shear load was therefore delivered to the anchor at 15mm from the face of the wall, thus representing a half of a 30 mm wide cavity. The purpose of this was to emulate the behaviour of anchor in the far leaf. The jack reacted against the ground floor slab as the fixed point of resistance for vertical shear tests and against the projecting main frame column for horizontal shear tests. Pull-out loads were applied to a nut on the threaded part of the anchor using a screw device. This was mounted on a four-legged steel bridging piece which used the wall's face as the fixed point of resistance.

4.6 Load measurement:

Measurement of loads in shear tests was intended to be by an independent load cell – fitted in series with the jack - reading in 10N (.01 kN) increments, with additional check readings from the hydraulic pressure gauge mounted integrally on the jack. In fact, during the third shear test it was noted that the jack's analog readings and the load cell's digital readings were becoming inconsistent. The divergence is recorded below:

Jack's integral analog gauge kN:	Load cell's digital display kN:
3 kN	2 kN
8 kN	6 kN
15 kN	12 kN
17 kN	14 kN

Where differences in reading were noted, the lower reading was used. Both instruments were checked in the Station's instrument workshop and the load cell's readings were found to be 'drifting' i.e. giving changing readings under a constant load. However the jack's pressure gauge reading under a known test load of 20 kN was found to be accurate and stable; it was therefore decided to use the jack's integral analog gauge for subsequent shear load readings. It is considered that the load cell readings which were used only for the first three of twenty-six tests, are representative as readings were made generally before the drift occurred. Where there was evidence of discrepancy in the third test – the lower value of the two was the one recorded and used. The jack's gauge (calibrated in August 2001) gave direct readings to 2 kN, or by assessment under close scrutiny - it was possible to use 1 kN increments. These 1 kN increments each represent a small load 'step' of approximately 5% of the total load at failure, so the accuracy of the results obtained can therefore be considered to be acceptable for the purposes of these tests.

The pull-out equipment was fitted with its own integral hydraulic pressure gauge (calibrated in August 2001) reading in 0.5 kN.

4.7 Displacement measurement:

A dial type strain gauge was used giving readings directly to 0.01 mm. The base of the strain gauge was mounted on a magnetic stand on a steel plate bolted rigidly to an adjacent, unloaded anchor. The end of the probe of the strain gauge bore onto one of the endplates of the jacking channel. Where this was the free, unloaded endplate the strain gauge accurately showed the free movement of the channel (and hence the projecting part of the anchor) relative to the wall. A concern was raised - by some witnesses in the post-testing meeting - that where the gauge's probe was bearing onto the loaded endplate (as it did in some cases) where the jack delivered its force, the readings might be distorted by endplate displacement due to local bending under the jack's loading. The calculations in Appendix E deal with these concerns and show the plate's maximum deflection under load to be negligible when compared to the total displacement recorded.

5 RESULTS.

5.1 Failure types:

All ties were tested to failure. The failure modes for shear tests were load loss, brickwork crushing or excessive bar displacement accompanied by local grout crushing around the bar at the exposed end of the sock, or combinations of these. In all the shear tests the local deformation of the projecting part of the tie was the most significant part of the total displacement. For pull-out tests the mode of failure was load loss combined with slip displacement between the grouted sock and the brickwork. The wall remained stable overall throughout the tests, and there was no cracking or movement observed around individual bricks. Spalling of the brickwork only occurred in the area local to the sock.

5.2 Certificates:

The results of all the in-situ load tests are given on Cintec Test Certificates numbers 0189 to 0210 and 0240 to 0243 (representing 26 tests on 25 anchors). Measurement of loads and displacements were monitored closely by Magnox, W S Atkins and Babtie and a representative of each organisation signed each test certificate at the test site as each test was completed. The Certificates in Excel format are attached in Appendix C, together with summaries of load displacement charts for shear load tests; the original, signed paper versions of these certificates are held in LTSR files, and are available for inspection on request.

6 REFERENCES

Document ref 1: P Griffies BABTIE: Cintec Anchor test report ref 201995-R-)8 December 2001

Document ref 2: CK0509/R102 Wylfa Power Station – Civil Redesign of Hot Gas And Steam Release Stage Submissions 1, 2A and 6 Design Philosophy.

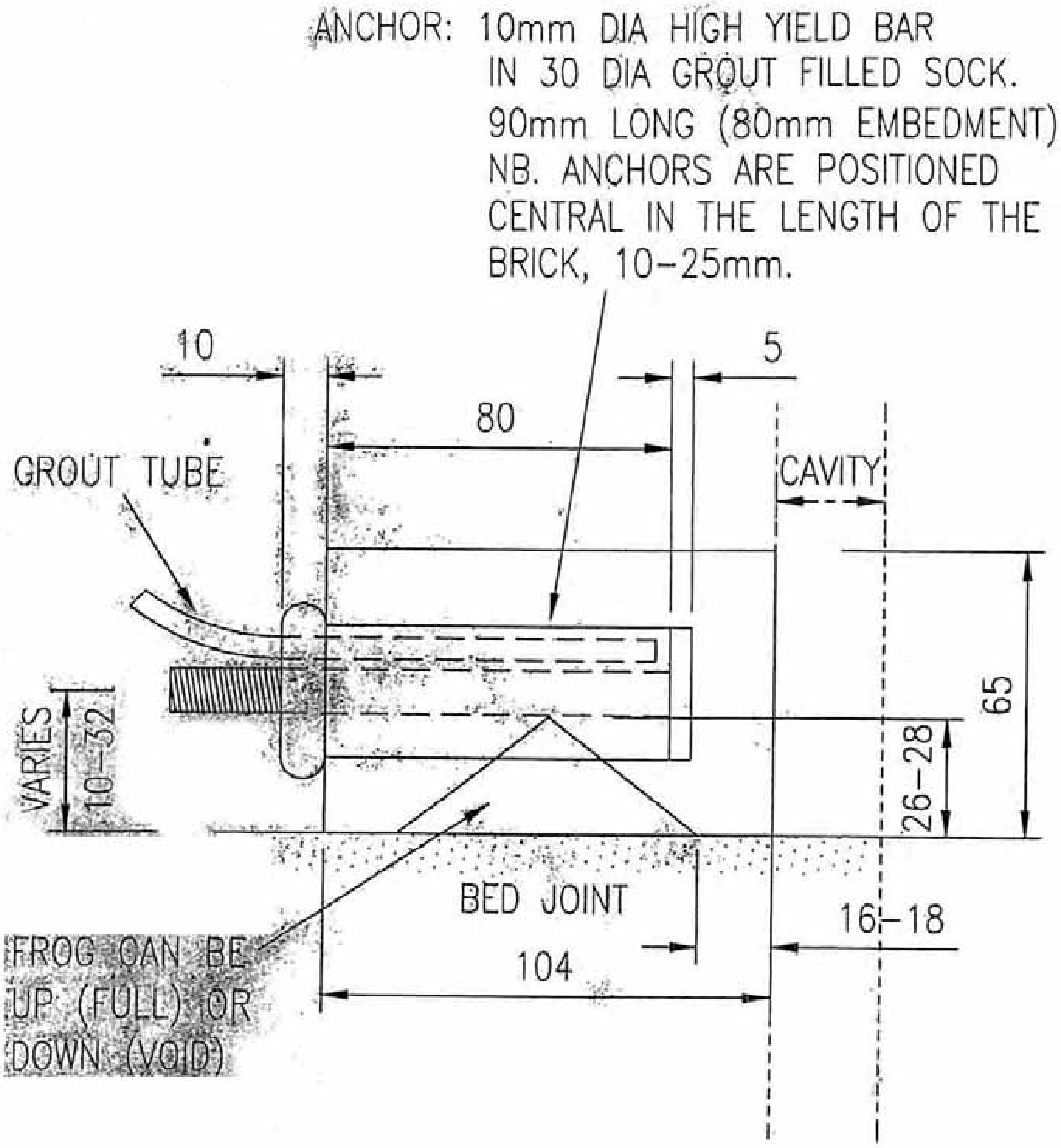
Documents ref 3: LTSR Quality Plan number 14392/30/GQP/1005 rev B and Method Statement number 14392/30/GMS/1005 rev B.

7 CONCLUSIONS

The installation was carried out without major difficulty and the speed of installation was good (see 4.2). The strengths of the various components is assessed in Appendix E. Load/deflection charts are shown in Appendix C. The results indicate that frog orientation (up or down) did not significantly affect the behaviour or the ultimate load of the anchor. The results demonstrate the ability of the Cintec anchor to adapt to non-uniform hole shapes The modes of failure were consistent throughout the tests; these are discussed in item 5.1 and illustrated in Appendix G.

Overall, the installation and testing showed the suitability of Cintec anchors for use in walls of the Wylfa type, and demonstrated the anchors' load-bearing capacities in vertical and horizontal shear and pull-out to be consistent and adequate.

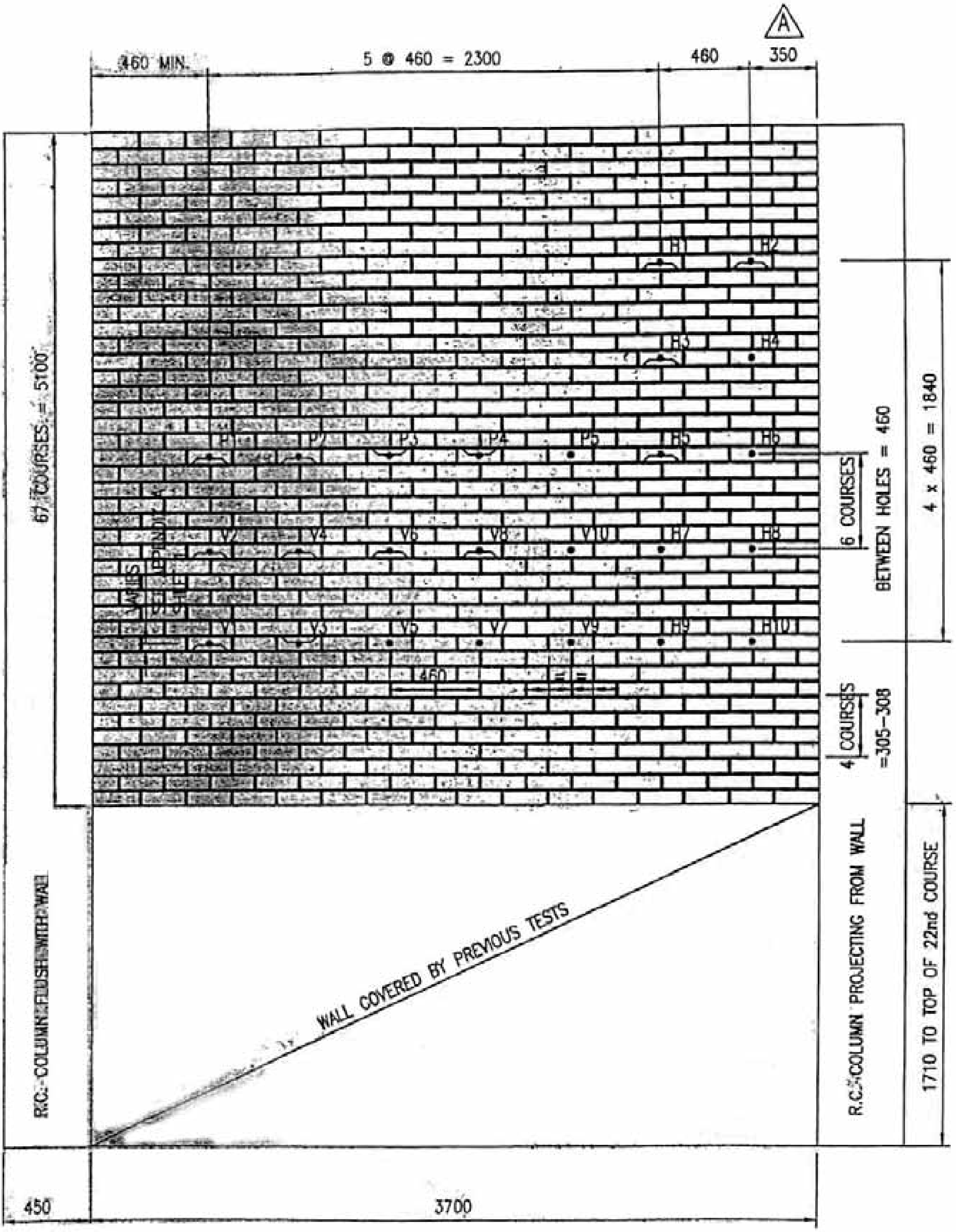
8 APPENDICES follow >>>>>



ANCHOR: 10mm DIA HIGH YIELD BAR
IN 30 DIA GROUT FILLED SOCK.
90mm LONG (80mm EMBEDMENT)
NB. ANCHORS ARE POSITIONED
CENTRAL IN THE LENGTH OF THE
BRICK, 10–25mm.

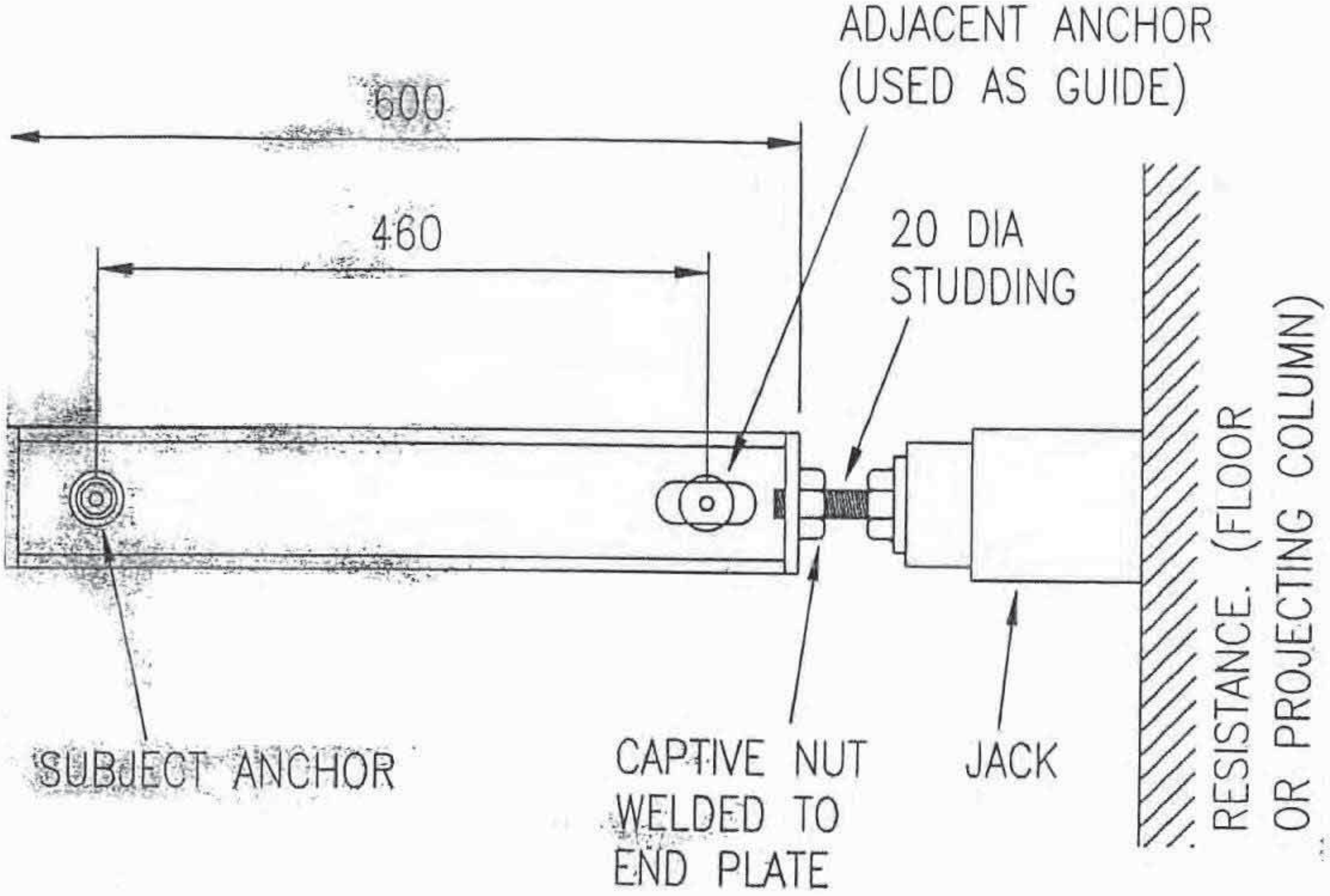
TYPICAL TEST ANCHOR IN BRICKWORK

APPENDIX A
SHEET 1

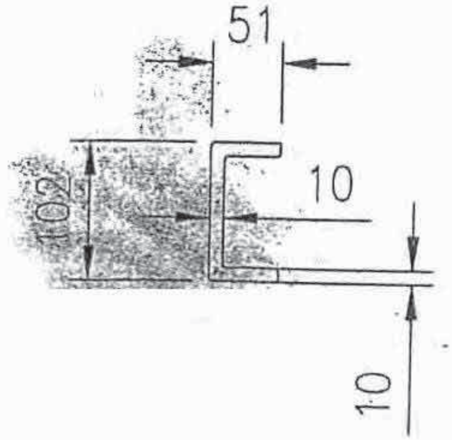


LAYOUT OF ANCHORS IN TRIAL WALL

APPENDIX A
SHEET 2 REV A.

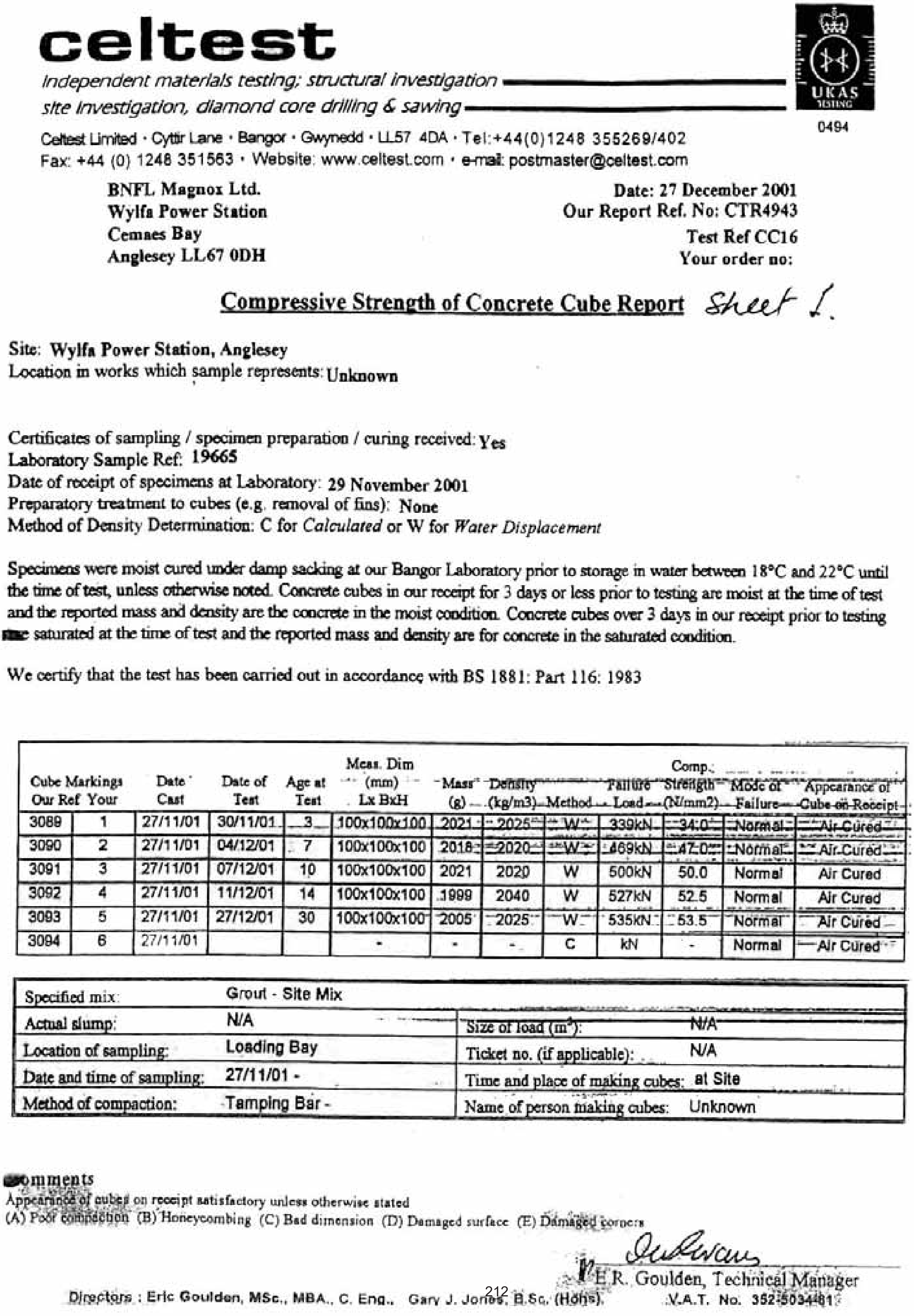


DETAIL OF REVERSIBLE JACKING CHANNEL



TYPICAL SECTION THROUGH CHANNEL

APPENDIX A
SHEET 3



celtest

independent materials testing; structural investigation
site investigation, diamond core drilling & sawing

UKAS TESTING
0494

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Fax: +44 (0) 1248 351563 · Website: www.celtest.com · e-mail: postmaster@celtest.com

BNFL Magnox Ltd.
Wylfa Power Station
Cemaes Bay
Anglesey LL67 0DH

Date: 27 December 2001
Our Report Ref. No: CTR4943
Test Ref CC16
Your order no:

Compressive Strength of Concrete Cube Report Sheet 1.

Site: **Wylfa Power Station, Anglesey**
Location in works which sample represents: **Unknown**

Certificates of sampling / specimen preparation / curing received: **Yes**
Laboratory Sample Ref: **19665**
Date of receipt of specimens at Laboratory: **29 November 2001**
Preparatory treatment to cubes (e.g. removal of fins): **None**
Method of Density Determination: C for *Calculated* or W for *Water Displacement*

Specimens were moist cured under damp sacking at our Bangor Laboratory prior to storage in water between 18°C and 22°C until the time of test, unless otherwise noted. Concrete cubes in our receipt for 3 days or less prior to testing are moist at the time of test and the reported mass and density are the concrete in the moist condition. Concrete cubes over 3 days in our receipt prior to testing are saturated at the time of test and the reported mass and density are for concrete in the saturated condition.

We certify that the test has been carried out in accordance with BS 1881: Part 116: 1983

Cube Markings Our Ref	Your	Date Cast	Date of Test	Age at Test	Meas. Dim (mm) Lx BxH	Mass (g)	Density (kg/m3)	Method	Failure Load	Comp. Strength (N/mm2)	Mode of Failure	Appearance of Cube on Receipt
3089	1	27/11/01	30/11/01	3	100x100x100	2021	2025	W	339kN	34.0	Normal	Air Cured
3090	2	27/11/01	04/12/01	7	100x100x100	2018	2020	W	469kN	47.0	Normal	Air Cured
3091	3	27/11/01	07/12/01	10	100x100x100	2021	2020	W	500kN	50.0	Normal	Air Cured
3092	4	27/11/01	11/12/01	14	100x100x100	1999	2040	W	527kN	52.5	Normal	Air Cured
3093	5	27/11/01	27/12/01	30	100x100x100	2005	2025	W	535kN	53.5	Normal	Air Cured
3094	6	27/11/01			-	-	-	C	kN	-	Normal	Air Cured

Specified mix:	Grout - Site Mix		
Actual slump:	N/A	Size of load (m^3):	N/A
Location of sampling:	Loading Bay	Ticket no. (if applicable):	N/A
Date and time of sampling:	27/11/01 -	Time and place of making cubes:	at Site
Method of compaction:	Tamping Bar -	Name of person making cubes:	Unknown

Comments
Appearance of cubes on receipt satisfactory unless otherwise stated
(A) Poor compaction (B) Honeycombing (C) Bad dimension (D) Damaged surface (E) Damaged corners

E R. Goulden, Technical Manager

Directors : Eric Goulden, MSc., MBA., C. Eng., Gary J. Jones, B.Sc. (Hons). V.A.T. No. 352 5034 81

celtest
Independent materials testing; structural investigation
site investigation, diamond core drilling & sawing

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UKAS TESTING
0494

BNFL Magnox Ltd.
Wylfa Power Station
Cemaes Bay
Anglesey LL67 0DH

Date: 27 December 2001
Our Report Ref. No: CTR4944
Test Ref CC16
Your order no:

Compressive Strength of Concrete Cube Report Sheet 2.

Site: **Wylfa Power Station, Anglesey**
Location in works which sample represents: **Unknown**

Certificates of sampling / specimen preparation / curing received: **Yes**
Laboratory Sample Ref: **19665**
Date of receipt of specimens at Laboratory: **29 November 2001**
Preparatory treatment to cubes (e.g. removal of fins): **None**
Method of Density Determination: C for *Calculated* or W for *Water Displacement*

Specimens were moist cured under damp sacking at our Bangor Laboratory prior to storage in water between 18°C and 22°C until the time of test, unless otherwise noted. Concrete cubes in our receipt for 3 days or less prior to testing are moist at the time of test and the reported mass and density are the concrete in the moist condition. Concrete cubes over 3 days in our receipt prior to testing are saturated at the time of test and the reported mass and density are for concrete in the saturated condition.

We certify that the test has been carried out in accordance with BS 1881: Part 116: 1983

Cube Markings Our Ref	Your	Date Cast	Date of Test	Age at Test	Meas. Dim (mm) Lx BxH	Mass (g)	Density (kg/m3)	Method	Failure Load	Comp. Strength (N/mm2)	Mode of Failure	Appearance of Cube on Receipt
3095	7	27/11/01	30/11/01	3	100x100x100	2012	2015	W	359kN	36.0	Normal	Air Cured
3096	8	27/11/01	04/12/01	7	100x100x100	2011	2015	W	476kN	47.5	Normal	Air Cured
3097	9	27/11/01	07/12/01	10	100x100x100	2018	2020	W	492kN	49.0	Normal	Air Cured
3098	10	27/11/01	11/12/01	14	100x100x100	2011	2015	W	522kN	52.0	Normal	Air Cured
3099	11	27/11/01	27/12/01	30	100x100x100	2038	2020	W	554kN	55.5	Normal	Air Cured
3100	12	27/11/01			-	-	-	C	kN	-	Normal	Air Cured

Specified mix:	Grout - Site Mix		
Actual slump:	N/A	Size of load (m³):	N/A
Location of sampling:	Loading Bay	Ticket no. (if applicable):	N/A
Date and time of sampling:	27/11/01 -	Time and place of making cubes:	at Site
Method of compaction:	Tamping Bar -	Name of person making cubes:	Unknown

Comments
ppearance of cubes on receipt satisfactory unless otherwise stated
A) Poor compaction (B) Honeycombing (C) Bad dimension (D) Damaged surface (E) Damaged corners

E.R. Goulden, Technical Manager

Directors : Eric Goulden, MSc., MBA., C. Eng., Gary J. Jones, B.Sc. (Hons). V.A.T. No. 352-5034-81

CINTEC

Designed Anchor Systems

SPECIFIC PROJECT TEST DATA AND IN HOUSE TEST DATA

77 Howard Street, Toronto, Canada Testing by Halsall and Associates, Toronto Corbel Anchors (May 1992)

Toronto Hydro Building, Canada Testing by Halsall and Associates, Toronto.

Corbel Anchors and RAC wall tie (September 1992).

Botanical Gardens Montreal, Canada Testing of RAC type Anchors by L M Suave (1994).

Real Audencia, san Juan, Puerto Rico.

457 Sussex Drive, Ottawa, Canada.

Manoir Richelieu, Malbaie, QC Canada. Testing in "SIPROX" [low density concrete product].

Nov Electricifcation of British Rail, At Royal Wootton Bassett Wils.

Load test results of in house testing supervised by Peter Sobek Ing.

SECURING THE PAST FOR THE FUTURE

CINTEC ANCHOR TESTING

77 Howard Street, Toronto, Canada

TYPE:

TESTING OF CORBELL ANCHORS

BY:

HALSALL AND ASSOCIATES TORONTO (MAY 1992)

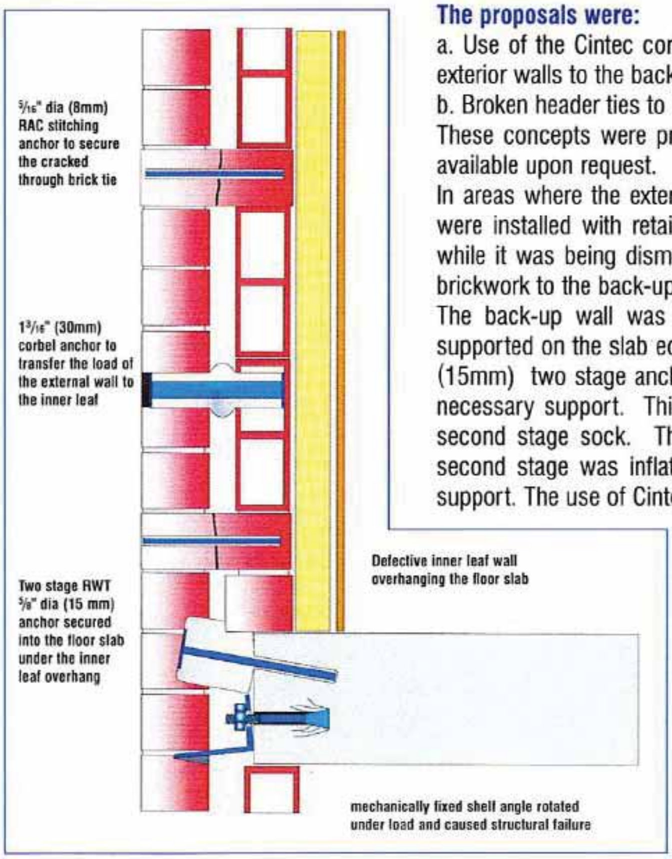
77 Howard Street, Toronto, Ontario, Canada

Exterior wall restoration

This 24-storey apartment block's exterior wall consists of two wythes tied together by courses of header bricks. The exterior wythe is a glazed clay brick and is supported by a painted steel shelf angle connected at each floor into the floor slab. The inner wythe consisted of a 4" (100mm) hollow concrete block back-up wall. Deterioration is due to vertical loads imposed by shortening of the structural frame. Lack of soft joints below the shelf angles to accommodate movement has resulted in;

1. Bowing of walls.
2. Crushing of over stressed units.
3. Shear failure of the header courses.
4. Rotation of shelf angles

Corrosion deterioration has also occurred in the shelf angles and connecting bolts. Due to occupation of the dwellings, complete replacement of the walls was impractical. Thus Halsall Associates in conjunction with Cintec Canada participated in the development of a stabilization strategy.



The proposals were:

a. Use of the Cintec corbel anchor to transfer vertical loads from the exterior walls to the back-up walls.

b. Broken header ties to be restored using Cintec stitching anchors.

These concepts were proven with full laboratory load tests. Results available upon request.

In areas where the exterior walls were beyond repair, Cintec anchors were installed with retaining plates to prevent collapse of the panel, while it was being dismantled. The anchor was used to tie the new brickwork to the back-up wall.

The back-up wall was found, during construction, to be not fully supported on the slab edge at some locations. A special RWT, 5/8" dia (15mm) two stage anchor was designed and supplied to provide the necessary support. This special two-stage anchor had an oversized second stage sock. This was secured into the floor slab, and the second stage was inflated under the inner leaf overhang to provide support. The use of Cintec anchors thus provided stabilization and repair on this project, without disturbance or relocation of the tenants.

Conclusions of the Test Report:

The test assembly failed by crushing of the concrete block interior (back-up) wythe at the corbel anchors. The observed failure load of 10.3 Kn (2295 lb) exceeded the design (service) load of 2.85 Kn (636 lb) by a factor of 3.6.

Engineers
Halsall Associates, Toronto, Ontario, Canada

Contractors
Maxim Group General Contractors, Concord, Ontario, Canada

T Howard 3'

TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED
FOR: CINTEC CANADA
COMPONENT SUPPLIER: CINTEC CANADA

PAGE 1 OF 9
PROJECT NO.: 92x722C
DATE: 21 MAY, 1992

LOAD TEST DATA

ROBERT HALSALL
AND ASSOCIATES LIMITED
CONSULTING ENGINEERS

TEST PERFORMED BY:	ROBERT HALSALL AND ASSOCIATES LTD.
PROJECT NO.:	92x722C
LOCATION:	BURLINGTON, ONTARIO, CANADA
DATE:	21 MAY, 1992
CLIENT:	CINTEC CANADA
TEST COMPONENT SUPPLIER:	CINTEC CANADA

CINTEC
CANADA LTD.

COMPONENT DESCRIPTION:

Cintec Harke Cementitious Corbel and Stitching Grout Anchors.

OBJECT:

To determine the load carrying capacity in vertical shear of a masonry exterior wall system using CINTEC injection anchors to tie the two wythes together and to transfer gravity load of the exterior wythe to the interior (back-up) wythe.

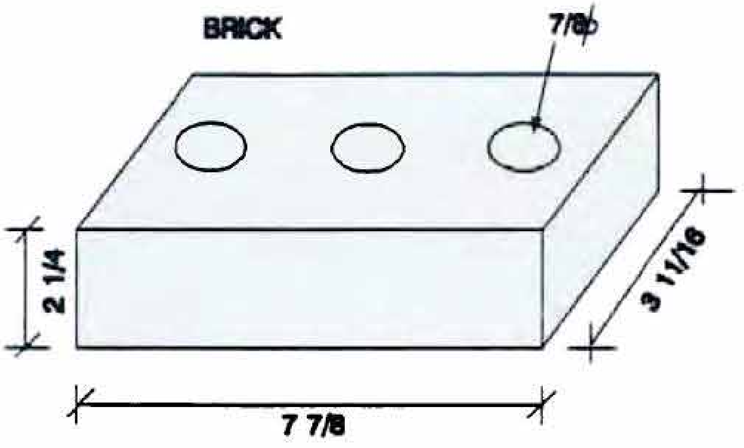
CONCLUSIONS:

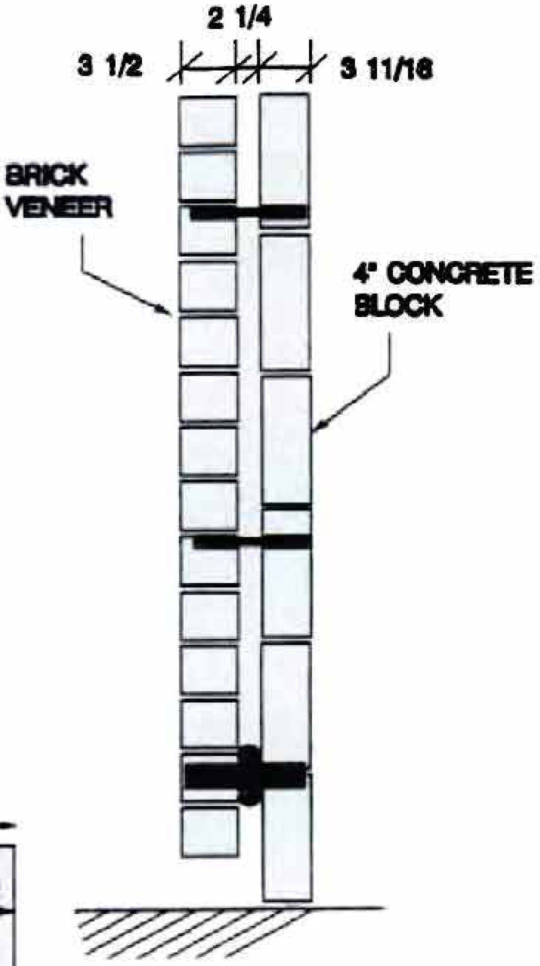
The test assembly failed by crushing of the concrete block interior (back-up) wythe at the corbel anchors. The observed failure load of 10.3 Kn (2295 lb) exceeded the design (service) load of 2.85 Kn (636 lb) by a factor of 3.6.

Test witnessed by: Eric P. Jokinen, P.Eng.

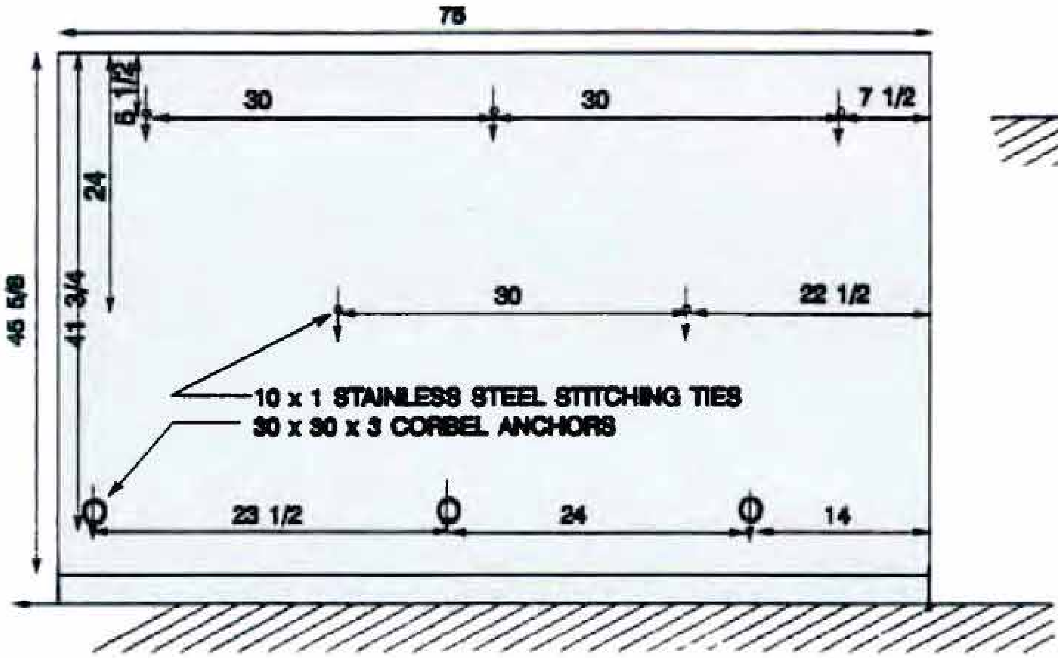
Report prepared by: Eric P. Jokinen, P.Eng.

ERIC P. JOKINEN



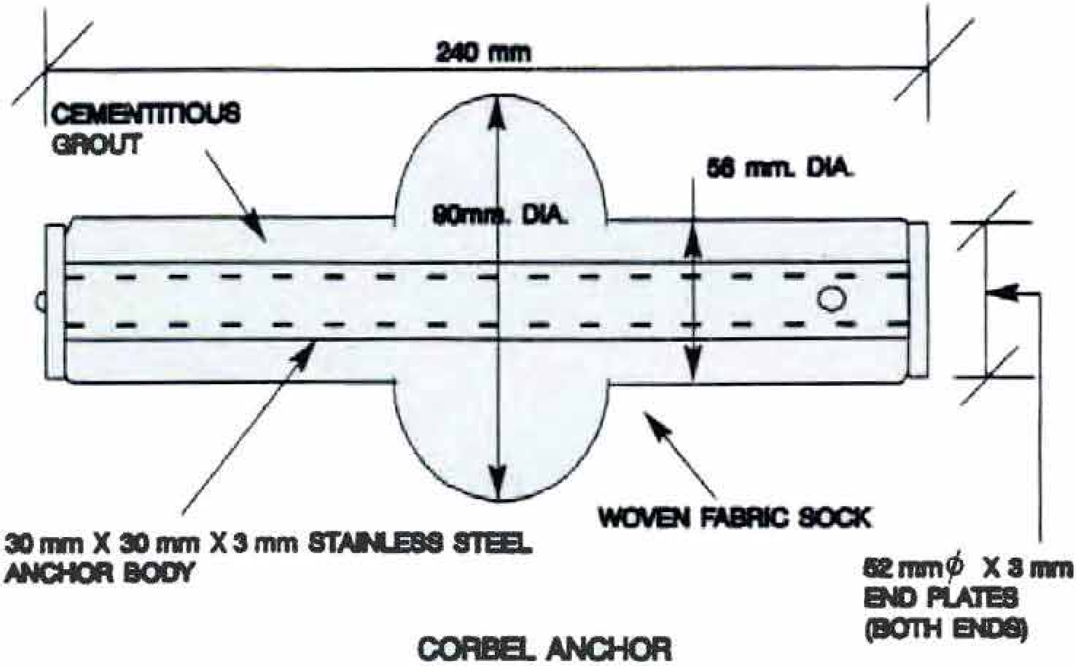


TEST WALL SECTION

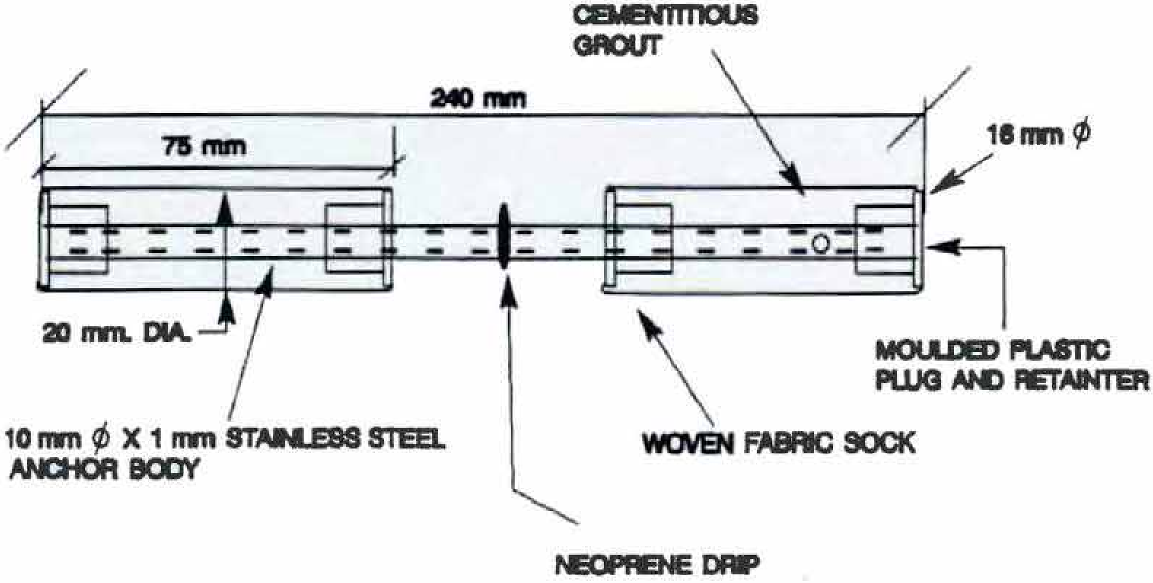


ANCHOR LAYOUT

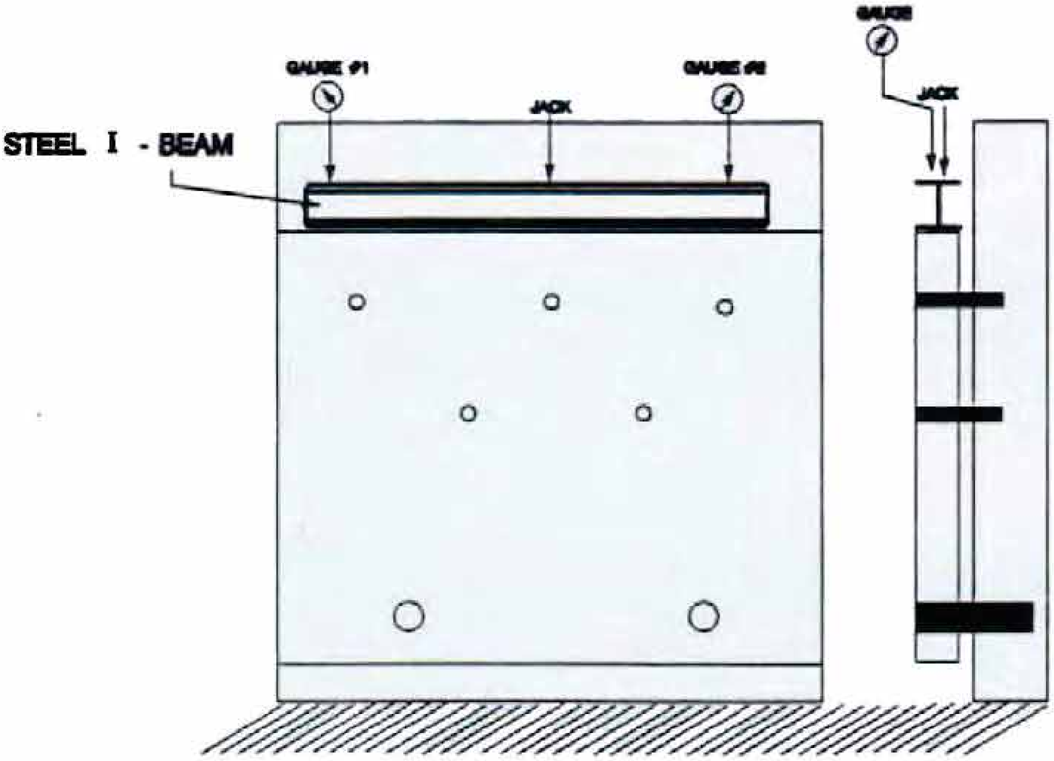
ALL MEASUREMENTS IN INCHES



CORBEL ANCHOR

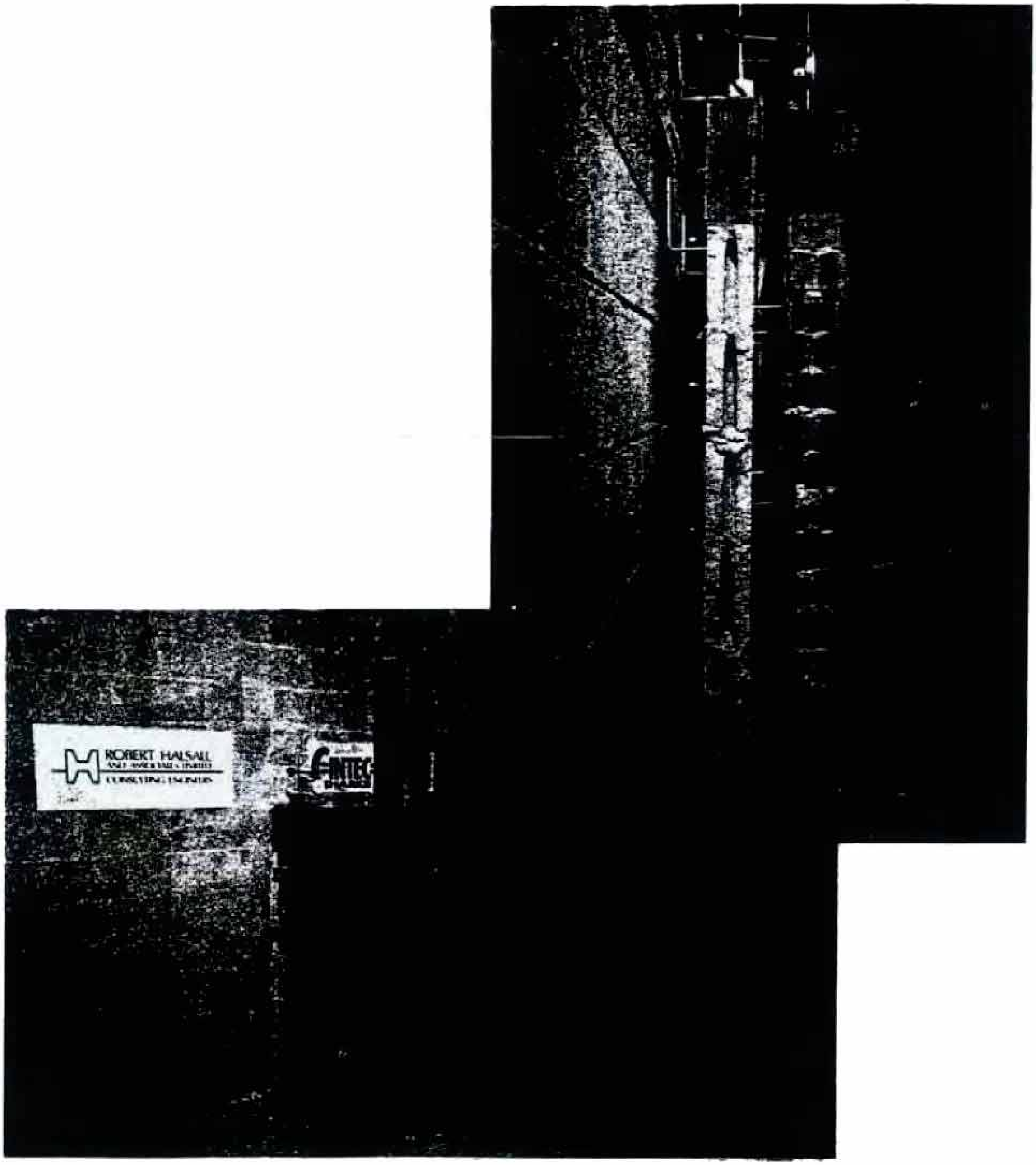


STITCHING ANCHOR



TEST SET-UP

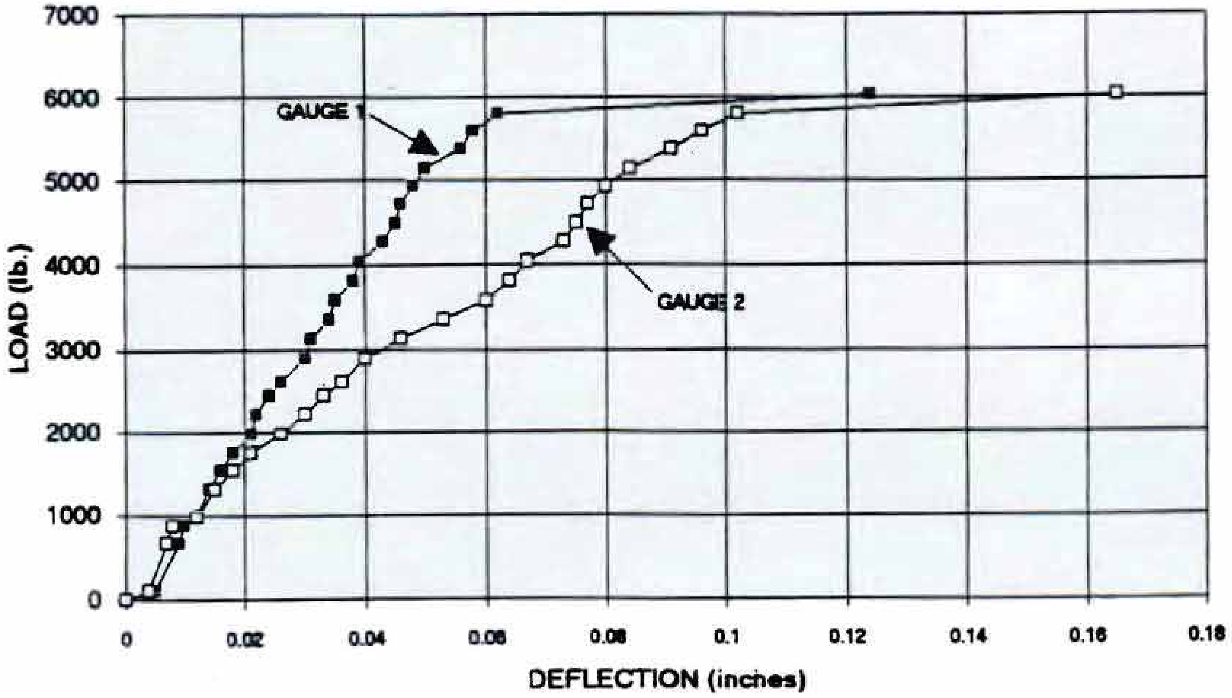
TEST SET UP PHOTOGRAPHS



TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED
FOR: CINTEC CANADA
COMPONENT SUPPLIER: CINTEC CANADA

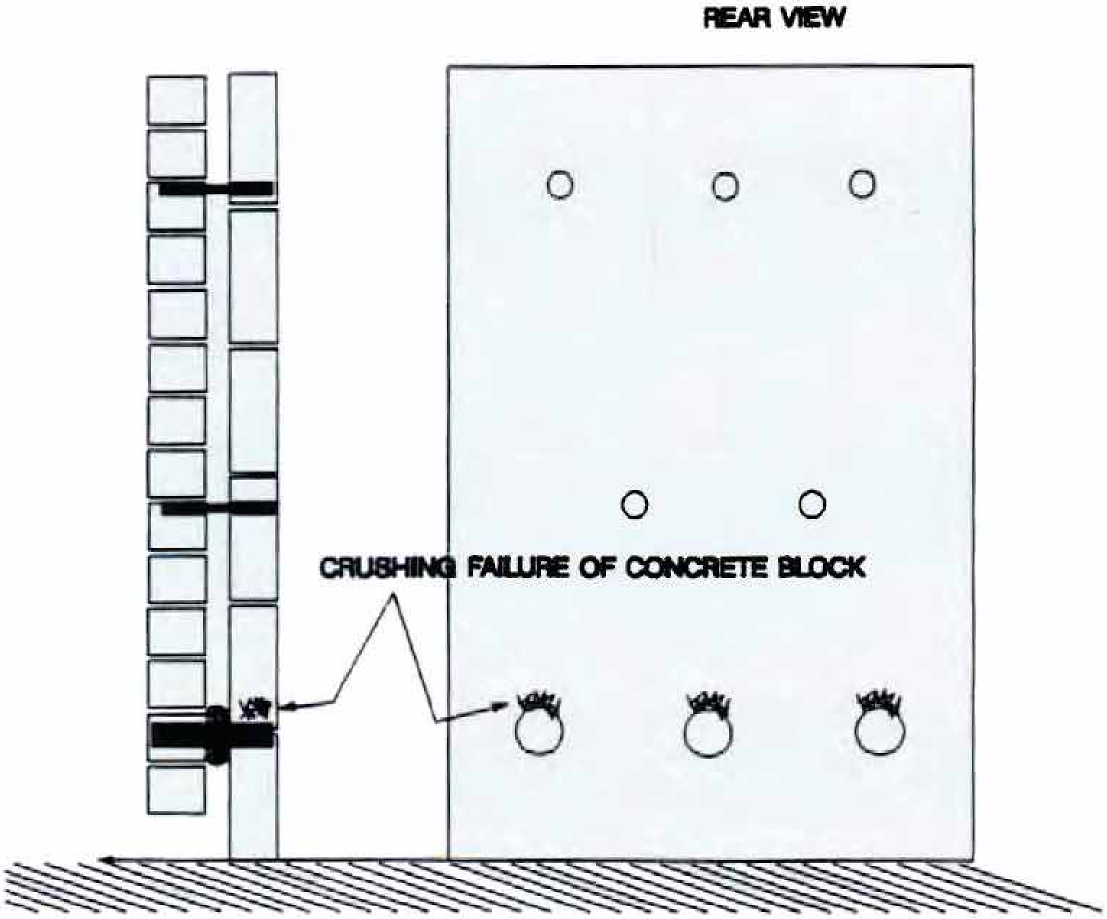
PAGE 6 OF 9
PROJECT NO.: 92x722C
DATE: 21 MAY, 1992

P (lb.)	DEFLECTION GAUGE 1 (in)	DEFLECTION GAUGE 2 (in)
0	1.600	1.600
109	1.595	1.596
656	1.591	1.593
875	1.590	1.592
984	1.588	1.588
1313	1.586	1.585
1531	1.584	1.582
1750	1.582	1.579
1979	1.579	1.574
2208	1.578	1.570
2437	1.576	1.567
2606	1.574	1.564
2895	1.570	1.560
3125	1.569	1.554
3353	1.566	1.547
3582	1.565	1.540
3811	1.562	1.536
4040	1.561	1.533
4260	1.557	1.527
4480	1.555	1.525
4700	1.554	1.523
4920	1.552	1.520
5140	1.550	1.516
5360	1.544	1.509
5580	1.542	1.504
5800	1.538	1.498
6020	1.476	1.435



TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED
FOR: CINTEC CANADA
COMPONENT SUPPLIER: CINTEC CANADA

PAGE 7 OF 9
PROJECT NO.: 92x722C
DATE: 21 MAY, 1992



FAILURE MODE

LOAD PER ANCHOR AT FAILURE = 8.93 Kn (2007#)
DESIGN (SERVICE) LOAD PER ANCHOR FOR THIS TEST
ASSEMBLY = 2.85 Kn (636#)

TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED
FOR: CINTEC CANADA
COMPONENT SUPPLIER: CINTEC CANADA

PAGE 8 OF 9
PROJECT NO.: 92x722C
DATE: 21 MAY, 1992

MORTAR CUBE COMPRESSIVE STRENGTH

SPECIMEN		P(N)	DIMENSIONS (mm)	COMPRESSIVE STRENGTH (MPa)	AGE AT TEST
BLOCK WALL MORTAR	A1	12900	50.4 x 49.3	5.2	
	A2	13800	49.8 x 50.0	5.5	
	A3	12800	51.2 x48.95	5.1	
			AVERAGE:	5.3 MPa = 768 psi	@ 15 DAYS
BRICK WALL MORTAR	B1	20700	49.7 x 50.0	8.3	
	B2	25700	49.2 x 50.2	10.4	
	B3	24100	50.2 x 49.6	9.7	
			AVERAGE:	9.5 MPa = 1,380 psi	@ 14 DAYS
CINTEC ANCHORS GROUT	C1	111750	50.0 x 50.5	44.3	
	C2	107250	50.0 x 50.8	42.2	
	C3	110500	50.0 x 50.4	43.8	
			AVERAGE:	43.4 MPa = 6,295 psi	@ 5 DAYS

MORTAR CUBES

CUBES A1, A2, A3
CAST: 5 MAY, 1992 4:20PM TESTED: 20 MAY, 1992
MIX 1 PART TYPE 'S' MASONRY CEMENT (LAKE ONTARIO CEMENT)
3 PARTS CLEAR BRICK SAND
CLEAN TAP WATER

MIX 1/2 HOUR OLD AT TIME OF CASTING, MORTAR USED FOR BOTTOM 5 COURSES OF CONCRETE BLOCK WALL, D PALMOLIVE DISH DETERGENT RELEASE AGENT IN FORMS, CUBES REMOVED FROM FORM AT 11:00PM, 5 MAY, 1992, AND LEFT ON FLOOR OF LAB TO CURE

CUBES B1, B2, B3
CAST: 6 MAY, 1992 1:30PM TESTED: 20 MAY, 1992
MIX: SAME AS 1st SET
MORTAR NEWLY MADE; USED FOR BOTTOM 5 COURSES OF CONCRETE BLOCK WALL
CUBES REMOVED FROM FORM AT 7:00PM

CUBES C1, C2, C3
CAST: 15 MAY, 1992 11:00AM TESTED: 20 MAY, 1992
GROUT FOR CINTEC ANCHOR

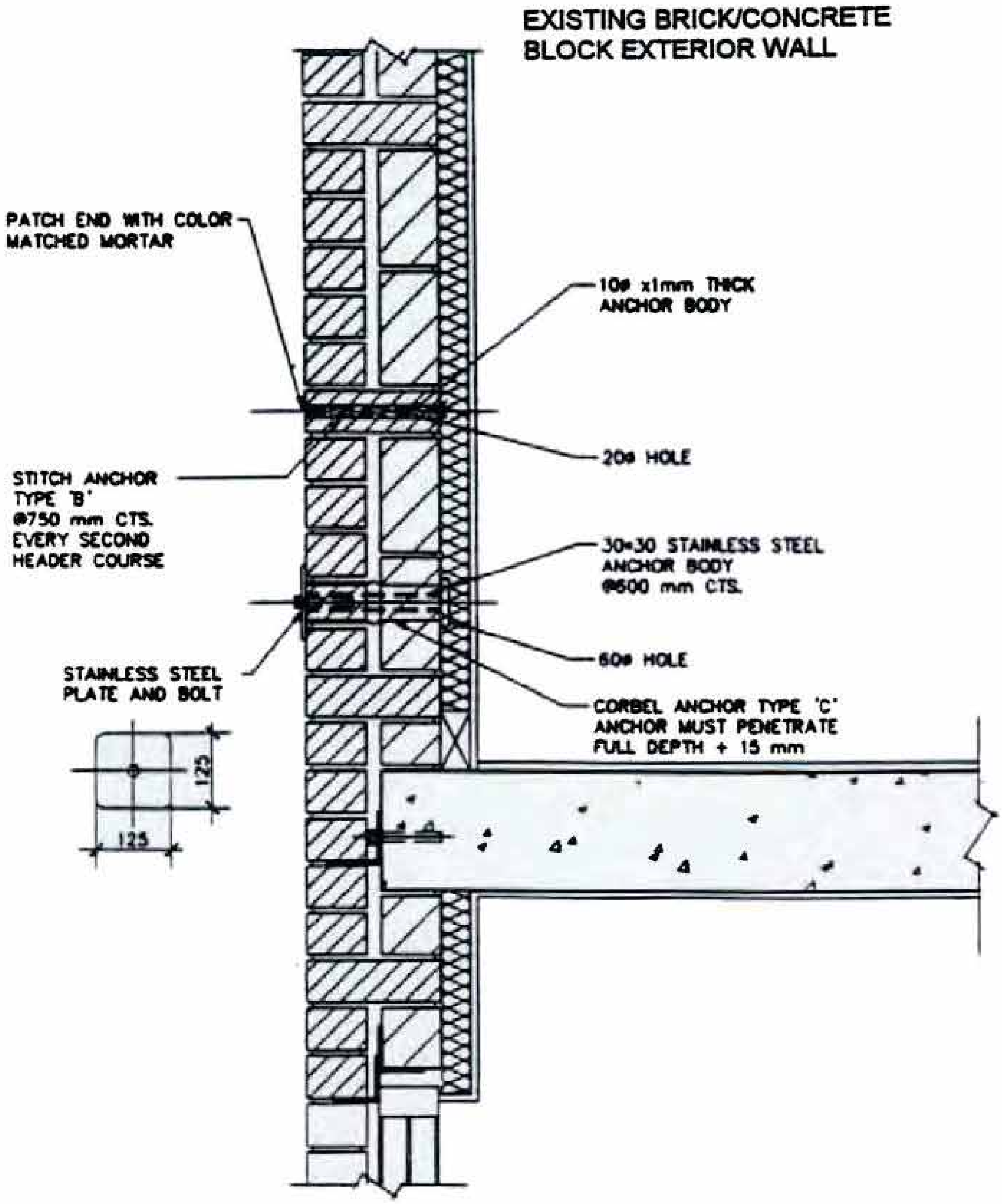
BRICK VENEER DENSITY MEASUREMENT

1. REPRESENTATIVE SECTION OF BRICK VENEER
Represents 0.082 sq.m. of wall = 0.880 s.f.
Weight = 14.70 kg (32.93#)
Calculated Weight / Surface Area of Wall:
179.27 kg/sq.m or 37.42 p.s.f.

2. INDIVIDUAL BRICK USED IN TEST INSTALLATION
Represents 0.013 sq.m of wall = 0.138 s.f
Weight = 2.0 kg (4.48#)
Calculated Weight / Surface Area of Wall:
153.85 kg/sq.m or 36.46 p.s.f.

TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED
FOR: CINTEC CANADA
COMPONENT SUPPLIER: CINTEC CANADA

PAGE 9 OF 9
PROJECT NO.: 92x722C
DATE: 21 MAY, 1992



PROPOSED ANCHOR APPLICATION

CINTEC ANCHOR TESTING

Toronto Hydro Building Canada

TYPE: TESTING OF CORBELL ANCHORS FOR SHEAR LOADS

BY: HALSALL AND ASSOCIATES (SEPTEMBER 1992)

Toronto Hydro Building, Toronto

LOAD TEST DATA

TEST PERFORMED BY: ROBERT HALSALL AND ASSOCIATES LTD.
PROJECT NO.: 92x713C

LOCATION: BURLINGTON, ONTARIO, CANADA
DATE: 9 SEPTEMBER, 1992

CLIENT: TORONTO HYDRO

TEST COMPONENT SUPPLIER: CINTEC CANADA

COMPONENT DESCRIPTION:

Cintec Harke Cementitious Corbel and Stitching Grout Anchors.

OBJECT:

To determine the load carrying capacity in vertical shear of a masonry exterior wall system using CINTEC injection anchors to tie the two wythes together and to transfer gravity load of the exterior wythe to the interior (back-up) wythe.

CONCLUSIONS:

The test assembly failed by a flexural bond failure in the interior (back-up) wythe. The observed failure load of 40.6 Kn (9130 lb) exceeded the design (service) load of 5.67 Kn (1274 lb) by a factor of 7.2.

The ultimate shear capacity of the anchors could not be determined as the wall assembly failed prior to reaching the failure load of the anchors.

Test witnessed by: Eric P. Jokinen, P.Eng.

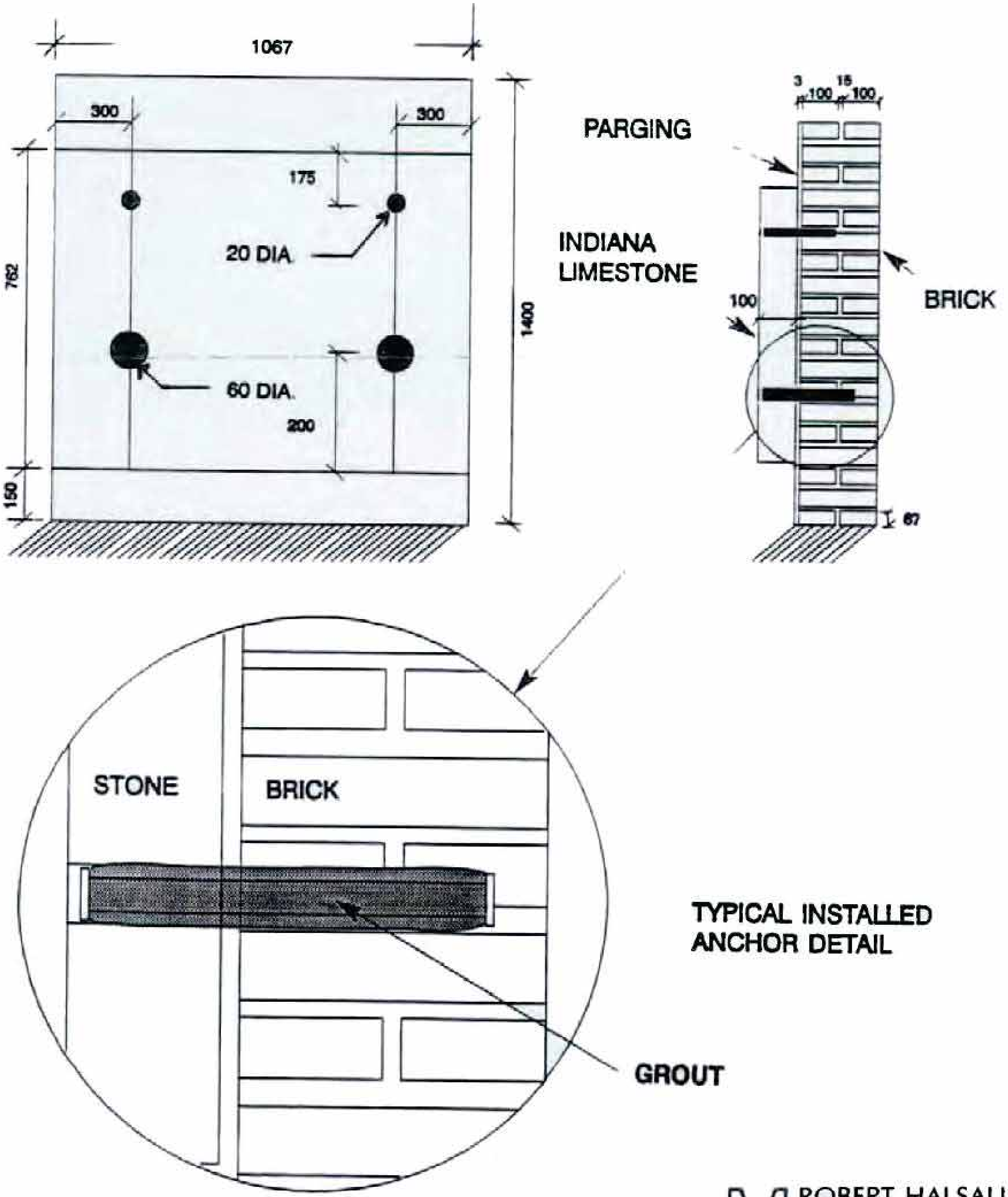
Report prepared by: Eric P. Jokinen, P.Eng.

LICENSED PROFESSIONAL ENGINEER
ERIC P. JOKINEN
PROVINCE OF ONTARIO

TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED
FOR: TORONTO HYDRO
COMPONENT SUPPLIER: CINTEC CANADA

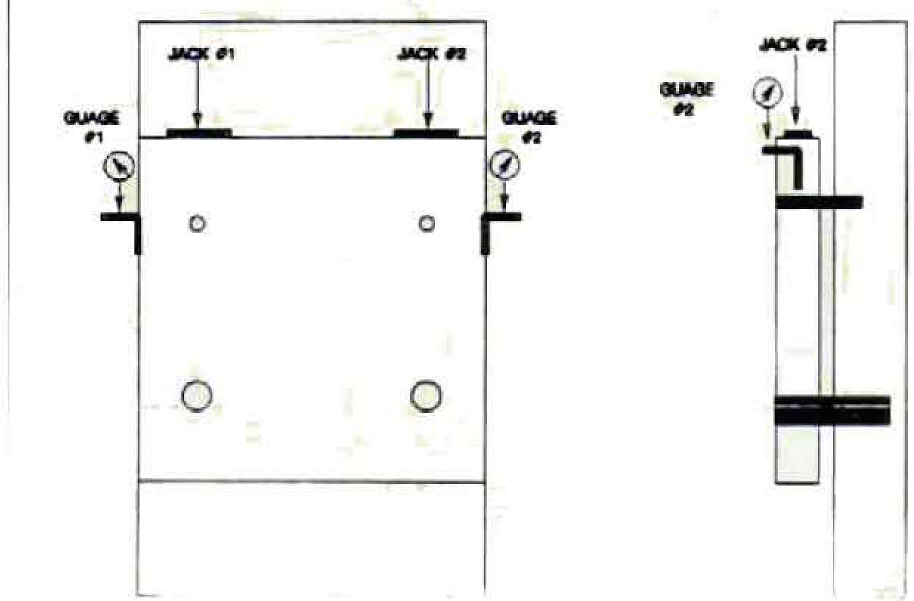
Page 2 of 8
PROJECT NO.: 92x713C/a
DATE: 9 SEPTEMBER, 1992

TEST ASSEMBLY DRAWINGS (all measurments in mm):



TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED Page 3 of 8
FOR: TORONTO HYDRO PROJECT NO.: 92x713C/a
COMPONENT SUPPLIER: CINTEC CANADA DATE: 9 SEPTEMBER, 1992

TEST SET-UP

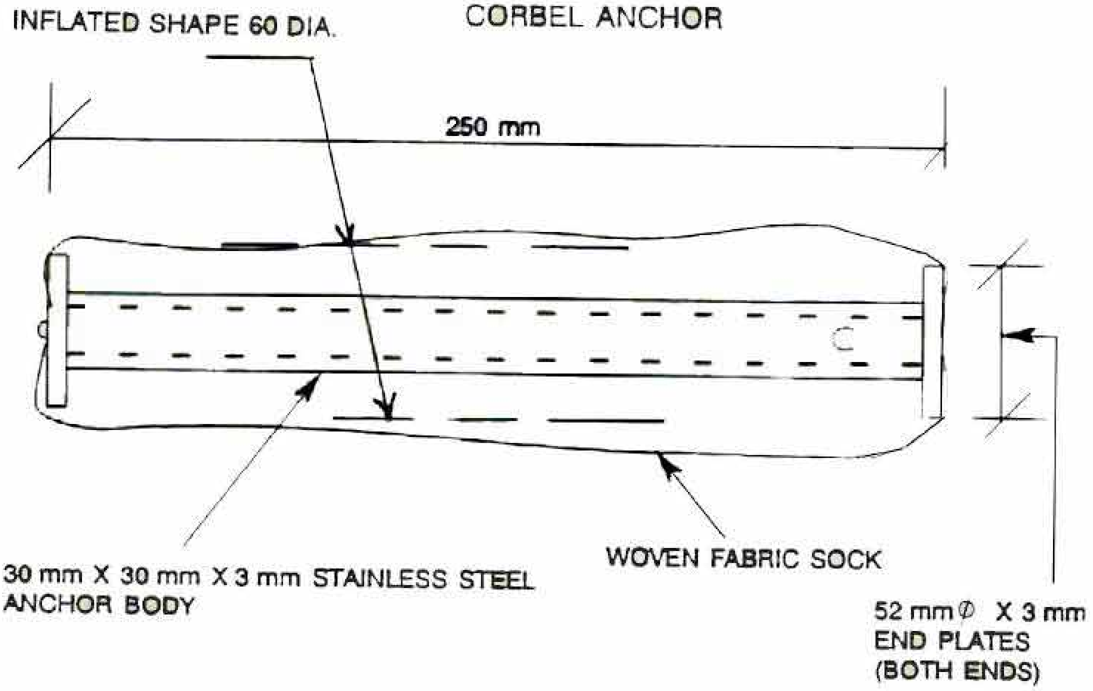


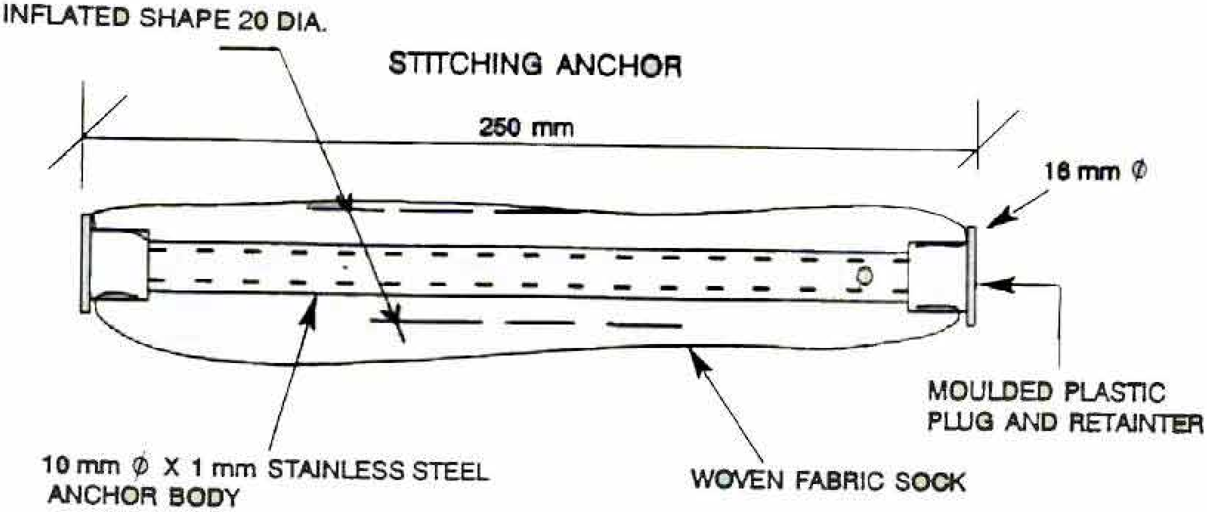
TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED Page 4 of 8
FOR: TORONTO HYDRO PROJECT NO.: 92x713C/a
COMPONENT SUPPLIER: CINTEC CANADA DATE: 9 SEPTEMBER, 1992

TEST SET-UP PHOTO

TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED
FOR: TORONTO HYDRO
COMPONENT SUPPLIER: CINTEC CANADA

Page 5 of 8
PROJECT NO.: 92x713C/a
DATE: 9 SEPTEMBER, 1992



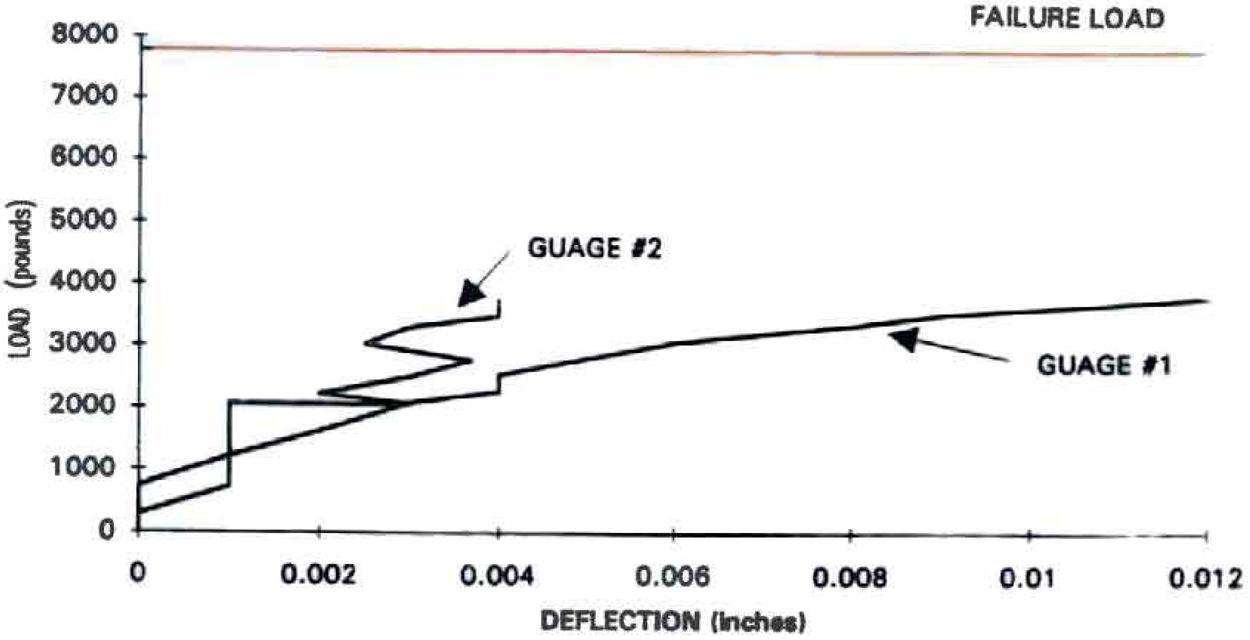


TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED Page 6 of 8
FOR: TORONTO HYDRO PROJECT NO: 92x713C/a
COMPONENT SUPPLIER: CINTEC CANADA DATE: 9 SEPTEMBER, 1992

LOAD TEST

LOAD (pounds)		DEFLECTION (in)	
JACK #1	JACK #2	GUAGE #1	GUAGE #2
0	0	0	0
279	275	0	0
729	720	0	0.001
1215	1200	0.001	0.001
1620	1600	0.002	0.001
2070	2044	0.003	0.001
2070	2044	0.003	0.003
2250	2222	0.004	0.002
2520	2489	0.004	0.003
2790	2755	0.005	0.0037
3060	3022	0.006	0.0025
3330	3289	0.008	0.003
3510	3467	0.009	0.004
3780	3733	0.012	0.004

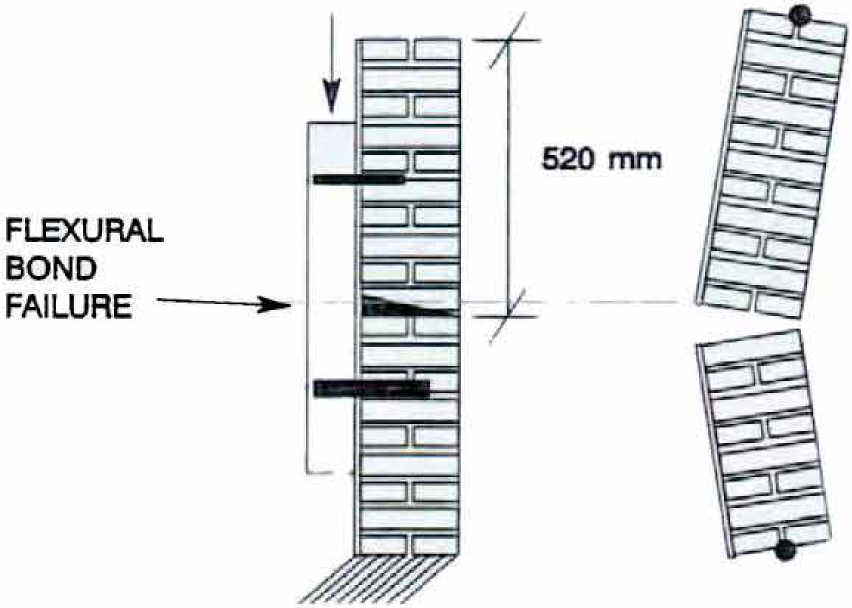
FAILURE LOAD 15,518 POUNDS TOTAL ON 2 JACK'S



ROBERT HALSALL AND ASSOCIATES LIMITED
CONSULTING ENGINEERS

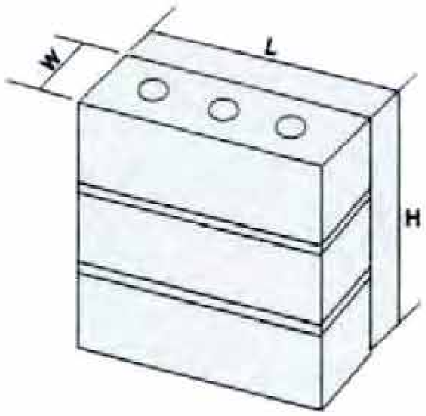
TEST BY: ROBERT HALSALL AND ASSOCIATES LIMITED Page 7 of 8
FOR: TORONTO HYDRO PROJECT NO.: 92x713C/a
COMPONENT SUPPLIER: CINTEC CANADA DATE: 9 SEPTEMBER, 1992

FAILURE MODE:



LOAD PER ANCHOR
AT FAILURE = 35.5 Kn
(7989#)

DESIGN (SERVICE)
LOAD PER ANCHOR
FOR THIS TEST
ASSEMBLY = 4.95 Kn
(1115#)



TYPICAL PRISM

- PRISMS WERE CUT FROM TEST WALL
- PRISM ENDS WERE CAPPED WITH HYDROSTONE CEMENT

PRISM #	L	H	W	LOAD	COMPRESSIVE STRESS	
					(psi)	(MPa)
1	8.5"	8.25"	3.875"	116,500	3537	24.4
2	8.375"	8.25"	3.875"	103,500	3189	22.0
3	6.5"	8.25"	4"	89,000	3423	23.6
				AVG	3383	23.3

TESTS PERFORMED BY McMASTER UNIVERSITY, HAMILTON, ONTARIO

PRISMS MADE: 20 AUGUST, 1992
TESTED: 22 OCTOBER, 1992
AGE: 63 DAYS

CINTEC GROUT CUBE COMPRESSION TEST:

CUBE	COMPRESSIVE STRENGTH
A	35.5 MPa
B	34.0 MPa
C	37.1 MPa
AVG	35.5 MPa = 5148 PSI @ 11 DAYS

50 mm CUBES CAST 28 AUGUST, 1992; TESTED 8 SEPTEMBER, 1992 BY J.T. DONALD CONSULTANTS LTD.

STONE DENSITY MEASUREMENT

SAMPLE: 12" x 12" x 2.25" INDIANA GREY LIMESTONE
MEASURED WEIGHT: 11.8 Kg = 26 lbs
DENSITY: 2354 Kg/cm = 147 PCF

CINTEC ANCHOR TESTING

Botanical Gardens

Botanical Gardens Montreal Canada

TYPE:

RAC (10MM X 1 CHS – [3/8” DIA CHS])

TESTING ENGINEERS:

JASMIN TRUDEL ING. LM SAUVÉ (1994)

L.M. SAUVÉ (1964) Limitée

St-Léonard, May 4th, 1994

Monsieur François Robert
Gestionnaire de projet - Ville de Montréal
Services de l'Approvisionnement et des immeubles
Module des services professionnels immobiliers
Division programmes et projets
385, rue Sherbrooke est
Montréal (Québec) - H2X 1E3

Subject: **Montreal's Botanical Garden**

Sir,

You will find, included, a copy of the results obtained after some tests were done on the anchor's traction CINTEC/HARKE.

We would like to point out that the weakest results obtained are shown on tests Nos. 5, 6 and 7. Please take note that these tests were performed on the roof level where the masonry joints are totally damaged. We have to take into consideration the weakness of the terra-cota in that zone.

Hoping you will find everything to your satisfaction, we remain,

Yours truly,

L.M. SAUVÉ (1964) LIMITÉE
A Sauvé Group Company

Jasmin Trudel

Jasmin Trudel, Ing. Jr.
Project manager

Encl.

JT/gl

COMPANY ADDRESS

L.M. SAUVE
8305 LAFRENAIE
329-3399

TEST ANCHORS & RESULTS

DATE 94 5 14.

SITE ADDRESS

JARDIN BOTANIQUE
DE MONTRÉAL

TEST REQUIRED	TEST NO	INSTALL TIME	TYPE OF ANCHOR	LOAD REQUIRED	LOAD ACHEIVED	BASE MATERIAL	SOCK IMBEDMENT	SOCK DIAMETER	PULLOUT TIME
JARDIN	1	27/4/94			11 KN	2400 LBS	10.5 POUCES		29/4/94
BOTANIQUE	2	"			9.5 KN	2000 LBS	"		2/5/94
	3	"			13.1 KN	2900 LBS	"		"
	4	"			11 KN	2400 LBS	"		"
	5	"			7.6 KN	1650 LBS	"		"
	6	"			5.5 KN	1200 LBS	"		"
	7	"			5.0 KN	1100 LBS	"		"

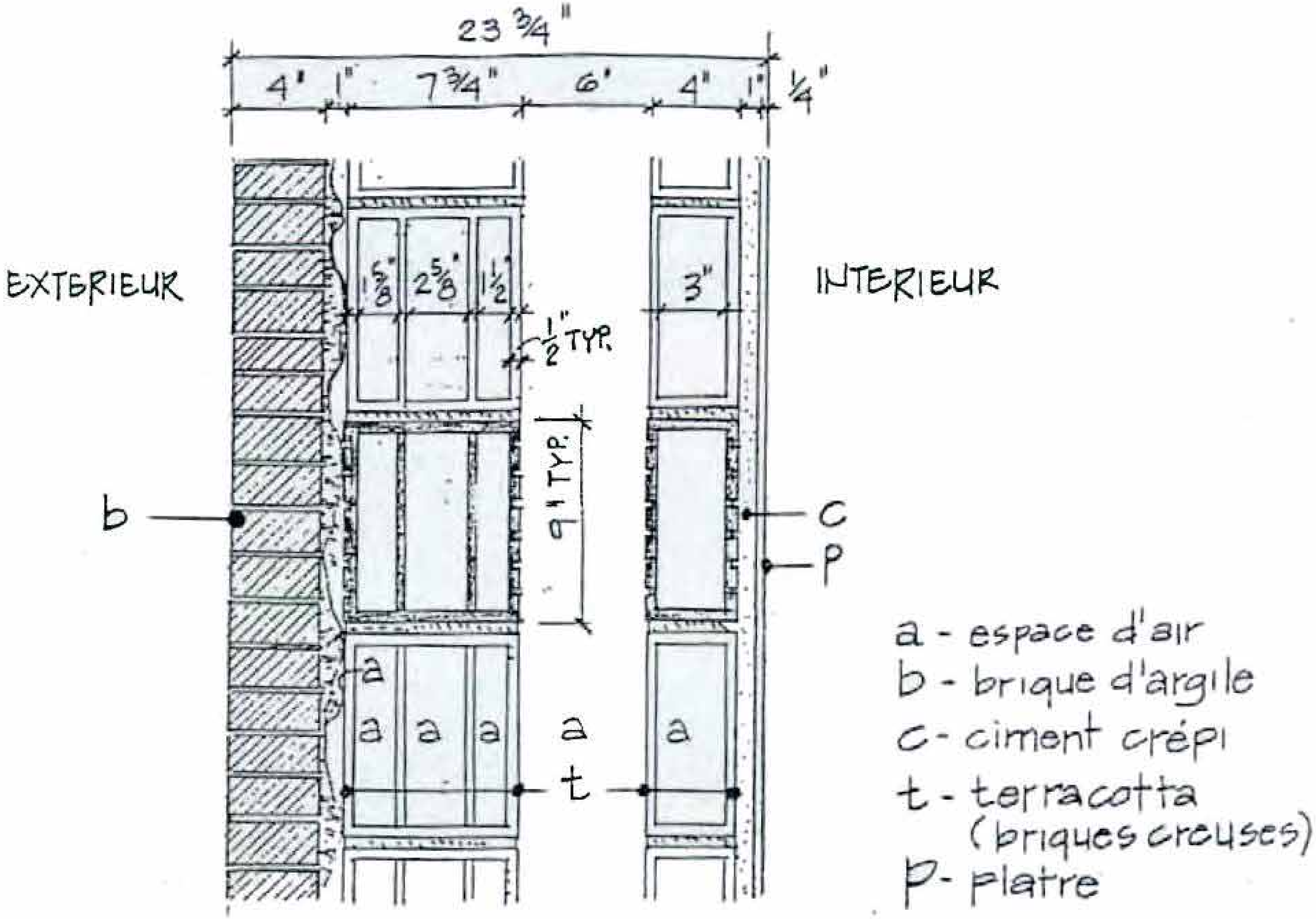
PERSONS PRESENT ON TEST/DEMONSTRATION

PRINT NAME	COMPANY	POSITION	PHONE NUMBER
JASMIN TRUDEL	L.M. SAUVE.	DIRECTEUR DE PROJET	329-3399

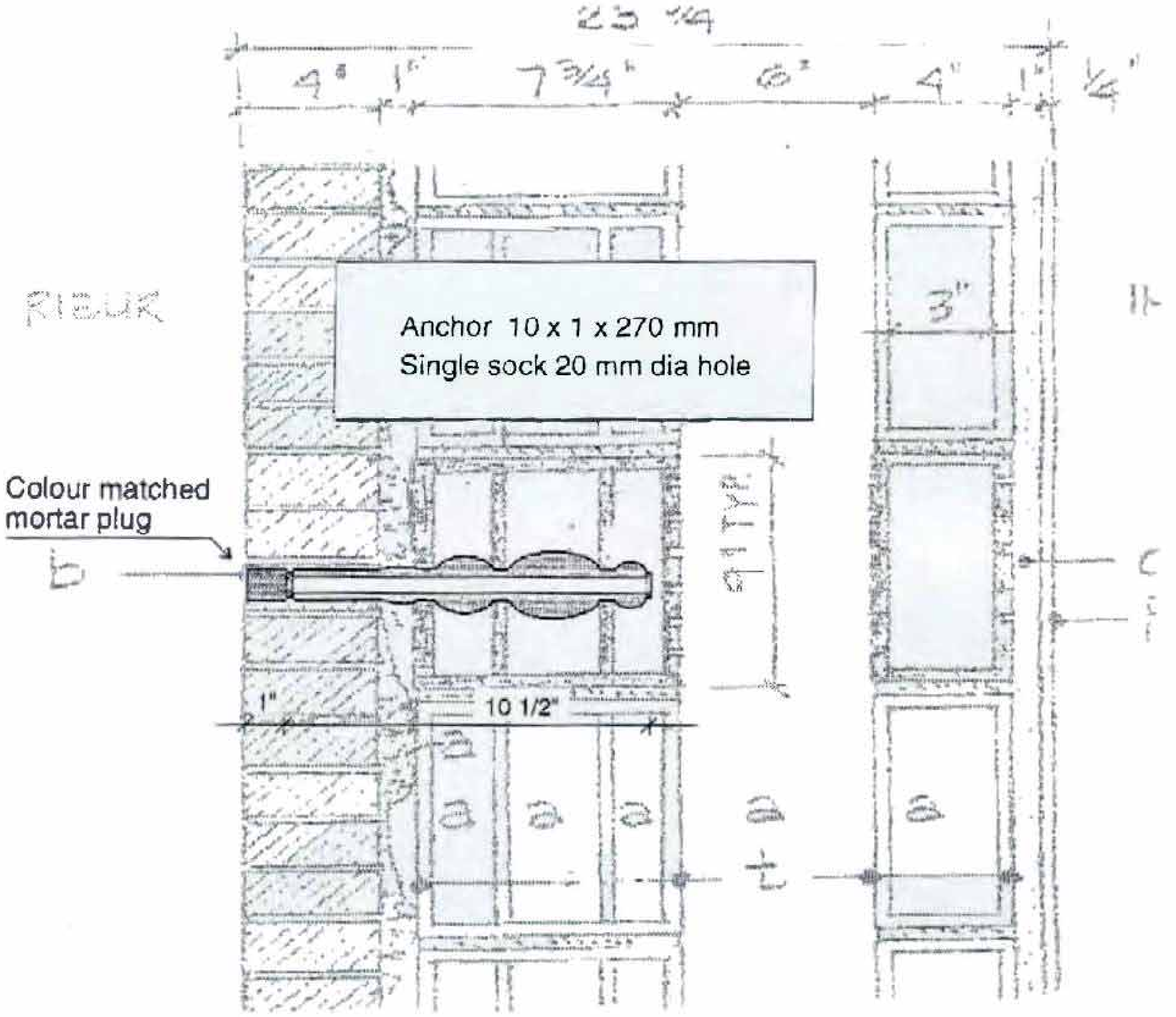
COMMENTS

SIGNED Jasmin Trudel ing. jr.
FOR & ON BEHALF OF CAVITY LOCK SYSTEMS LTD.
POSITION :-

SIGNED
FOR & ON BEHALF OF Ville de Montréal
POSITION :-



MUR TYPE I (TYMPAN)

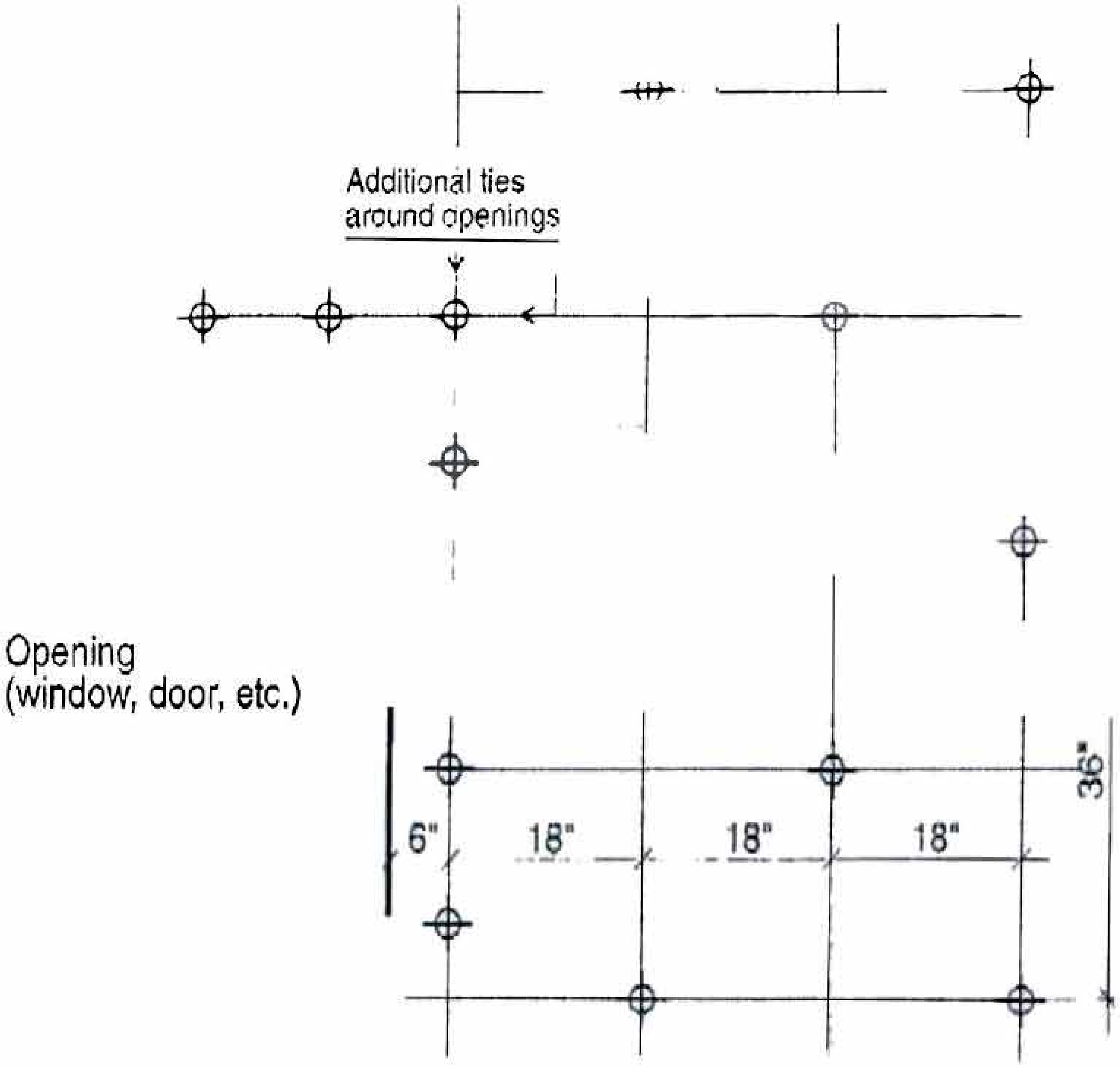


Anchor 10 x 1 x 270 mm
Single sock 20 mm dia hole

Colour matched mortar plug

Anchor Layout

18 x 36system



CINTEC ANCHOR TESTING

In-house Testing
Real Audencia, San Juan, Puerto Rico

TYPE:

AXIAL PULL TESTS (1995)

Test Report
on Axial Pull Tests on Inflated Cintec Anchors

Project:	Real Audencia Fortaleza Street
Location:	San Juan, P.R.
Client:	Government of Puerto Rico State Historic Office La Fortaleza San Juan, P.R. 00901
Architect:	Roca and Associates 253 Fortaleza Street 4th Floor San Juan, P.R. 00902-2876
Engineer:	Wigberto Ponton Consulting Engineer 509 Sagrado Corazon Street Santurce, P.R. 00915
Contractor:	Redondo Construction GPO Box 4185 San Juan, P.R. 00936
Testing:	Robert Lloyd-Rees, F.F.B. Cavity Lock Systems Ltd.

Introduction

The property constructed in approximately 1710 os built of Calicanto [sand, limestone and brick rubble] and has been left derilect in recent years pending restoration. The roof was the original roof structure but was covered with temporary metal sheet finish. We understand that the property is a "listed Historic Building" and is to be restored. Following periods of torential rainfall and a minor earthquake on Friday 27th October sections of the roof together with sections of the walls collapsed. Following a site inspection on Tuesday 31st October the following test procedures were agreed.

Test procedures: [NB - All directions are based on facing the building from outside]

Front right hand room - Left hand partition wall. A core sample of the full depth of the wall was taken in order to determine the strength of the Calicanto.

Front wall: 7 N° Cintec Anchors type RCT [rigid circular tie] 10 x 1 x 203mm '3/8"⊘ x 8" long] with single sock and 10 x 1 x 203 [3/8"⊘ x 8"] with two 76mm [3"] socks were inserted in 20mm [3/4"] ⊘ holes which had been cleared of all loose debris and had been prewetted. At 1300hrs Atlantic time, Wednesday November 1st 1995 a batch of grout was made comprising 12.5kg of Presstec grout mixed with 3 litres of portable water. The anchors were then injected with the grout mix until it was evident that the front section of the sock was fully inflated. The injection nozzle was then held in place for a further ten (10) seconds. At the same time 3 test cubes of grout were taken. The first being taken before the injection of anchors, the second during and the third after, the anchors had been injected.

Testing

The testing took place on Friday November 3rd 1995 at 10:00hrs some 45hrs after the anchors had been inflated in the presence of Eric Jokinen and Alexis Ocasio both being engineers.

Testing Equipment

Hilti MKV comprising standard 150mm long load spreading bridge, tester with interchangeable gauges [0 - 20kN]. Copy of original calibration certificate dated 28th June 1995 for gauges ref. HT94B2 and HT94B1. For the tests gauge HT94B1 was used.

Test Procedure

The load is applied on the anchor using a hilti tester (loading jack) with appropriate gauge attached. The anchor is connected to the loading jack through a threaded bar, nuts and washers.

The testing jack is supported on a load spreading bridge with 3 legs resting on the wall surface.

When the knob on the jack is turned the jack applies a load to the anchor. The load applied is related to the pressure indicated by the pressure gauge attached to the jack.

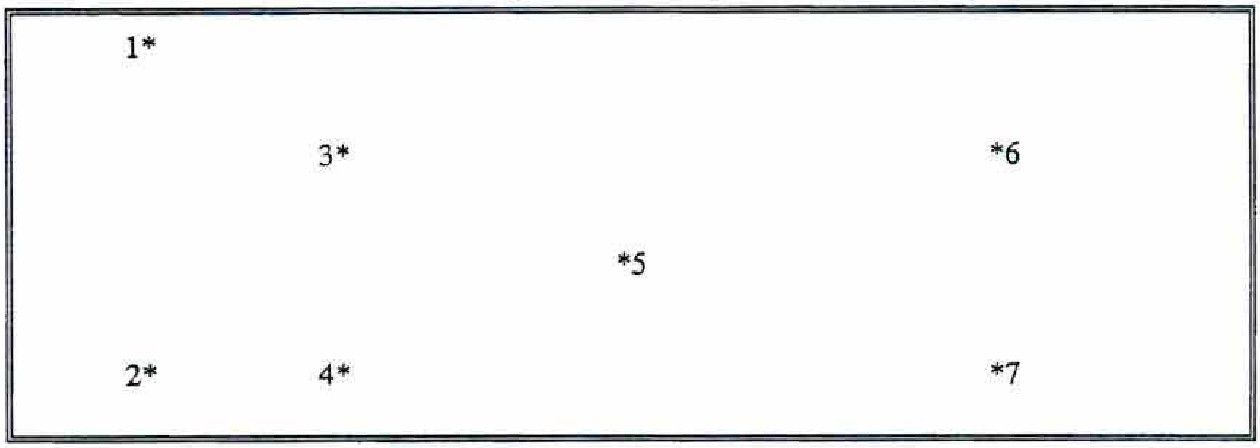
The load is to be applied in increments of 220lbs (1kN). The load at each increment to be held for one minute and the anchor to be observed for any indications of failure.

Load
Anchors to be tested to failure/20kN.

Test Results

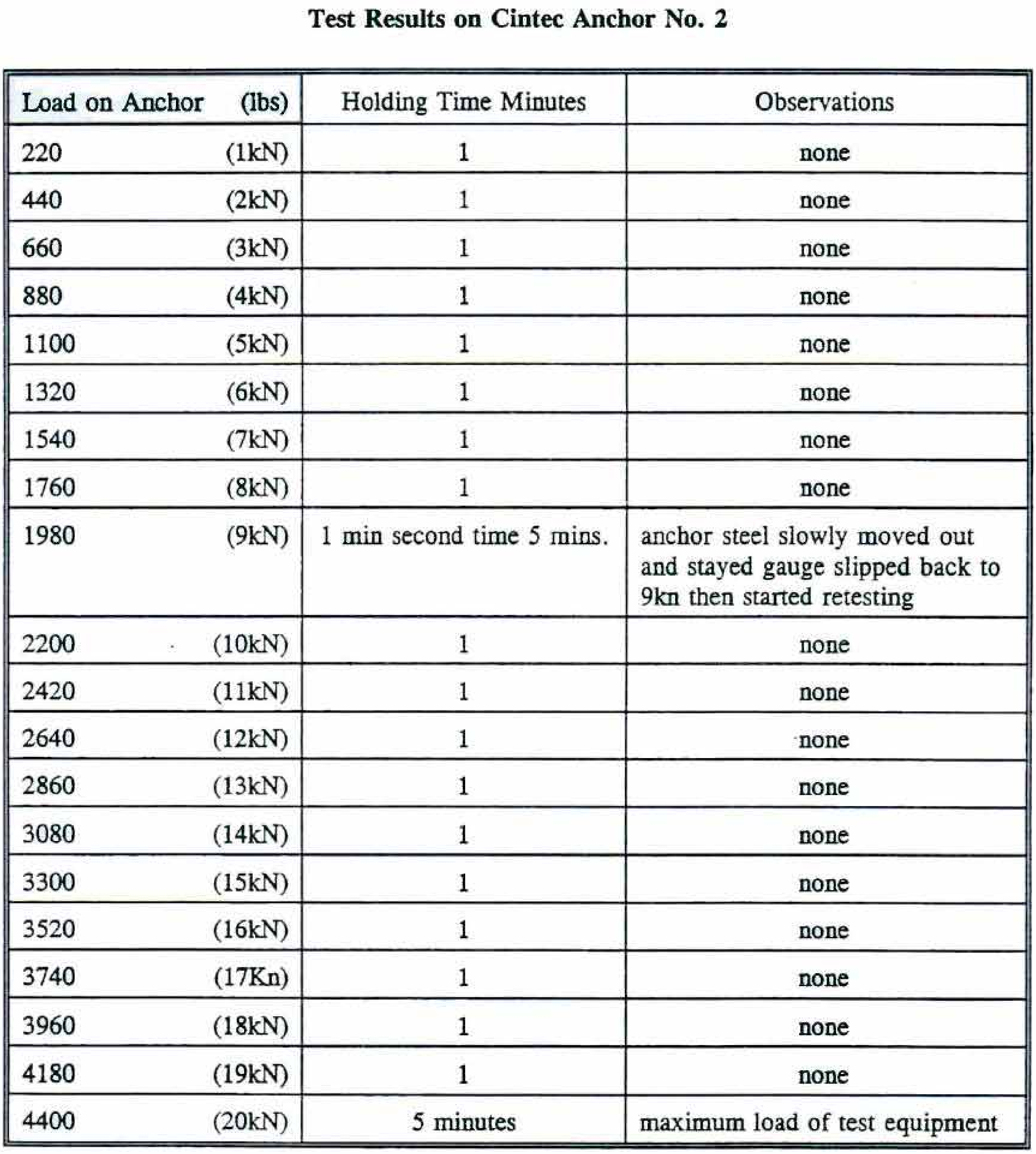
The anchors were loaded and observations were recorded as shown in the attached tables.

Anchor Layout Front Righthand Wall



Test Results on Cintec Anchor No. 1

Load on Anchor (lbs)	Holding Time (minutes)	Observations
220 (1kN)	1	none
440 (2kN)	1	none
660 (3kN)	1	none
880 (4kN)	1	none
1100 (5kN)	1	none
1320 (6kN)	1	none
1540 (7kN)	1	none
1760 (8kN)	1	none
1980 (9kN)	1	none
2200 (10kN)	1	stripped thread of test anchor



Test Results on Cintec Anchor No. 2

Load on Anchor (lbs)	Holding Time Minutes	Observations
220 (1kN)	1	none
440 (2kN)	1	none
660 (3kN)	1	none
880 (4kN)	1	none
1100 (5kN)	1	none
1320 (6kN)	1	none
1540 (7kN)	1	none
1760 (8kN)	1	none
1980 (9kN)	1 min second time 5 mins.	anchor steel slowly moved out and stayed gauge slipped back to 9kn then started retesting
2200 (10kN)	1	none
2420 (11kN)	1	none
2640 (12kN)	1	none
2860 (13kN)	1	none
3080 (14kN)	1	none
3300 (15kN)	1	none
3520 (16kN)	1	none
3740 (17Kn)	1	none
3960 (18kN)	1	none
4180 (19kN)	1	none
4400 (20kN)	5 minutes	maximum load of test equipment

Test Results on Cintec Anchor No. 3

Load on Anchor (lbs)	Holding Time Minutes	Observations
220 (1kN)	1	none
440 (2kN)	1	none
660 (3kN)	1	none
880 (4kN)	1	none
1100 (5kN)	1	none
1320 (6kN)	1	none
1540 (7kN)	1	none
1760 (8kN)	1	none
1980 (9kN)		stripped thread on test anchor

Test Results on Cintec Anchor No. 4

Load on Anchor (lbs)	Holding Time Minutes	Observations
220 (1kN)	1	none
440 (2kN)	1	none
660 (3kN)	1	none
880 (4kN)	1	none
1100 (5kN)	1	none
1320 (6kN)	1	none
1540 (7kN)	1	none
1760 (8kN)	1	none
1980 (9kN)	1	none
2200 (10kN)	1	none
2420 (11kN)	1	none
2640 (12kN)	1	none
2860 (13kN)	1	none
3080 (14kN)	1	none
3300 (15kN)	1	none
3520 (16kN)	1	none
3740 (17Kn)	1	none
3960 (18kN)	1	none
4180 (19kN)	1	none
4400 (20kN)	5 minutes	maximum load of test equipment

No visible damage to the anchor was observed at all increments of the load.

Test Results on Cintec Anchor No. 5

Load on Anchor (lbs)	Holding Time Minutes	Observations
220 (1kN)	1	none
440 (2kN)	1	none
660 (3kN)	1	none
880 (4kN)	1	none
1100 (5kN)	1	none
1320 (6kN)	1	none
1540 (7kN)	1	none
1760 (8kN)	1	none
1980 (9kN)		steel connector broke

Test Results on Cintec Anchor No. 6

Load on Anchor (lbs)	Holding Time Minutes	Observations
220 (1kN)	1	none
440 (2kN)	1	none
660 (3kN)	1	none
880 (4kN)	1	none
1100 (5kN)	1	none
1320 (6kN)	1	none
1540 (7kN)		stripped thread on test anchor

Test Results on Cintec Anchor No. 7

Load on Anchor (lbs)	Holding Time Minutes	Observations
220 (1kN)	1	none
440 (2kN)	1	none
660 (3kN)	1	none
880 (4kN)	1	none
1100 (5kN)	1	none
1320 (6kN)	1	none
1540 (7kN)		none
1760 (8kN)	1	none
1980 (9kN)	1	none
2200 (10kN)		stripped thread on test anchor

Compressive strength of grout

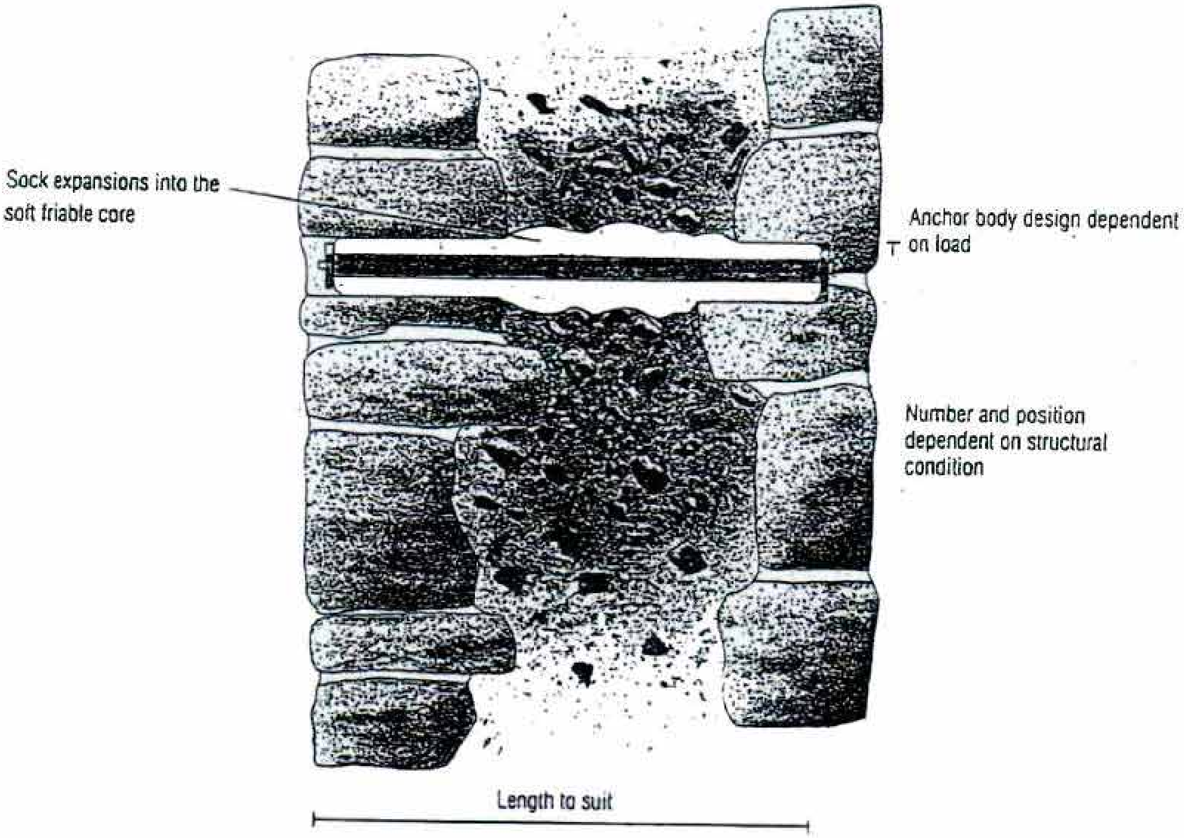
Sample 1	8,500 lb
Sample 2	10,000 lb
Sample 3	9,000 lb

Average strength of sample 9,267

Strength of Calicanto

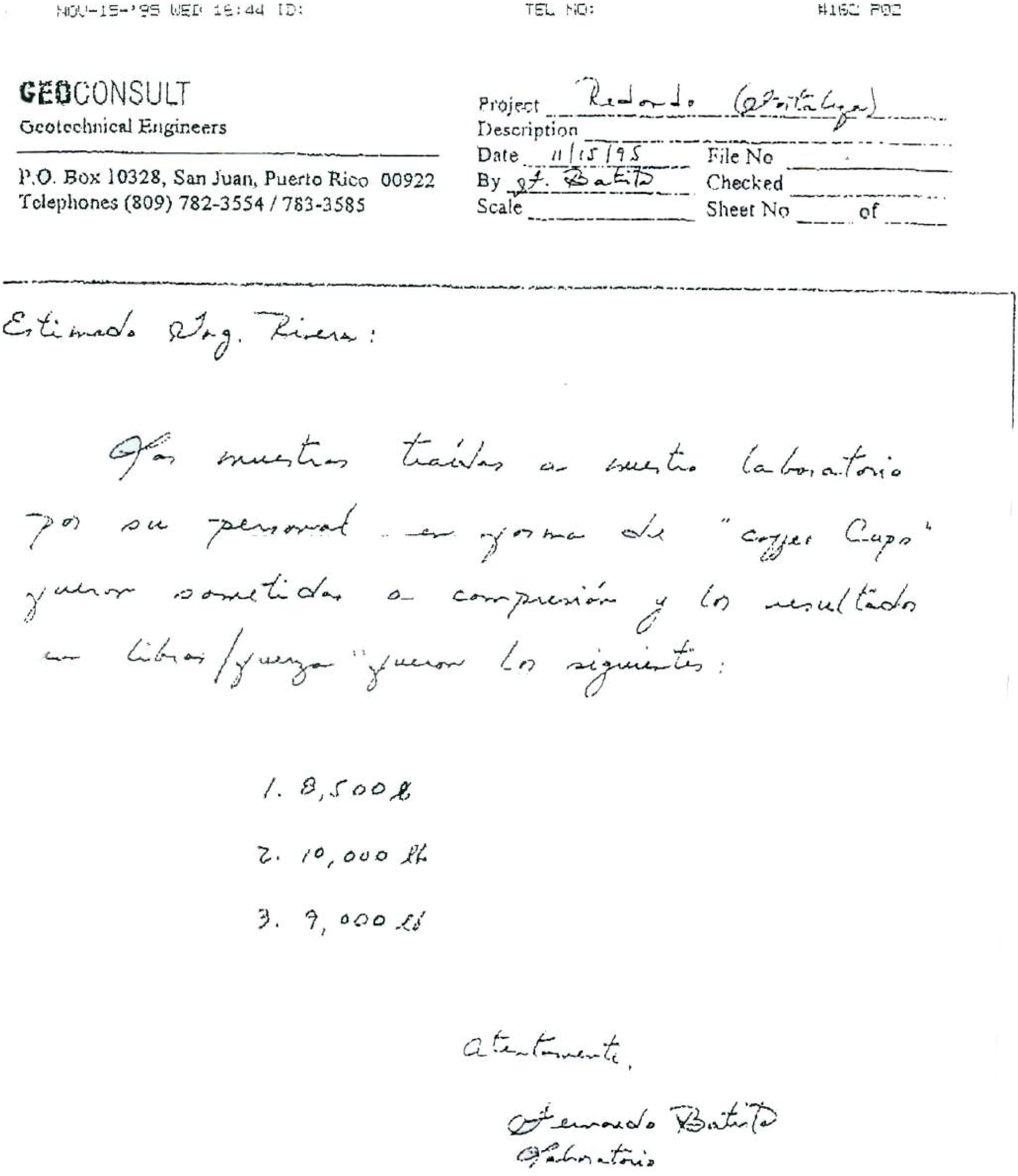
CINTEC AMERICA INC.

STITCHING ANCHOR



TEL 1-800-363-6066
FAX 1-800-461-1862

CINTEC MC SYSTEMS
DESIGNED ANCHOR SYSTEMS FOR THE CONSTRUCTION INDUSTRY



NOV-15-'95 WED 16:44 ID: TEL NO: #162 P02

GEOCONSULT
Geotechnical Engineers

P.O. Box 10328, San Juan, Puerto Rico 00922
Telephones (809) 782-3554 / 783-3585

Project Redondo (Fortaleza)
Description
Date 11/15/95
File No
By F. Batista
Checked
Scale
Sheet No of

Estimado Ing. Rivera:

Las muestras traídas a nuestro laboratorio por su personal en forma de "coffee Cups" fueron sometidas a compresión y los resultados en libras/fuerza" fueron los siguientes:

1. 8,500 lb
2. 10,000 lb
3. 9,000 lb

Atentamente,

Fernando Batista
Laboratorio

CINTEC
REINFORCEMENT SYSTEMS

Mr. James Reid
Keystone Traditional Masonry Inc.
Ashton, Ontario
K0A1B0

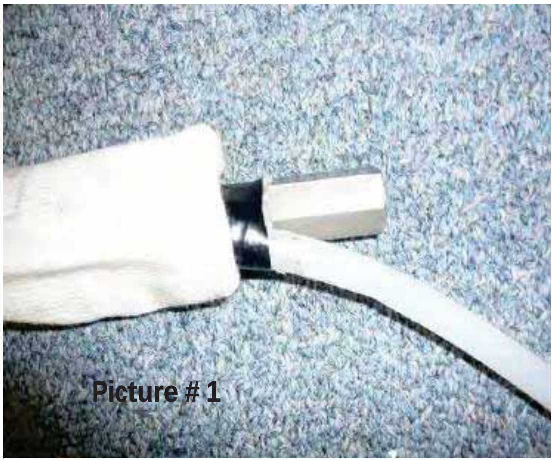
Re: Anchor Testing
457 Sussex Drive
Ottawa, Ontario

Dear Mr. Reid

Following your request, Cintec Reinforcement Systems Ltd. (Cintec) performed pull out tests at the above mentioned site. Testing was done by Gene Quesnel and Brad Fraser of Cintec.

Fieldwork was carried out on March 3rd, 2015.

Present as observers were: Agatha Lopez - DFS Inc., Joe Hoskins - NCC, Steve Woodbury - Jokinen Engineering Services and James Reid - Keystone Traditional Masonry Inc.



Picture # 1

Testing was conducted on three (3) Cintec anchors (Type A, M12) with overall length of 16 inches, socked 15 1/4 inches and exposed 3/4inch. A ½ inch diameter joining nut was attached to allow connection to testing equipment. See picture # 1.

Anchors were installed on February 23rd, 2015 and embedded full depth in a 1 ¼ inch cored hole and allowing 2 inches to wall face for hole plugging and make good. All three (3) anchors were installed in second floor area of West Elevation. Substrate was inner / outer stone with rubble infill. Each anchor location was given a unique identifying number. The Test Anchors were designated 31-14, 36-11 and 36-15.

Anchors were loaded in 1 Kn increments and held for a period of three (3) minutes between loadings. Loads at beginning and end of each three (3) minute intervals were recorded. Dial readings at beginning and end of each three (3) minute intervals were also recorded. Data recorded on "Field Data Form" and witnessed by Observers. Loading continued to 4Kn. See picture # 2

Picture # 2

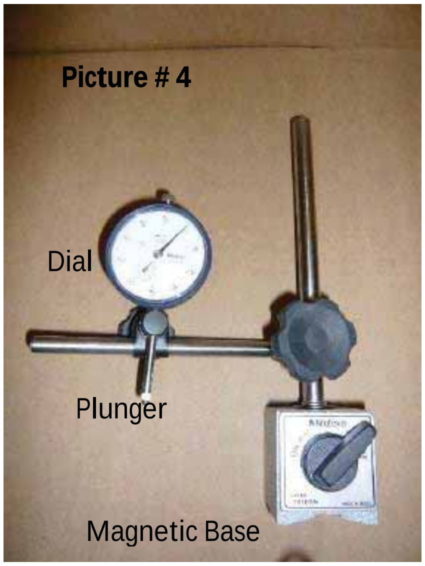
Note that test requirement was to 3 Kn but early loading showed "settling" of apparatus so was continued to 4 Kn to confirm no anchor / substrate movement.

Testing was carried out with a calibrated Hydrajaws, Model 2000 Tester, Serial # 01675430370 and a Mitutoyo #2416s deflection dial meter.

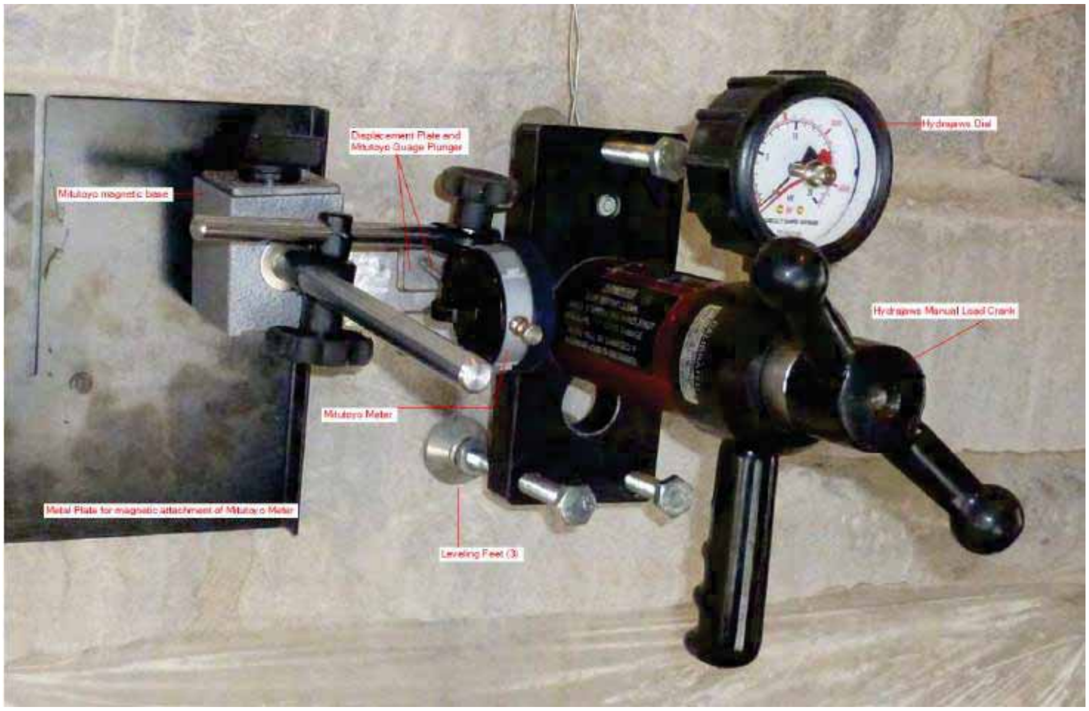
Picture # 3

The Hydrajaws test apparatus is a purpose made system for testing anchors and consists of a mechanical screw-jack arrangement fitted through a hydraulic load cell. The tester was suspended from above by means of a wire attached to a Tapcon concrete screw. The Cintec anchor was attached to the test equipment using an M12 threaded rod and nut adapter. The leg lengths of the test equipment were adjusted so that all 3 legs were in contact with the base material and the line of action of the test meter was axial with the anchor under test. See picture # 3, 5 and 6

The Mitutoyo 2416S-10 dial indicator is used to measure surface variations. It has a measurement range of 0 to 1.0", graduations of 0.001", an accuracy of + or - 0.002", and a range per revolution of 0.1". The dial has a jeweled bearing for accurate readings. This model is a continuous dial with a reading of 0-100, for direct readings.
See picture # 4, 5 and 6



Picture # 4



Picture # 5

Picture # 6

FIELD DATA FORM DATE: March 3, 2015

Anchors to be loaded in 1 Kn increments and held for a period of 3 minutes between loadings. Loads at beginning and end of each three minute interval to be recorded. Dial reading at beginning and end of each three minute interval to be recorded (elongation). Note any changes to substrate and / or anchor body.

ANCHOR 1 #31-14

Load Begin	Load End	Dial Begin	Dial End	Dial Change	Observation
1 Kn	1 Kn	.0620	.0620	.0000	No discernible change to substrate
2 Kn	2 Kn	.0615	.0615	.0000	or anchor- dial gauge variance likely
3 Kn	3 Kn	.0615	.0580	.0035	due to equipment / surface settling
4 Kn	4 Kn	.0580	.0580	.0000	

ANCHOR 2 #36-11

Load Begin	Load End	Dial Begin	Dial End	Dial Change	Observation
1 Kn	1 Kn	.0420	.0420	.0000	No discernible change to substrate
2 Kn	2 KN	.0425	.0430	.0005	or anchor- dial gauge variance likely
3 Kn	3 Kn	.0440	.0440	.0000	due to equipment / surface settling
4 Kn	4 Kn	.0450	.0450	.0000	

ANCHOR 3 #36-15

Load Begin	Load End	Dial Begin	Dial End	Dial Change	Observation
1 Kn	1 Kn	.0565	.0565	.0000	No discernible change to substrate
2 Kn	2 kn	.0565	.0570	.0005	or anchor- dial gauge variance likely
3 Kn	3 Kn	.0540	.0540	.0000	due to equipment / surface settling
4 Kn	4 Kn	.0540	.0540	.0000	

PROJECT: 457 Sussex Drive

Signatures of Observers are on File with Cintec Reinforcement Systems

Field Paperwork on File with Cintec Reinforcement Systems

OBSERVERS:

NAME	COMPANY	SIGNATURE (on file)
Agatha Lopez	DFS Inc.	*Agatha Lopez*
Joe Hoskins	NCC	*Joe Hoskins*
Steve Woodburry	Jokinen Engineering	*Steve Woodburry*
James Reid	Keystone Masonry	*James Reid*

CINTEC
REINFORCEMENT SYSTEMS

OBSERVATIONS

All anchoring withstood a minimum of 4.0 Kn load.
No apparent fracturing or movement of the substrate.
No apparent movement, distortion or failure of the anchor.
No apparent failure of grout bond to anchor body or substrate.

Trusting the above meets your requirements and should you have any further questions, please do not hesitate in contacting the undersigned.

Yours truly

Gene P. Quesnel

Cintec Reinforcement Systems Ltd.

38 Auriga Drive,

Nepean, Ontario, Canada

K2E 8A5

Francis Vanasse
STGM Architectes
2980 boul. Sainte-Anne,
Quebec, QC G1E 3J3

Philip Bernard
WSP Canada Inc.
5355, boulevard des Gradins,
Quebec, QC G2J 1C8

September 29, 2016

John Diodati
EVOQ Architecture / FGMA
1435Rue St-Alexandre, Bureau 1000
Montreal, QC H3A 2G4

<u>REFERENCE</u>
Anchor Testing
Manoir Richelieu
Malbaie, QC

Gentlemen,

Following your request, Cintec Reinforcement Systems Ltd. performed installation and pull out tests at the above mentioned site of Cintec RAC anchors as shown in picture 1 & 2.

Installation Fieldwork was carried out on September 19, 2016 by Gene Quesnel of Cintec Reinforcement Systems Ltd. with the assistance of Guillom Hamel and Mathew of L'Intendant Constructeur.

Installation of 5 anchors of 4 ½" embed (terminating in Siporex) and 5 anchors of 5 ½" embed (terminating between Siporex and insulation). All anchors installed to Cintec protocol. Anchors were embedded in a ¾ inch cored and profiled hole. See picture 3. All anchors installed through ¾" plywood and into substrate. See pictures 4&5. Misalignment of hole in plywood with hole in substrate disallowed ideal placement of anchor washer to plywood face. See picture 6. This is not and should not be a concern as install was for capacity testing and not final installation. This condition is easily corrected in future. There was also concern about having the plywood tight against the roof. It was shown that the plywood could easily be drawn to the roof with a wood screw prior to anchor inflation. Once the anchor is in place the plywood cannot move.

Anchor testing fieldwork was carried out on September 27, 2016 by Gene Quesnel of Cintec Reinforcement Systems Ltd. and observed by Philippe Bernard of WSP Canada Inc.

Testing was conducted on six (6) Cintec type RAC anchors, 5 with embed length of 4 ½" inches and 1 with embed of 5 ½". All fitted with a shop installed female ferrule to allow attachment to test equipment. Since all anchors of 4 ½" embed depth exceeded test requirements there was no need to test all the longer anchors. Plywood was cut away around anchors so that test equipment could rest on the existing roof surface assuring pull test of anchor in Siporex material only. See picture 7.

Requirement was for a minimum of 100 lb. load, target load for safety was 500 lbs. and actual tested load was 700 lbs.

Anchors were loaded in 1 Kn (225 lbs.) increments and held for a period of 1 minute between loadings. Loads at beginning and end of each one minute intervals were observed. Failure is defined as the load point at which the load could not be maintained for the one minute period. The load at the end of the one minute period was considered the "hold" load. Loading continued through 2 Kn. and 3+ Kn. load. Final hold load was observed and photographed to be in excess of 3+ Kn. or 700 lbs. See picture 8.

Testing was carried out with a calibrated Hydrajaws, Model 2000 Fixing Tester, Serial # 01675430370. The Hydrajaws test meter is a purpose made system for testing fixings and consists of a mechanical screw-jack arrangement fitted through a hydraulic load cell. The ferrel of the Cintec anchor was attached to the test equipment using an M8 threaded rod and button adapter. The leg lengths of the test equipment were adjusted so that all 3 legs were in contact with the base material and the line of action of the test meter was axial with the anchor under test.

Observations

1. All anchoring withstood a minimum of 3+ Kn (700 lbs.) load.
2. No apparent fracturing or movement of the substrate.
3. No failure of the anchoring.
4. No apparent failure of grout bond to anchor body or substrate.
5. Anchors performed as expected and required.
6. The use of Cintec anchors allows installation of anchor and plywood in one step.
7. The use of Cintec anchors eliminates the need of washer and nut assembly.
8. The use of Cintec anchors eliminates the need of a second layer of plywood.

Summary

Cintec anchors use a grout that is all natural and will not negatively impact the surrounding Siporex product. As well, the installed anchors are totally fireproof which must be considered in this type of application. The cost of a Cintec anchoring system should not be looked at in isolation but as part of an overall system / solution cost.

We trust the above meets your requirements and should you have any further questions, please do not hesitate in contacting the undersigned.

Yours truly

Gene Quesnel
Cintec Reinforcement Systems Ltd.
38 Auriga Drive
Nepean, Ontario
K2E 8A5

1 613 225 3381

CINTEC
REINFORCEMENT SYSTEMS

Francis Vanasse
STGM Architectes
2980 boul. Sainte-Anne,
Quebec, QC G1E 3J3

Philip Bernard
WSP Canada Inc.
5355, boulevard des Gradins,
Quebec, QC G2J 1C8

Le 29 septembre 2016

John Diodati
EVOQ Architecture / FGMA
1435Rue St-Alexandre, Bureau 1000
Montreal, QC H3A 2G4

RÉFÉRENCE
Essais d'ancrage
Manoir Richelieu
Malbaie, QC

Messieurs,

Suite à votre demande, Cintec Reinforcement Systems Ltd. a effectué l'installation et les tests d'arrachement d’ancres Cintec RAC, comme indiqué dans les photos 1 & 2, au site mentionné ci-dessus,

L'installation a été effectué le 19 Septembre, 2016 par Gene Quesnel de Cintec Renforcement Systems Ltd. avec l'aide de Guillome Hamel et Mathieu de L'Intendant Constructeur.

Installation de 5 ancres de 4 ½ " intégration (se terminant dans le Siporex) et 5 ancres de 5 ½" intégration (se terminant entre le Siporex et isolation). Tous les points d'ancrage ont été installés selon le protocole Cintec. Les ancres ont été insérées dans un trou foré et profilée ¾ de pouce. Voir photo 3. Tous les points d'ancrage ont été installés à travers le contreplaqué ¾ " et dans le substrat. Voir les photos 4 et 5. Désalignement du trou en contreplaqué avec le trou dans le substrat empêche le placement idéal de la rondelle d'ancrage contre le contreplaqué. Voir photo 6. Cela ne veut pas et ne doit pas être un sujet de préoccupation car installation a été pour les tests de capacité et non de l'installation finale. Cette condition est facilement corrigée à l'avenir. On inquiétait aussi d'avoir le contreplaqué serré contre le toit. Nous avons montré que le contreplaqué pourrait facilement être rapproché sur le toit avec une vis à bois avant le gonflage de l'ancre. Une fois que l'ancre est en place le contreplaqué ne peut pas bouger.

Test d'ancrage effectué le 27 Septembre, 2016 par Gene Quesnel de Cintec Renforcement Systems Ltd. et observé par Philippe Bernard de WSP Canada Inc.

Essai a été effectué sur six (6) points d'ancrage de type Cintec RAC, 5 avec une longueur d'intégration de 4 ½ " et 1 avec intégration de 5 ½". Toutes équipé d'une férule pour permettre la fixation de l'équipement d'essai. Comme toutes les ancres de 4 ½" de profondeur d'intégration ont dépassé les exigences d'essai il n'y avait pas besoin de tester tous les points d'ancrage plus longs. Contreplaqué a été coupé autour des ancres de sorte que l'équipement de test pouvait reposer sur la surface de la toiture existante assurant essai de traction de l'ancre dans le matériel Siporex seulement. Voir photo 7.

L'exigence était pour un minimum de charge de 100 lbs, charge ciblée pour la sécurité était de 500 lbs. et la r charge réelle testée était de 700 lbs.

Les ancres ont été chargées par accroissements de1 Kn (225 lbs.) et maintenus pendant une période de 1 minute entre les chargements. Les charges au début et à la fin de chacun des intervalles d'une minute ont été observées. L'échec est défini comme étant le point où la charge ne peut pas être maintenue pendant la période d'une minute de charge. La charge à la fin de la période d'une minute a été considérée comme la charge de maintien. Le chargement fut poursuivi a travers 2 Kn. et 3+ Kn. La charge de maintien finale a été observée et photographiée à plus de 3+ Kn. ou 700 lbs. Voir photo 8.

Le test a été effectué avec un Hydrajaws calibré, modèle 2000, numéro de série 01675430370. Le compteur d'essai Hydrajaws est un système destiné spécifiquement aux évaluations de fixations d'essai et se compose d'un agencement vis-vérin mécanique monté à travers une cellule de charge hydraulique. Le ferrel de l'ancre Cintec a été attaché à l'équipement de test en utilisant une tige M8 filetée et un adapteur de bouton. La longueur de la jambe de l'équipement de test a été ajustée de telle sorte que toutes les 3 jambes soient en contact avec le matériau de base et la ligne d'action de l'appareil d'essai soit axiale avec le point d'ancrage à l'essai.

Observations

1. Tout d'ancrage a résisté à une charge minimum de 3+ Kn (700 lbs.)
2. Aucun mouvement ou fracturation apparent du substrat.
3. Aucune échec de l'ancrage.
4. Pas d'échec apparant du coulis au corps de l'ancre ou du substrat.
5. Les ancres ont agit comme prévu et selon les besoins.
6. L'utilisation des ancres Cintec permet l'installation de l'ancre et le contreplaqué en une seule étape.
7. L'utilisation des ancres Cintec élimine le besoin d'une rondelle et écrou.
8. L'utilisation des ancres Cintec élimine la nécessité d'une seconde couche de contreplaqué.

Résumé

Les ancres Cintec utilisent un coulis qui est tout naturel et qui n’aura pas une incidence négative au produit Siporex. De plus, les ancrages installés sont totalement ignifuges, ce qui doit être pris en considération dans ce type d'application. Le coût d'un système d'ancrage Cintec ne devrait pas être considérée seul, mais plutôt dans le cadre d'un coût global du système / solution.

Nous espérons que ce qui précède répond à vos exigences et si vous avez des questions supplémentaires, s'il vous plaît n’hésitez à contacter le soussigné.

Bien à vous

Gene Quesnel
Cintec Reinforcement Systems Ltd.
38 Auriga Drive
Nepean, Ontario
K2E 8A5

1 613 225 3381

Cintec International Limited

Ref/Job No: RS7 - Route Clearance
PAGE 1 OF3
01/10/2016

Digital Test Report

CLIENT DETAILS

Client: Hochtief
Contact: Daniel Parkes
Address:
Telephone: 07773046284
Email:
Ref/Job No: RS7 - Route Clearance

SITE DETAILS

Site Location: A3102 Royal Wootton Bassett
Site Contact(s): Daniel Parkes
Telephone:
Email:
Witnesses Present: Dennis Lee & Allan Buckley

FIXINGS DETAILS

FIXING 1

Manufacturer: Cintec International Limited
Size: 16mm
Type: Grip Bar
Fixing/Cable: Fixing
Material/Substrate: Brick
Application:
Embedment: 250mm
Description: 50mm drill hole

FIXING 2

Manufacturer: Cintec International Limited
Size: 16mm
Type: Grip Bar
Fixing/Cable: Fixing
Material/Substrate: Brick
Application:
Embedment: 250mm
Description: 50mm drill hole

FIXING 3

Manufacturer: Cintec International Limited
Size: 16mm
Type: Grip Bar
Fixing/Cable: Fixing
Material/Substrate: Brick
Application:
Embedment: 250mm
Description: 50mm drill hole

FIXING 4

Manufacturer: Cintec International Limited
Size: 16mm
Type: Grip Bar
Fixing/Cable: Fixing
Material/Substrate: Brick
Application:
Embedment: 250mm
Description: 50mm drill hole

Digital report powered by Hydrajaws Digital System.

Cintec International Limited

Ref/Job No: RS7 - Route Clearance
PAGE 2 OF3
01/10/2016

Digital Test Report

TESTING DETAILS

Testing Company:	Cintec International Limited
Testing Personnel:	Dennis Lee
Test Equipment Used:	Hydrajaws Model 2008 bluetooth
Test Conclusions:	All anchors achieved the test load required of 26.5 kN
Test Additional Info:	Each increment was held for 2 minutes and the required load for 5 minutes

Digital report powered by Hydrajaws Digital System.

Cintec International Limited

Ref/Job No: RS7 - Route Clearance
PAGE 3 OF3
01/10/2016

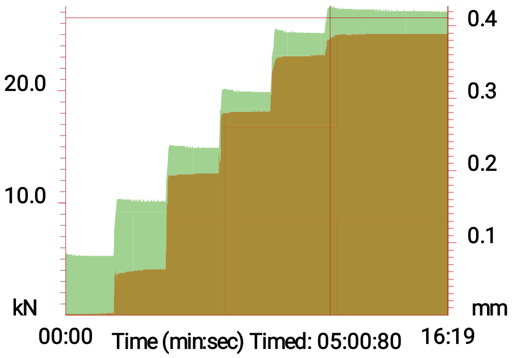
Digital Test Report

REPORT GRAPHS

GRAPH 1 : 30/09/2016 : 09:56

PASS

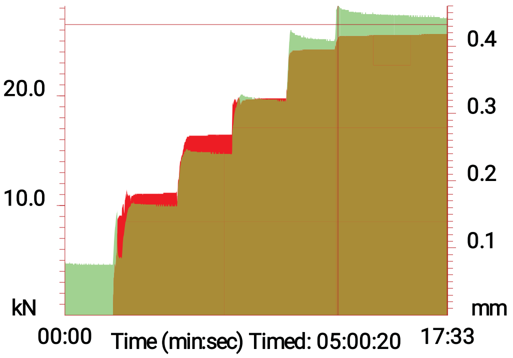
test 1 30/09/2016 : 09:56 (GPS: Lat: 51.54872, Long: -01.92510)
Target=26.50 High=27.56 - PASS



GRAPH 2 : 30/09/2016 : 10:18

PASS

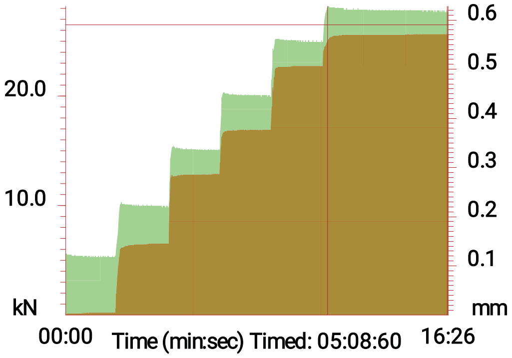
test 2 30/09/2016 : 10:18 (GPS: Lat: 51.53686, Long: -01.91199)
Target=26.50 High=28.20 - PASS



GRAPH 3 : 30/09/2016 : 11:23

PASS

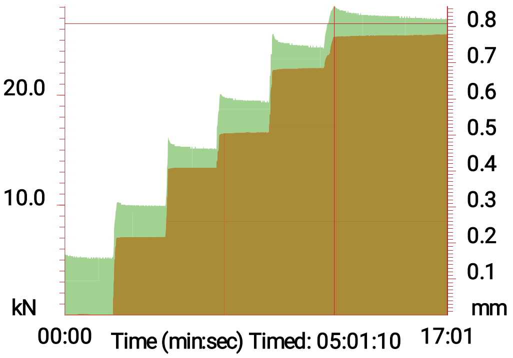
test 3 d 30/09/2016 : 11:23 (GPS: Lat: 51.53691, Long: -01.91163)
Target=26.50 High=28.20 - PASS



GRAPH 4 : 30/09/2016 : 11:45

PASS

test 4 30/09/2016 : 11:45 (GPS: Lat: 51.54872, Long: -01.92510)
Target=26.50 High=28.09 - PASS



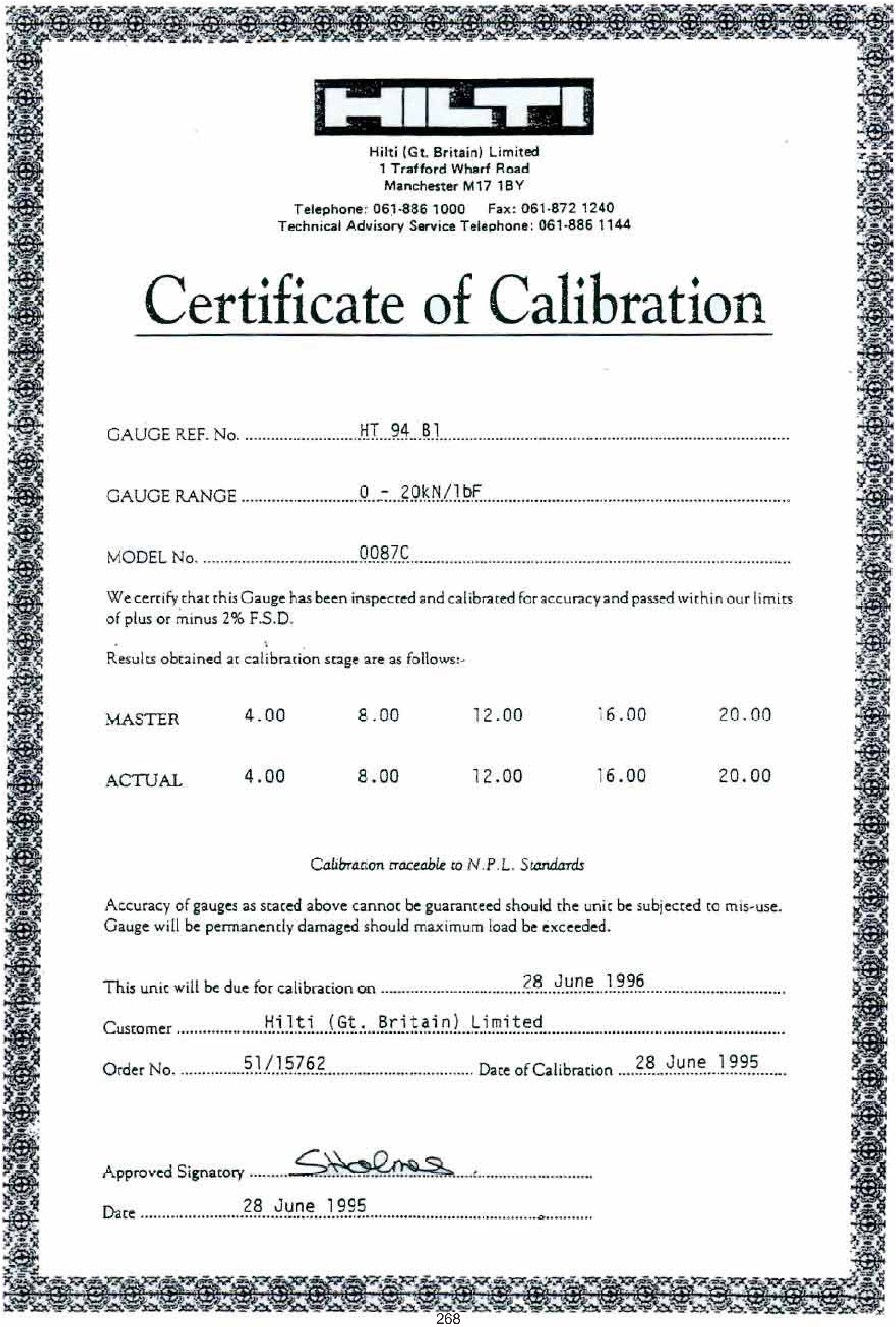
CINTEC ANCHOR TESTING

Load Test Results
In-house Testing

SUPERVISED BY:

PETER SOBEK ING.

(1996)



Hilti (Gt. Britain) Limited
1 Trafford Wharf Road
Manchester M17 1BY
Telephone: 061-886 1000 Fax: 061-872 1240
Technical Advisory Service Telephone: 061-886 1144

Certificate of Calibration

GAUGE REF. No. HT 94 B1

GAUGE RANGE 0 - 20kN/lbF

MODEL No. 0087C

We certify that this Gauge has been inspected and calibrated for accuracy and passed within our limits of plus or minus 2% F.S.D.

Results obtained at calibration stage are as follows:-

MASTER	4.00	8.00	12.00	16.00	20.00
ACTUAL	4.00	8.00	12.00	16.00	20.00

Calibration traceable to N.P.L. Standards

Accuracy of gauges as stated above cannot be guaranteed should the unit be subjected to mis-use. Gauge will be permanently damaged should maximum load be exceeded.

This unit will be due for calibration on 28 June 1996

Customer Hilti (Gt. Britain) Limited

Order No. 51/15762 Date of Calibration 28 June 1995

Approved Signatory SHolmes

Date 28 June 1995

CINTEC

Load Test Results

A wall measuring 1000mm thick was built from medium density bricks to conduct destructive testing on the Cintec Anchoring system.

An hydraulic hollow ram cylinder with a load range of 0 to 300 kn in 5 kn increments was used for two of the tests, but this was changed to a hollow ram cylinder with a load range of 0 to 120 kn with 2 kn increments this enabled us to achieve greater accuracy on the displacement values.
Displacement was measured using a digital readout dial gauge in 0.01 mm increments.

The characteristics of the stainless steel sections utilised were as follows :-

M12 stainless steel studding -

Grade 304

M16 stainless steel studding.

Grade 304

15mm x 15mm x 1.5mm stainless steel square hollow section.

Grade 304 S15
Proof stress = 195 N/mm^2
Tensile strength = 500 N/mm^2
Elongation = 40%

20mm x 20mm x 2mm stainless steel square hollow section.

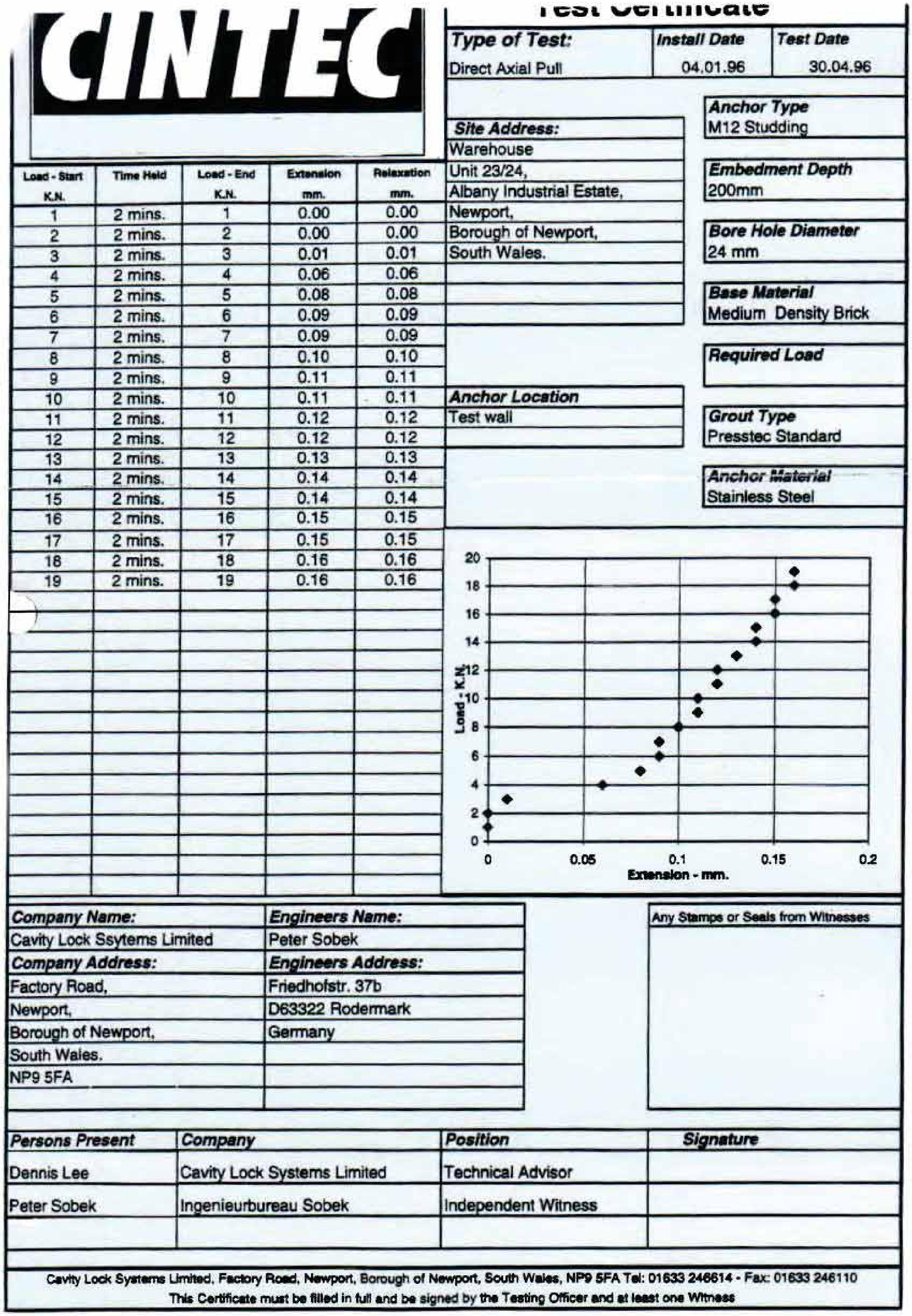
Grade 304 S15
Proof stress = 195 N/mm^2
Tensile strength = 500 N/mm^2
Elongation = 40%

(These values are for strip stainless steel and are altered slightly after forming into square hollow section)

The gout used was the standard Presstec Grout with the typical values as follows :-

Compression = 40 N/mm^2 @ 28 days
Tension = 3.3 N/mm^2 @ 28 days

All anchor failure modes were steel to grout . None of the failures were grout to parent material.



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Direct Axial Pull	04.01.96	30.04.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test wall

Anchor Type
M12 Studding

Embedment Depth
200mm

Bore Hole Diameter
24 mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

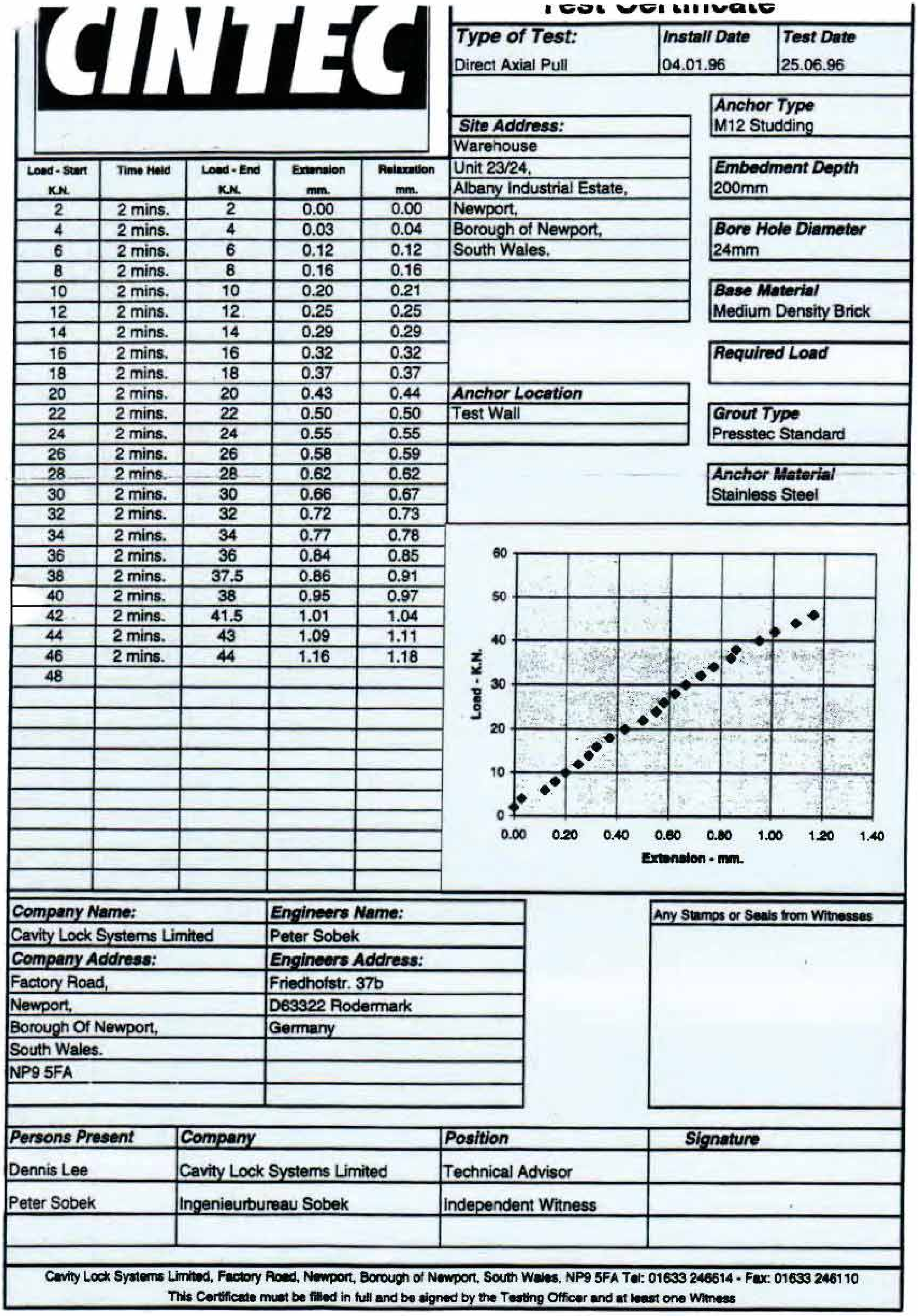
Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
1	2 mins.	1	0.00	0.00
2	2 mins.	2	0.00	0.00
3	2 mins.	3	0.01	0.01
4	2 mins.	4	0.06	0.06
5	2 mins.	5	0.08	0.08
6	2 mins.	6	0.09	0.09
7	2 mins.	7	0.09	0.09
8	2 mins.	8	0.10	0.10
9	2 mins.	9	0.11	0.11
10	2 mins.	10	0.11	0.11
11	2 mins.	11	0.12	0.12
12	2 mins.	12	0.12	0.12
13	2 mins.	13	0.13	0.13
14	2 mins.	14	0.14	0.14
15	2 mins.	15	0.14	0.14
16	2 mins.	16	0.15	0.15
17	2 mins.	17	0.15	0.15
18	2 mins.	18	0.16	0.16
19	2 mins.	19	0.16	0.16

Company Name:	Engineers Name:
Cavity Lock Ssytems Limited	Peter Sobek
Company Address:	**Engineers Address:**
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110
This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Direct Axial Pull	04.01.96	25.06.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
M12 Studding

Embedment Depth
200mm

Bore Hole Diameter
24mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

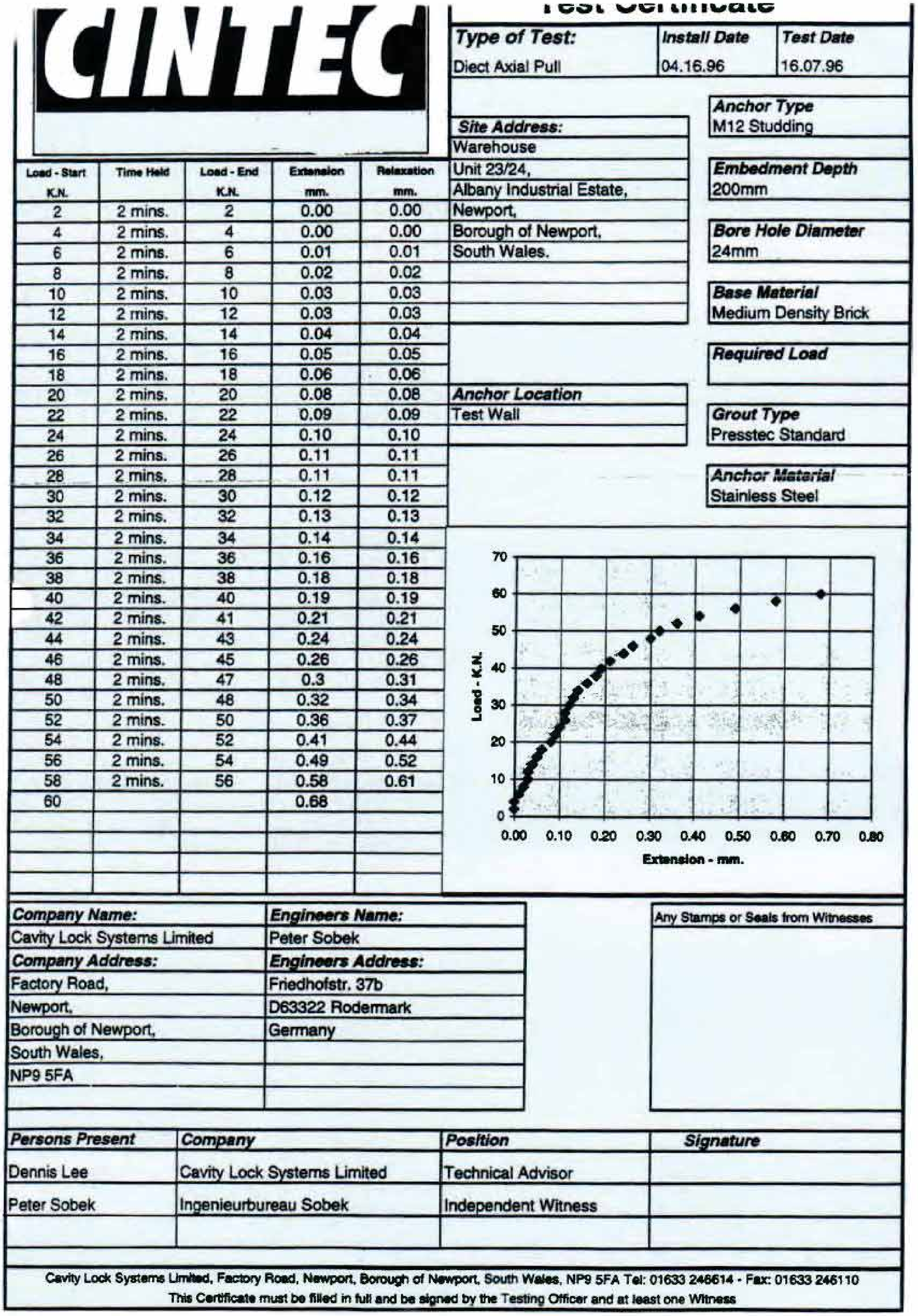
Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.03	0.04
6	2 mins.	6	0.12	0.12
8	2 mins.	8	0.16	0.16
10	2 mins.	10	0.20	0.21
12	2 mins.	12	0.25	0.25
14	2 mins.	14	0.29	0.29
16	2 mins.	16	0.32	0.32
18	2 mins.	18	0.37	0.37
20	2 mins.	20	0.43	0.44
22	2 mins.	22	0.50	0.50
24	2 mins.	24	0.55	0.55
26	2 mins.	26	0.58	0.59
28	2 mins.	28	0.62	0.62
30	2 mins.	30	0.66	0.67
32	2 mins.	32	0.72	0.73
34	2 mins.	34	0.77	0.78
36	2 mins.	36	0.84	0.85
38	2 mins.	37.5	0.86	0.91
40	2 mins.	38	0.95	0.97
42	2 mins.	41.5	1.01	1.04
44	2 mins.	43	1.09	1.11
46	2 mins.	44	1.16	1.18
48				

Company Name:	Engineers Name:
Cavity Lock Systems Limited	Peter Sobek
Company Address:	**Engineers Address:**
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough Of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110
This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Diect Axial Pull	04.16.96	16.07.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
M12 Studding

Embedment Depth
200mm

Bore Hole Diameter
24mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.01	0.01
8	2 mins.	8	0.02	0.02
10	2 mins.	10	0.03	0.03
12	2 mins.	12	0.03	0.03
14	2 mins.	14	0.04	0.04
16	2 mins.	16	0.05	0.05
18	2 mins.	18	0.06	0.06
20	2 mins.	20	0.08	0.08
22	2 mins.	22	0.09	0.09
24	2 mins.	24	0.10	0.10
26	2 mins.	26	0.11	0.11
28	2 mins.	28	0.11	0.11
30	2 mins.	30	0.12	0.12
32	2 mins.	32	0.13	0.13
34	2 mins.	34	0.14	0.14
36	2 mins.	36	0.16	0.16
38	2 mins.	38	0.18	0.18
40	2 mins.	40	0.19	0.19
42	2 mins.	41	0.21	0.21
44	2 mins.	43	0.24	0.24
46	2 mins.	45	0.26	0.26
48	2 mins.	47	0.3	0.31
50	2 mins.	48	0.32	0.34
52	2 mins.	50	0.36	0.37
54	2 mins.	52	0.41	0.44
56	2 mins.	54	0.49	0.52
58	2 mins.	56	0.58	0.61
60			0.68	

Company Name:
Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales,
NP9 5FA

Engineers Name:
Peter Sobek

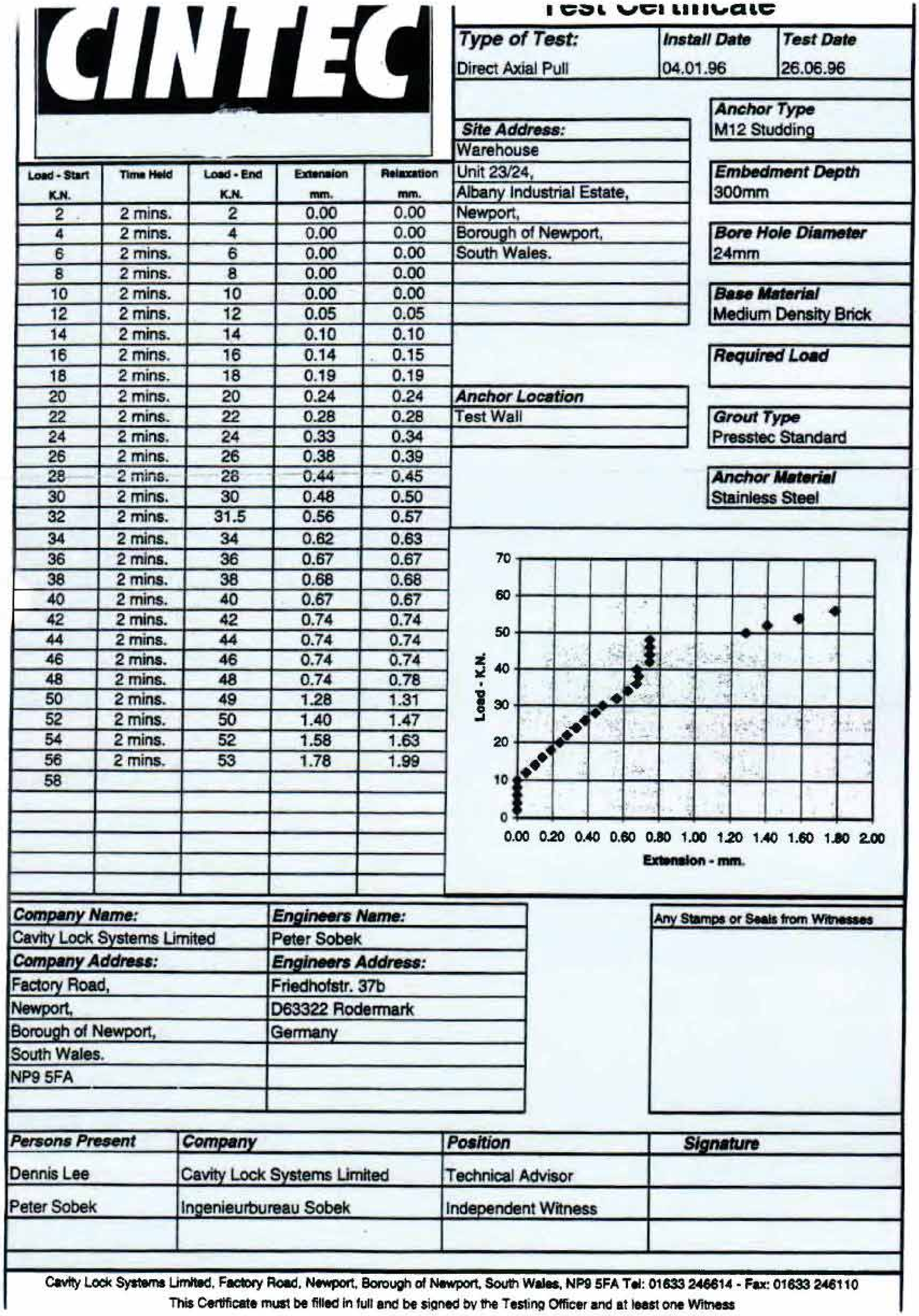
Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



Test Certificate

Type of Test:	Install Date	Test Date
Direct Axial Pull	04.01.96	26.06.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
M12 Studding

Embedment Depth
300mm

Bore Hole Diameter
24mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.00	0.00
10	2 mins.	10	0.00	0.00
12	2 mins.	12	0.05	0.05
14	2 mins.	14	0.10	0.10
16	2 mins.	16	0.14	0.15
18	2 mins.	18	0.19	0.19
20	2 mins.	20	0.24	0.24
22	2 mins.	22	0.28	0.28
24	2 mins.	24	0.33	0.34
26	2 mins.	26	0.38	0.39
28	2 mins.	28	0.44	0.45
30	2 mins.	30	0.48	0.50
32	2 mins.	31.5	0.56	0.57
34	2 mins.	34	0.62	0.63
36	2 mins.	36	0.67	0.67
38	2 mins.	38	0.68	0.68
40	2 mins.	40	0.67	0.67
42	2 mins.	42	0.74	0.74
44	2 mins.	44	0.74	0.74
46	2 mins.	46	0.74	0.74
48	2 mins.	48	0.74	0.78
50	2 mins.	49	1.28	1.31
52	2 mins.	50	1.40	1.47
54	2 mins.	52	1.58	1.63
56	2 mins.	53	1.78	1.99
58				

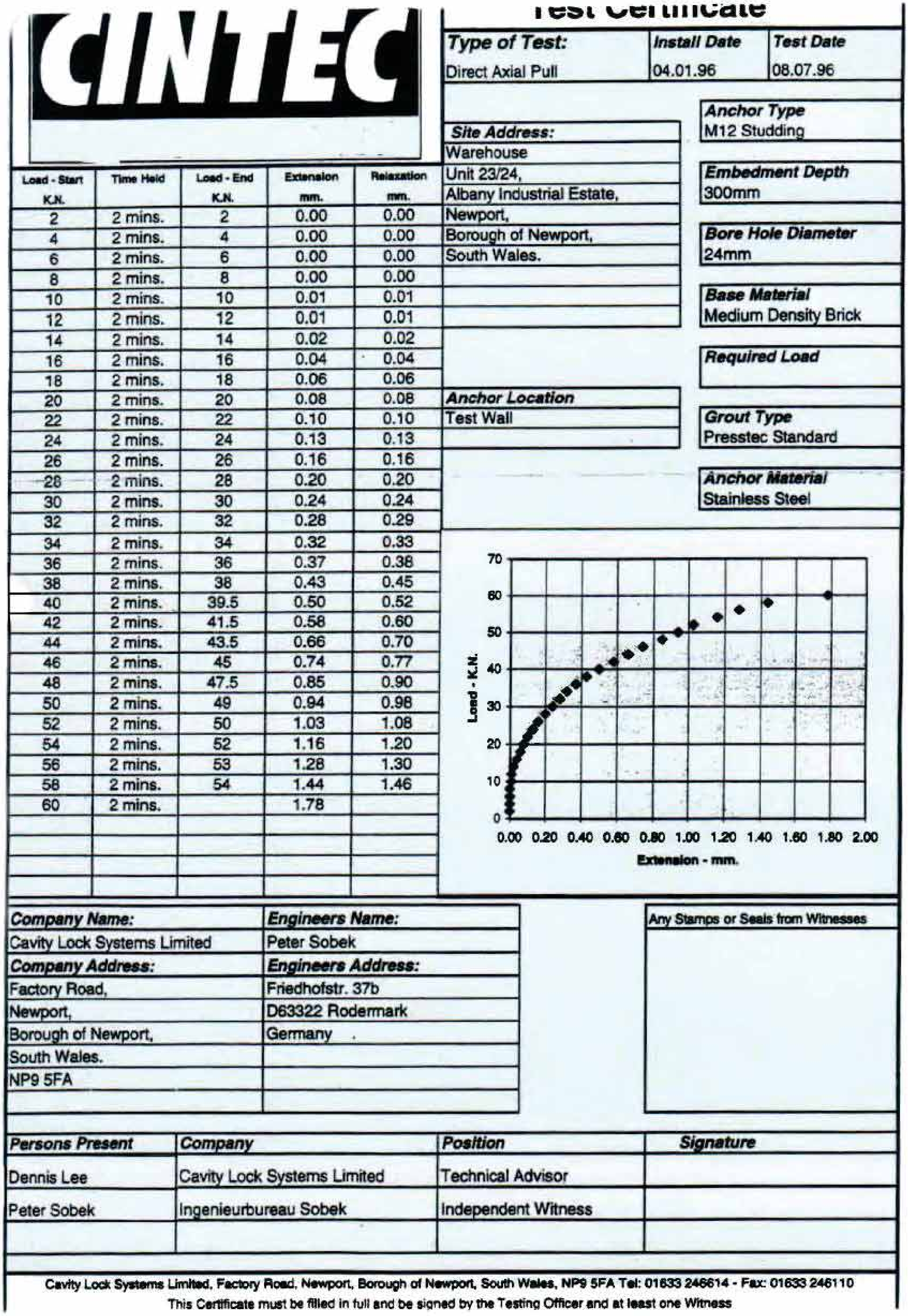
Company Name:	Engineers Name:
Cavity Lock Systems Limited	Peter Sobek
Company Address:	**Engineers Address:**
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Direct Axial Pull	04.01.96	08.07.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
M12 Studding

Embedment Depth
300mm

Bore Hole Diameter
24mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.00	0.00
10	2 mins.	10	0.01	0.01
12	2 mins.	12	0.01	0.01
14	2 mins.	14	0.02	0.02
16	2 mins.	16	0.04	0.04
18	2 mins.	18	0.06	0.06
20	2 mins.	20	0.08	0.08
22	2 mins.	22	0.10	0.10
24	2 mins.	24	0.13	0.13
26	2 mins.	26	0.16	0.16
28	2 mins.	28	0.20	0.20
30	2 mins.	30	0.24	0.24
32	2 mins.	32	0.28	0.29
34	2 mins.	34	0.32	0.33
36	2 mins.	36	0.37	0.38
38	2 mins.	38	0.43	0.45
40	2 mins.	39.5	0.50	0.52
42	2 mins.	41.5	0.58	0.60
44	2 mins.	43.5	0.66	0.70
46	2 mins.	45	0.74	0.77
48	2 mins.	47.5	0.85	0.90
50	2 mins.	49	0.94	0.98
52	2 mins.	50	1.03	1.08
54	2 mins.	52	1.16	1.20
56	2 mins.	53	1.28	1.30
58	2 mins.	54	1.44	1.46
60	2 mins.		1.78	

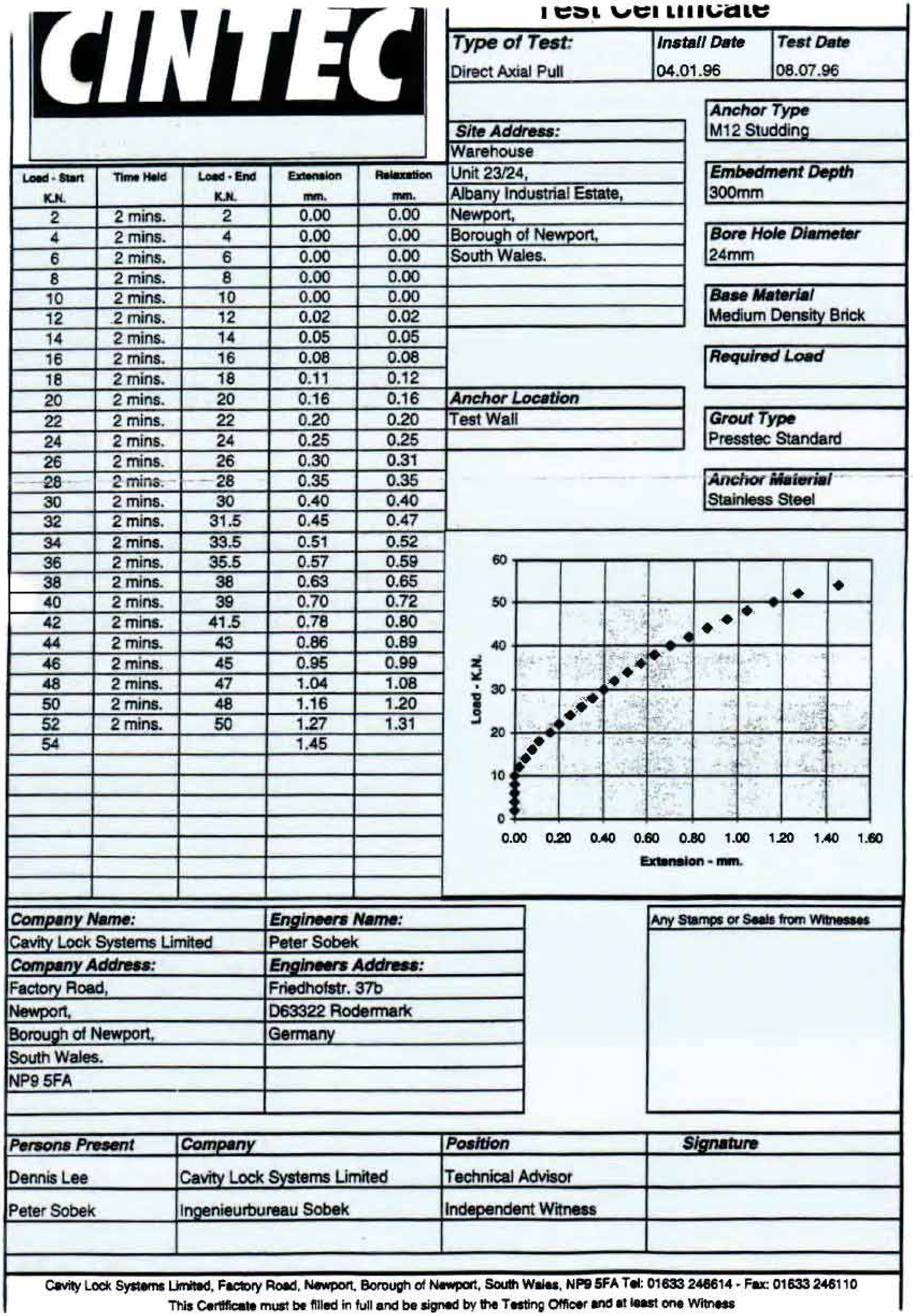
Company Name:	Engineers Name:
Cavity Lock Systems Limited	Peter Sobek
Company Address:	**Engineers Address:**
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Direct Axial Pull	04.01.96	08.07.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
M12 Studding

Embedment Depth
300mm

Bore Hole Diameter
24mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.00	0.00
10	2 mins.	10	0.00	0.00
12	2 mins.	12	0.02	0.02
14	2 mins.	14	0.05	0.05
16	2 mins.	16	0.08	0.08
18	2 mins.	18	0.11	0.12
20	2 mins.	20	0.16	0.16
22	2 mins.	22	0.20	0.20
24	2 mins.	24	0.25	0.25
26	2 mins.	26	0.30	0.31
28	2 mins.	28	0.35	0.35
30	2 mins.	30	0.40	0.40
32	2 mins.	31.5	0.45	0.47
34	2 mins.	33.5	0.51	0.52
36	2 mins.	35.5	0.57	0.59
38	2 mins.	38	0.63	0.65
40	2 mins.	39	0.70	0.72
42	2 mins.	41.5	0.78	0.80
44	2 mins.	43	0.86	0.89
46	2 mins.	45	0.95	0.99
48	2 mins.	47	1.04	1.08
50	2 mins.	48	1.16	1.20
52	2 mins.	50	1.27	1.31
54			1.45	

Company Name:
Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales.
NP9 5FA

Engineers Name:
Peter Sobek

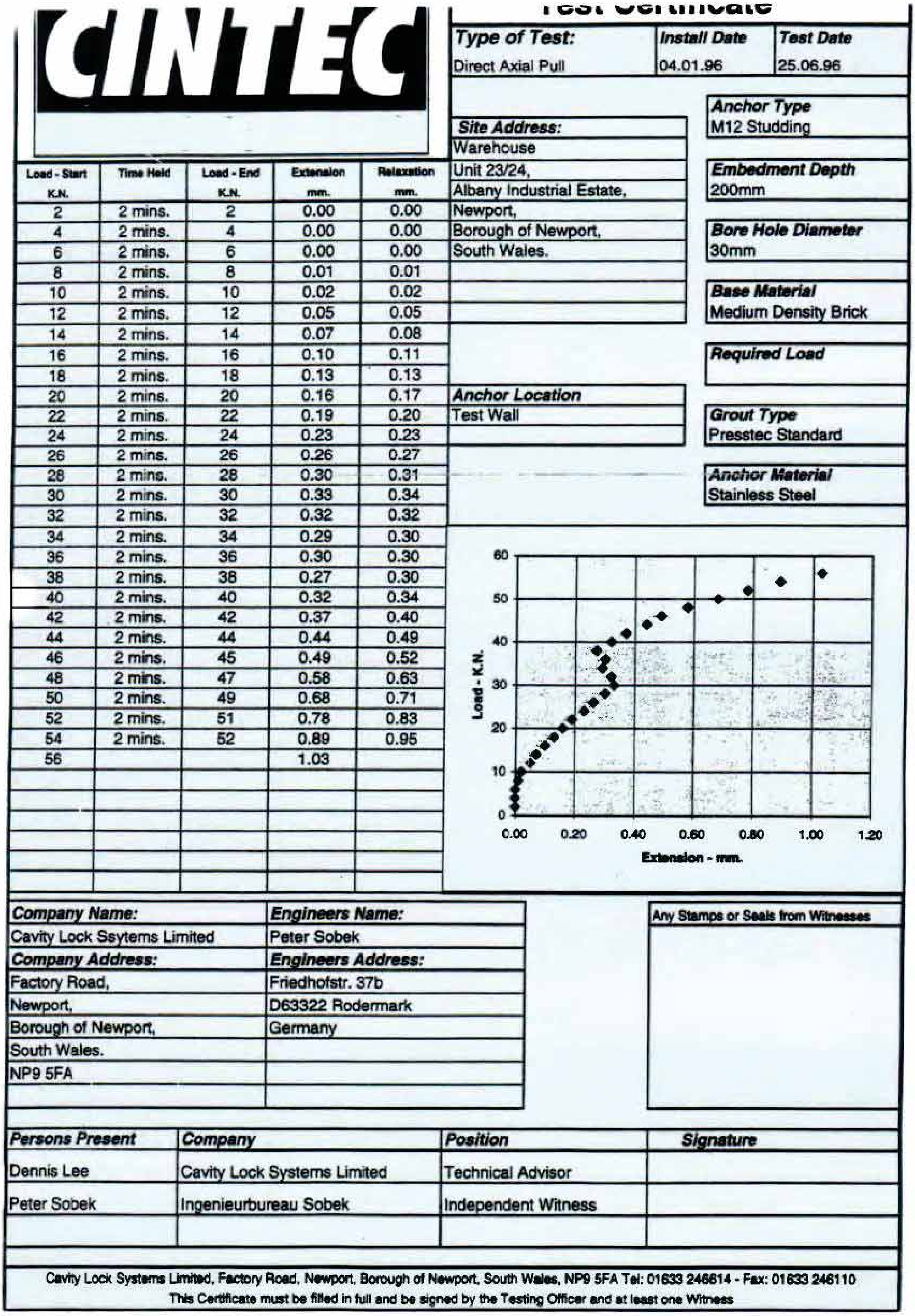
Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	***Install Date***	***Test Date***
Direct Axial Pull	04.01.96	25.06.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Type
M12 Studding

Embedment Depth
200mm

Bore Hole Diameter
30mm

Base Material
Medium Density Brick

Required Load

Anchor Location
Test Wall

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.01	0.01
10	2 mins.	10	0.02	0.02
12	2 mins.	12	0.05	0.05
14	2 mins.	14	0.07	0.08
16	2 mins.	16	0.10	0.11
18	2 mins.	18	0.13	0.13
20	2 mins.	20	0.16	0.17
22	2 mins.	22	0.19	0.20
24	2 mins.	24	0.23	0.23
26	2 mins.	26	0.26	0.27
28	2 mins.	28	0.30	0.31
30	2 mins.	30	0.33	0.34
32	2 mins.	32	0.32	0.32
34	2 mins.	34	0.29	0.30
36	2 mins.	36	0.30	0.30
38	2 mins.	38	0.27	0.30
40	2 mins.	40	0.32	0.34
42	2 mins.	42	0.37	0.40
44	2 mins.	44	0.44	0.49
46	2 mins.	45	0.49	0.52
48	2 mins.	47	0.58	0.63
50	2 mins.	49	0.68	0.71
52	2 mins.	51	0.78	0.83
54	2 mins.	52	0.89	0.95
56			1.03	

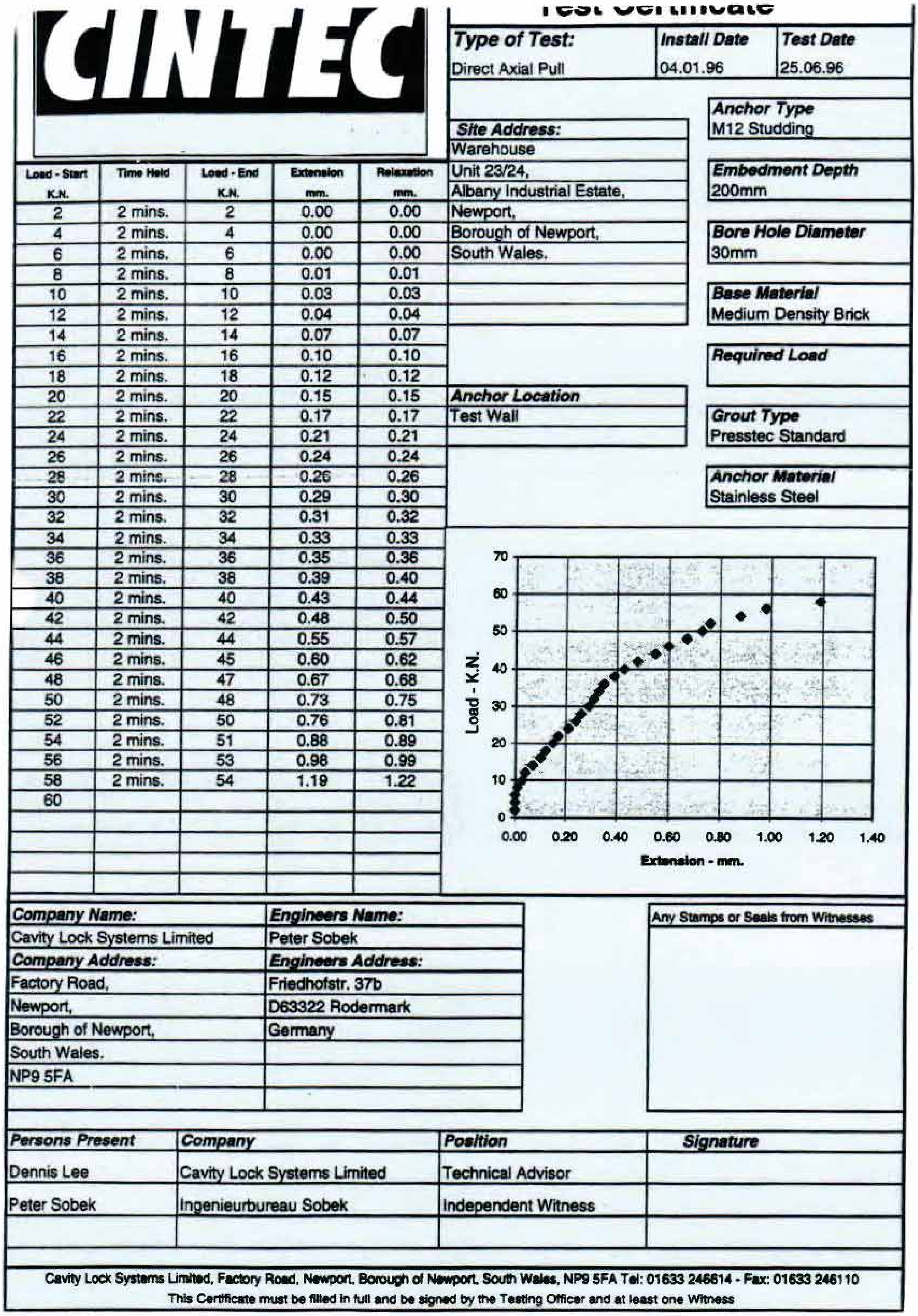
Company Name:	***Engineers Name:***
Cavity Lock Ssytems Limited	Peter Sobek
Company Address:	***Engineers Address:***
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

Persons Present	***Company***	***Position***	***Signature***
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	***Install Date***	***Test Date***
Direct Axial Pull	04.01.96	25.06.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Type
M12 Studding

Embedment Depth
200mm

Bore Hole Diameter
30mm

Base Material
Medium Density Brick

Required Load

Anchor Location
Test Wall

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

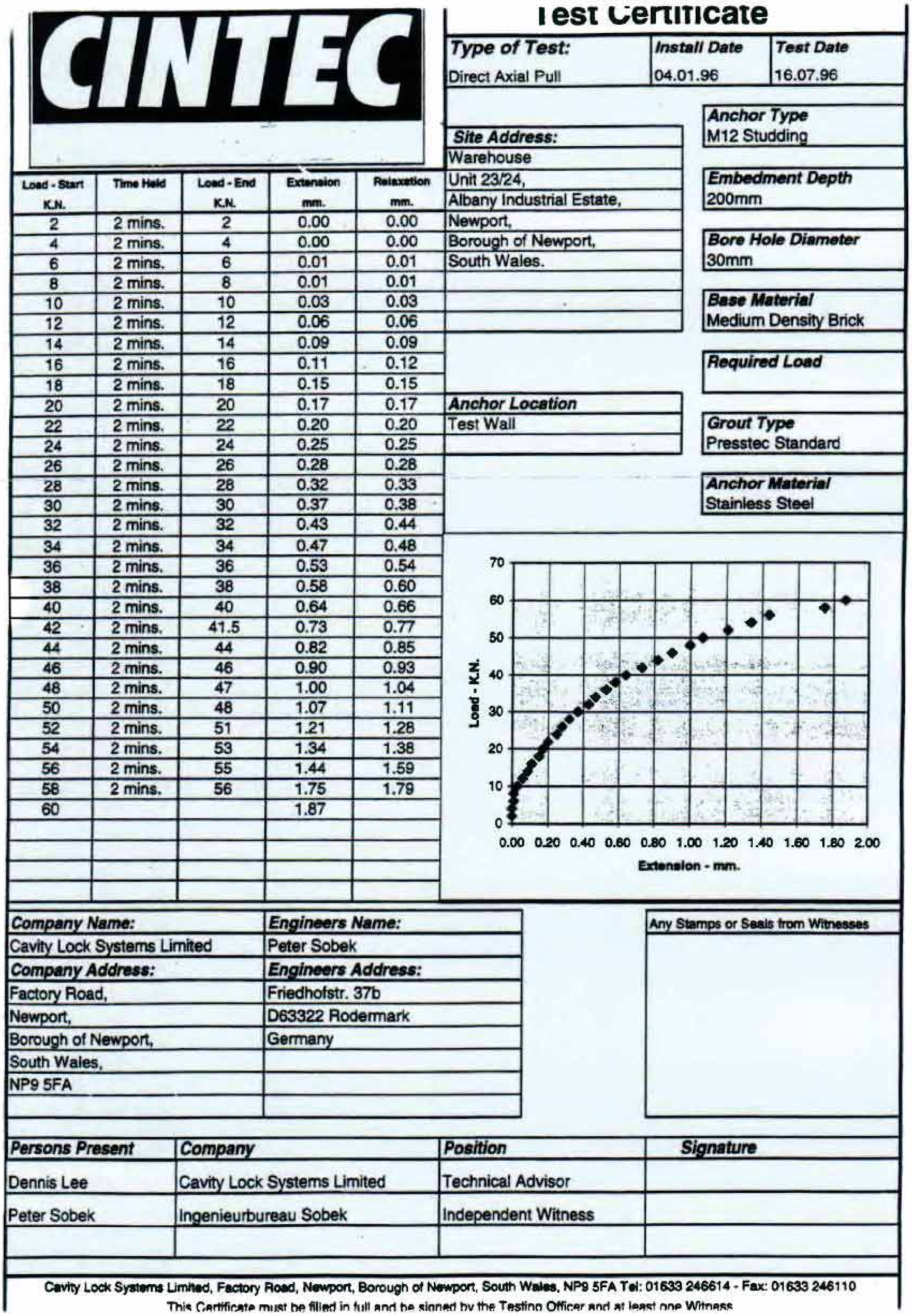
Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.01	0.01
10	2 mins.	10	0.03	0.03
12	2 mins.	12	0.04	0.04
14	2 mins.	14	0.07	0.07
16	2 mins.	16	0.10	0.10
18	2 mins.	18	0.12	0.12
20	2 mins.	20	0.15	0.15
22	2 mins.	22	0.17	0.17
24	2 mins.	24	0.21	0.21
26	2 mins.	26	0.24	0.24
28	2 mins.	28	0.26	0.26
30	2 mins.	30	0.29	0.30
32	2 mins.	32	0.31	0.32
34	2 mins.	34	0.33	0.33
36	2 mins.	36	0.35	0.36
38	2 mins.	38	0.39	0.40
40	2 mins.	40	0.43	0.44
42	2 mins.	42	0.48	0.50
44	2 mins.	44	0.55	0.57
46	2 mins.	45	0.60	0.62
48	2 mins.	47	0.67	0.68
50	2 mins.	48	0.73	0.75
52	2 mins.	50	0.76	0.81
54	2 mins.	51	0.88	0.89
56	2 mins.	53	0.98	0.99
58	2 mins.	54	1.19	1.22
60				

Company Name:	***Engineers Name:***
Cavity Lock Systems Limited	Peter Sobek
Company Address:	***Engineers Address:***
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

Persons Present	***Company***	***Position***	***Signature***
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110
This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:
Direct Axial Pull

Install Date
04.01.96

Test Date
16.07.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
M12 Studding

Embedment Depth
200mm

Bore Hole Diameter
30mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.01	0.01
8	2 mins.	8	0.01	0.01
10	2 mins.	10	0.03	0.03
12	2 mins.	12	0.06	0.06
14	2 mins.	14	0.09	0.09
16	2 mins.	16	0.11	0.12
18	2 mins.	18	0.15	0.15
20	2 mins.	20	0.17	0.17
22	2 mins.	22	0.20	0.20
24	2 mins.	24	0.25	0.25
26	2 mins.	26	0.28	0.28
28	2 mins.	28	0.32	0.33
30	2 mins.	30	0.37	0.38
32	2 mins.	32	0.43	0.44
34	2 mins.	34	0.47	0.48
36	2 mins.	36	0.53	0.54
38	2 mins.	38	0.58	0.60
40	2 mins.	40	0.64	0.66
42	2 mins.	41.5	0.73	0.77
44	2 mins.	44	0.82	0.85
46	2 mins.	46	0.90	0.93
48	2 mins.	47	1.00	1.04
50	2 mins.	48	1.07	1.11
52	2 mins.	51	1.21	1.28
54	2 mins.	53	1.34	1.38
56	2 mins.	55	1.44	1.59
58	2 mins.	56	1.75	1.79
60			1.87	

Company Name:
Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales,
NP9 5FA

Engineers Name:
Peter Sobek

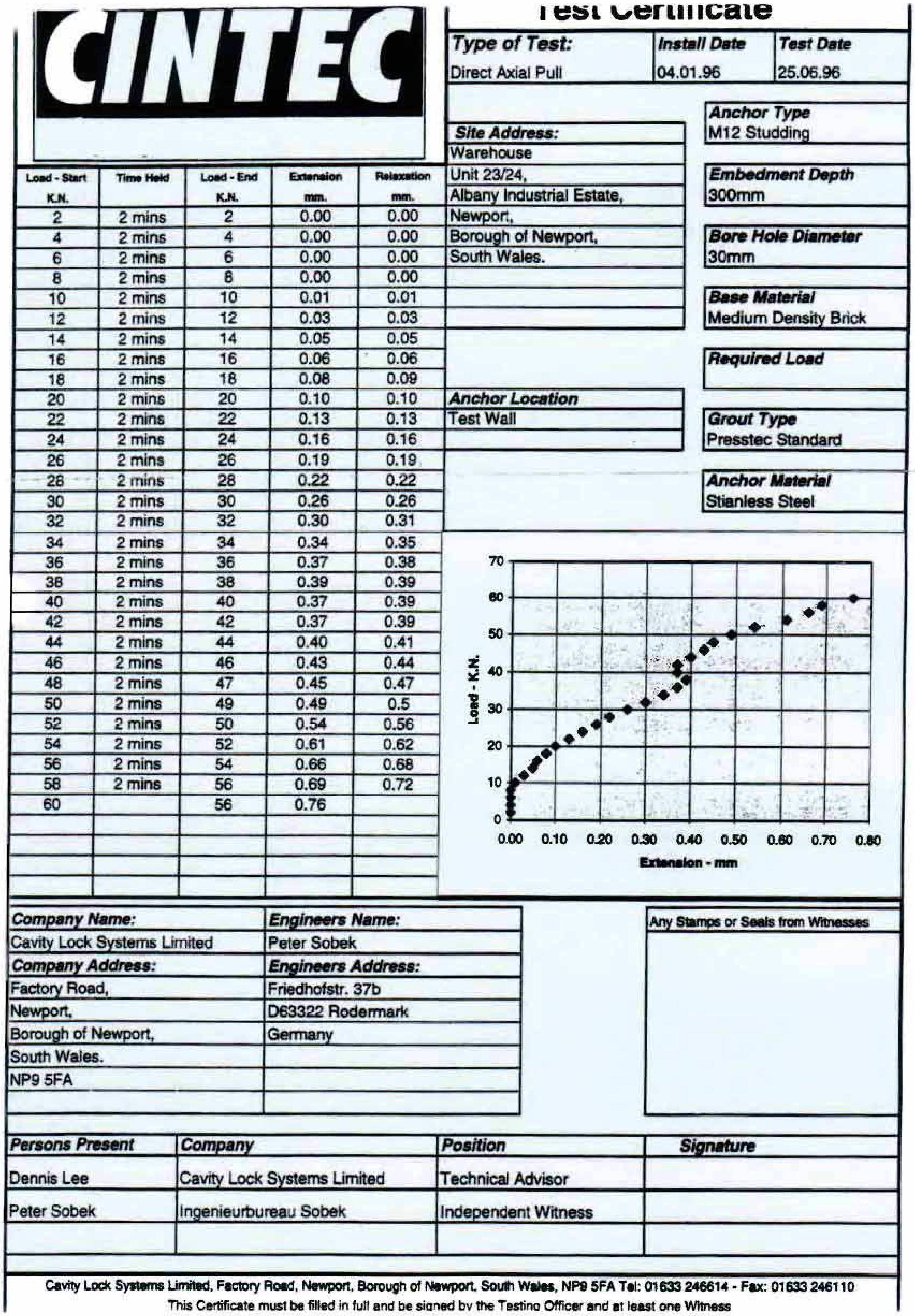
Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



Test Certificate

Type of Test: Direct Axial Pull

Install Date 04.01.96

Test Date 25.06.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Type M12 Studding

Embedment Depth 300mm

Bore Hole Diameter 30mm

Base Material Medium Density Brick

Required Load

Anchor Location Test Wall

Grout Type Presstec Standard

Anchor Material Stianless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins	2	0.00	0.00
4	2 mins	4	0.00	0.00
6	2 mins	6	0.00	0.00
8	2 mins	8	0.00	0.00
10	2 mins	10	0.01	0.01
12	2 mins	12	0.03	0.03
14	2 mins	14	0.05	0.05
16	2 mins	16	0.06	0.06
18	2 mins	18	0.08	0.09
20	2 mins	20	0.10	0.10
22	2 mins	22	0.13	0.13
24	2 mins	24	0.16	0.16
26	2 mins	26	0.19	0.19
28	2 mins	28	0.22	0.22
30	2 mins	30	0.26	0.26
32	2 mins	32	0.30	0.31
34	2 mins	34	0.34	0.35
36	2 mins	36	0.37	0.38
38	2 mins	38	0.39	0.39
40	2 mins	40	0.37	0.39
42	2 mins	42	0.37	0.39
44	2 mins	44	0.40	0.41
46	2 mins	46	0.43	0.44
48	2 mins	47	0.45	0.47
50	2 mins	49	0.49	0.5
52	2 mins	50	0.54	0.56
54	2 mins	52	0.61	0.62
56	2 mins	54	0.66	0.68
58	2 mins	56	0.69	0.72
60		56	0.76	

Company Name: Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales.
NP9 5FA

Engineers Name: Peter Sobek

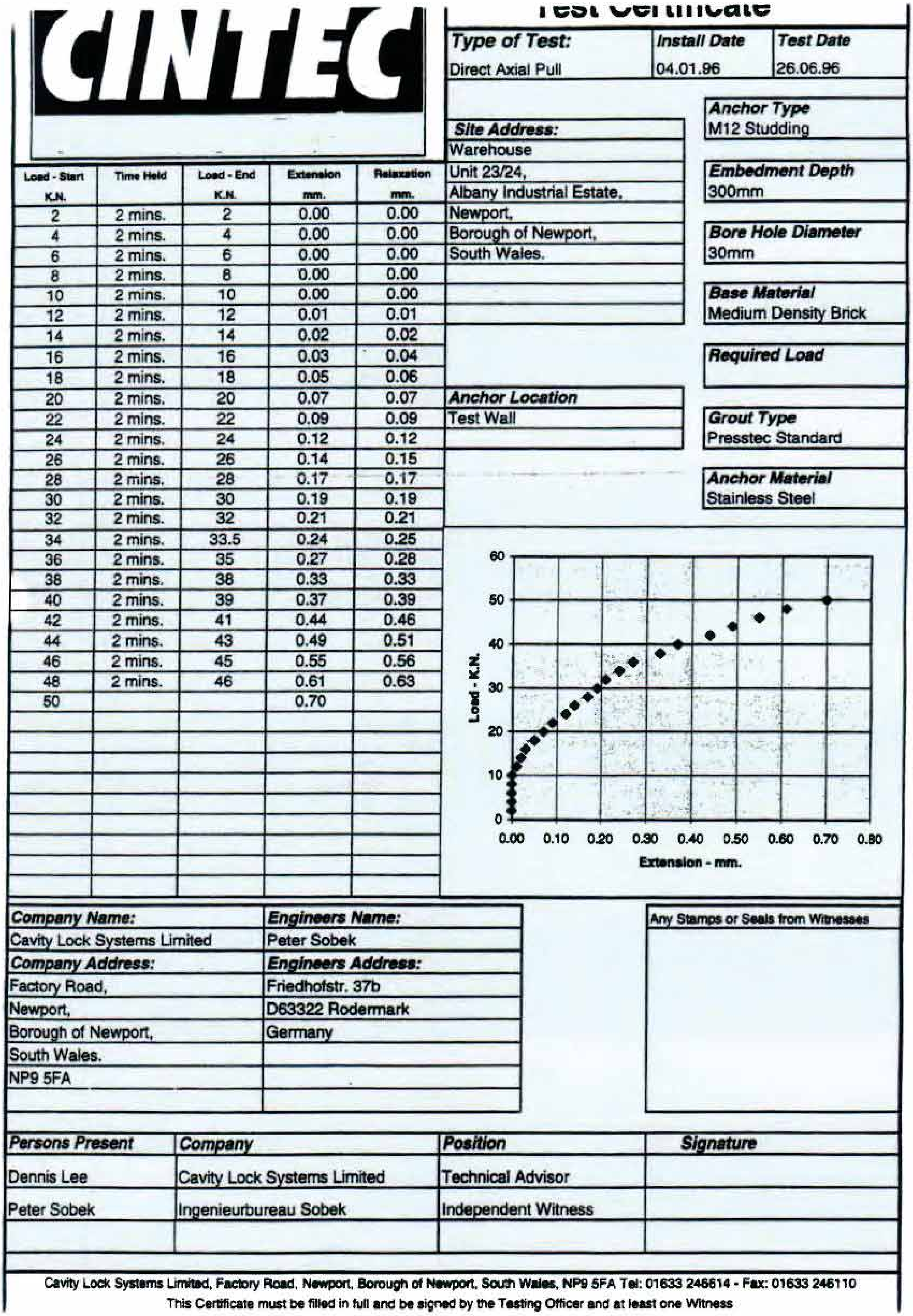
Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



Test Certificate

Type of Test:	Install Date	Test Date
Direct Axial Pull	04.01.96	26.06.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
M12 Studding

Embedment Depth
300mm

Bore Hole Diameter
30mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.00	0.00
10	2 mins.	10	0.00	0.00
12	2 mins.	12	0.01	0.01
14	2 mins.	14	0.02	0.02
16	2 mins.	16	0.03	0.04
18	2 mins.	18	0.05	0.06
20	2 mins.	20	0.07	0.07
22	2 mins.	22	0.09	0.09
24	2 mins.	24	0.12	0.12
26	2 mins.	26	0.14	0.15
28	2 mins.	28	0.17	0.17
30	2 mins.	30	0.19	0.19
32	2 mins.	32	0.21	0.21
34	2 mins.	33.5	0.24	0.25
36	2 mins.	35	0.27	0.28
38	2 mins.	38	0.33	0.33
40	2 mins.	39	0.37	0.39
42	2 mins.	41	0.44	0.46
44	2 mins.	43	0.49	0.51
46	2 mins.	45	0.55	0.56
48	2 mins.	46	0.61	0.63
50			0.70	

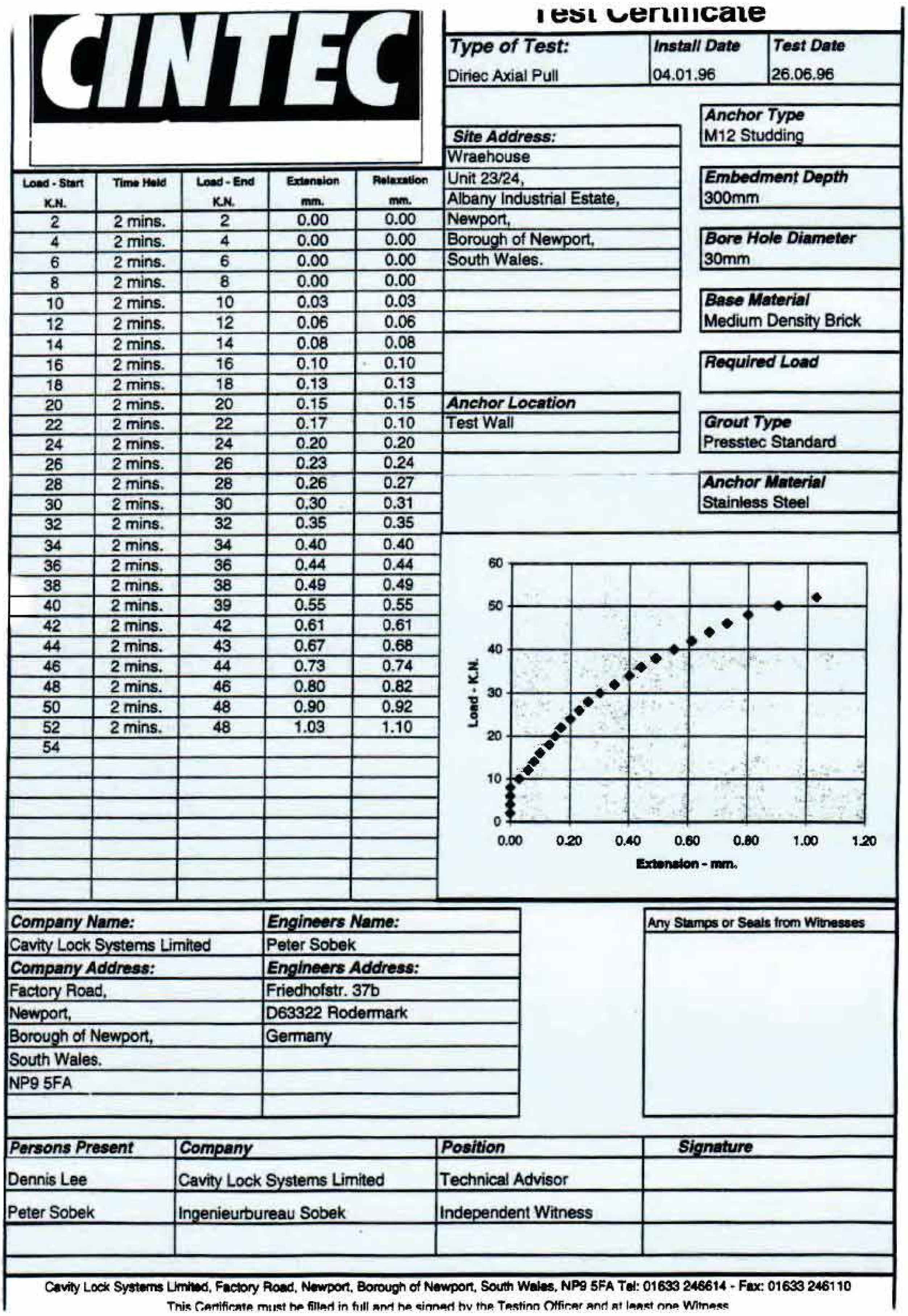
Company Name:	Engineers Name:
Cavity Lock Systems Limited	Peter Sobek
Company Address:	**Engineers Address:**
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Diriec Axial Pull	04.01.96	26.06.96

Site Address:
Wraehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
M12 Studding

Embedment Depth
300mm

Bore Hole Diameter
30mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.00	0.00
10	2 mins.	10	0.03	0.03
12	2 mins.	12	0.06	0.06
14	2 mins.	14	0.08	0.08
16	2 mins.	16	0.10	0.10
18	2 mins.	18	0.13	0.13
20	2 mins.	20	0.15	0.15
22	2 mins.	22	0.17	0.10
24	2 mins.	24	0.20	0.20
26	2 mins.	26	0.23	0.24
28	2 mins.	28	0.26	0.27
30	2 mins.	30	0.30	0.31
32	2 mins.	32	0.35	0.35
34	2 mins.	34	0.40	0.40
36	2 mins.	36	0.44	0.44
38	2 mins.	38	0.49	0.49
40	2 mins.	39	0.55	0.55
42	2 mins.	42	0.61	0.61
44	2 mins.	43	0.67	0.68
46	2 mins.	44	0.73	0.74
48	2 mins.	46	0.80	0.82
50	2 mins.	48	0.90	0.92
52	2 mins.	48	1.03	1.10
54				

Company Name:
Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales.
NP9 5FA

Engineers Name:
Peter Sobek

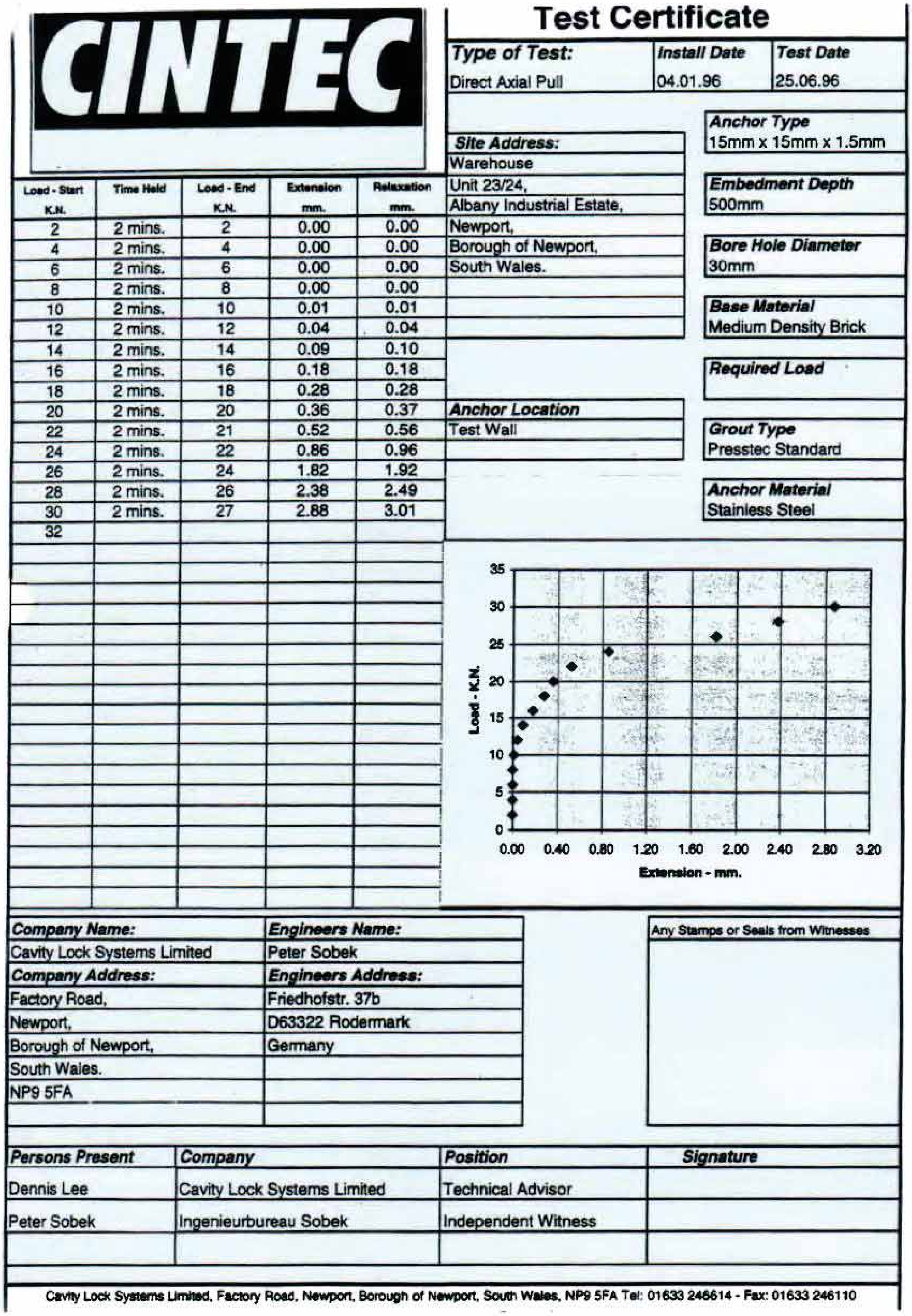
Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Direct Axial Pull	04.01.96	25.06.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
15mm x 15mm x 1.5mm

Embedment Depth
500mm

Bore Hole Diameter
30mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

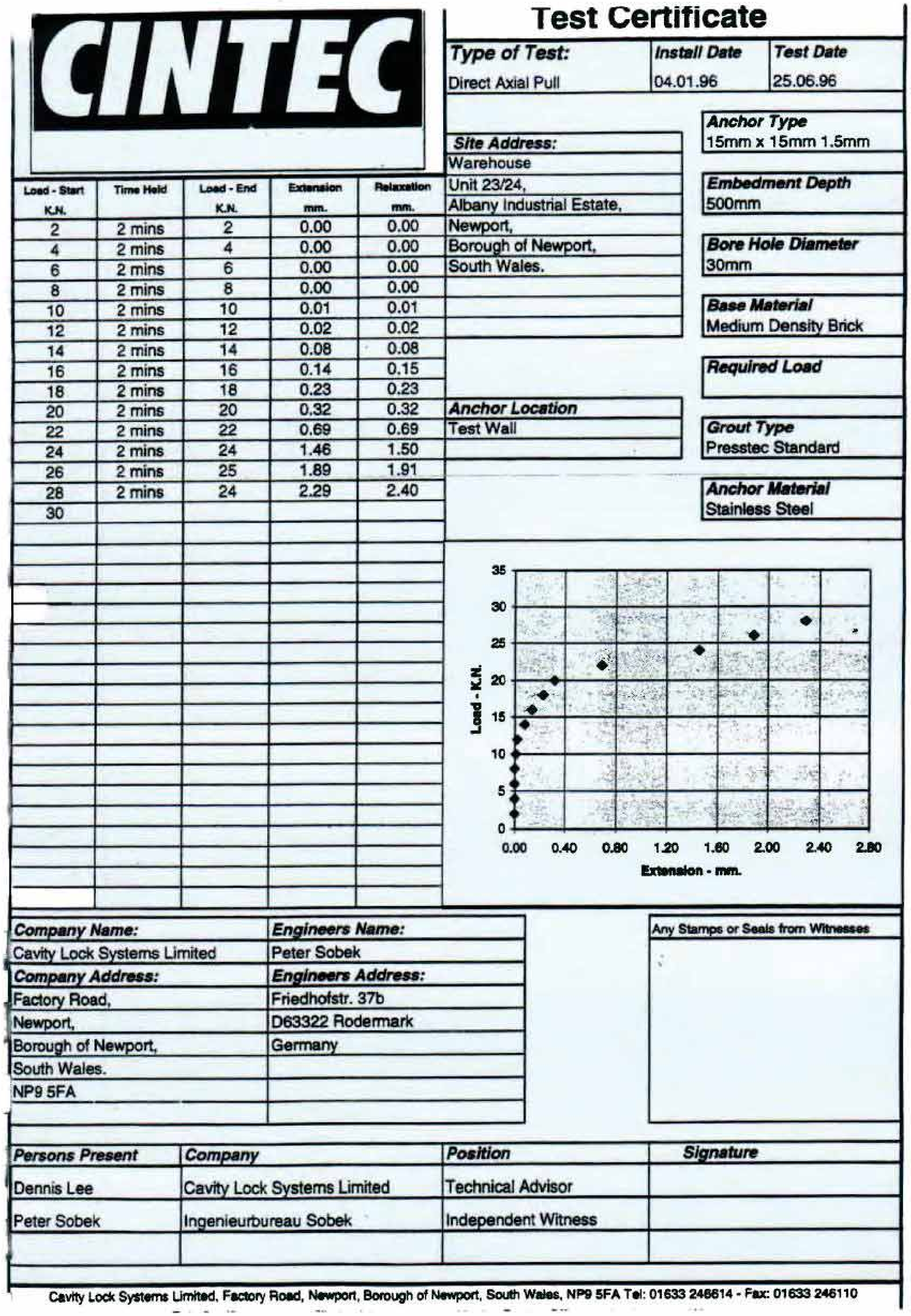
Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.00	0.00
10	2 mins.	10	0.01	0.01
12	2 mins.	12	0.04	0.04
14	2 mins.	14	0.09	0.10
16	2 mins.	16	0.18	0.18
18	2 mins.	18	0.28	0.28
20	2 mins.	20	0.36	0.37
22	2 mins.	21	0.52	0.56
24	2 mins.	22	0.86	0.96
26	2 mins.	24	1.82	1.92
28	2 mins.	26	2.38	2.49
30	2 mins.	27	2.88	3.01
32				

Company Name:	Engineers Name:
Cavity Lock Systems Limited	Peter Sobek
Company Address:	**Engineers Address:**
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110



CINTEC

Test Certificate

Type of Test:
Direct Axial Pull

Install Date
04.01.96

Test Date
25.06.96

Anchor Type
15mm x 15mm 1.5mm

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Embedment Depth
500mm

Bore Hole Diameter
30mm

Base Material
Medium Density Brick

Required Load

Anchor Location
Test Wall

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins	2	0.00	0.00
4	2 mins	4	0.00	0.00
6	2 mins	6	0.00	0.00
8	2 mins	8	0.00	0.00
10	2 mins	10	0.01	0.01
12	2 mins	12	0.02	0.02
14	2 mins	14	0.08	0.08
16	2 mins	16	0.14	0.15
18	2 mins	18	0.23	0.23
20	2 mins	20	0.32	0.32
22	2 mins	22	0.69	0.69
24	2 mins	24	1.46	1.50
26	2 mins	25	1.89	1.91
28	2 mins	24	2.29	2.40
30				

Company Name:
Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales.
NP9 5FA

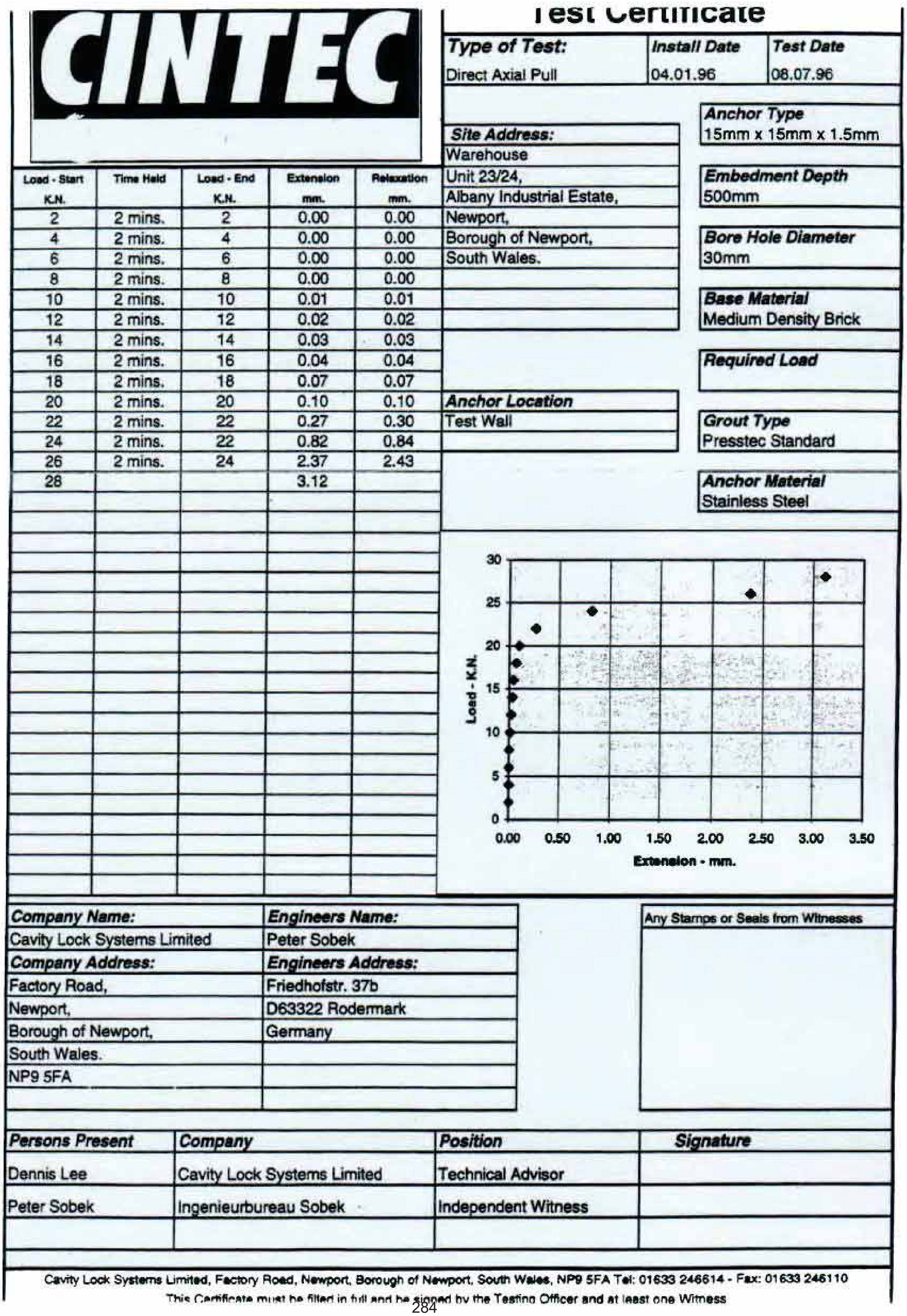
Engineers Name:
Peter Sobek

Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110



CINTEC

Test Certificate

Type of Test:	**Install Date**	**Test Date**
Direct Axial Pull	04.01.96	08.07.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
15mm x 15mm x 1.5mm

Embedment Depth
500mm

Bore Hole Diameter
30mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.00	0.00
10	2 mins.	10	0.01	0.01
12	2 mins.	12	0.02	0.02
14	2 mins.	14	0.03	0.03
16	2 mins.	16	0.04	0.04
18	2 mins.	18	0.07	0.07
20	2 mins.	20	0.10	0.10
22	2 mins.	22	0.27	0.30
24	2 mins.	22	0.82	0.84
26	2 mins.	24	2.37	2.43
28			3.12	

Company Name:	**Engineers Name:**
Cavity Lock Systems Limited	Peter Sobek
Company Address:	**Engineers Address:**
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

Persons Present	**Company**	**Position**	**Signature**
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness

CINTEC

Test Certificate

Type of Test: Direct Axial Pull

Install Date 04.01.96

Test Date 25.06.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Type 15mm x 15mm x 1.5mm

Embedment Depth 500mm

Bore Hole Diameter 55mm

Base Material Medium Density Brick

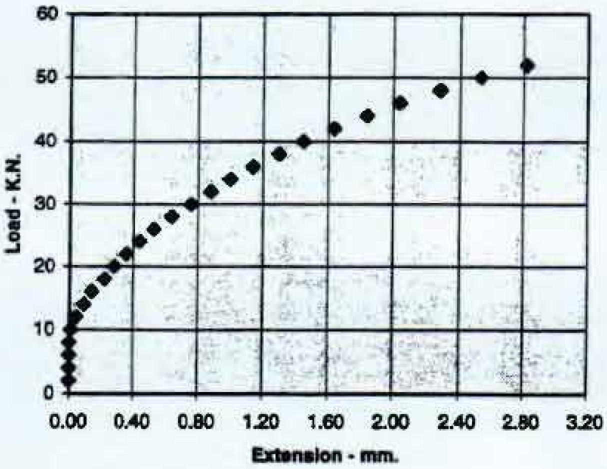
Required Load

Anchor Location Test Wall

Grout Type Presstec Standard

Anchor Material Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.00	0.00
10	2 mins.	10	0.01	0.01
12	2 mins.	12	0.04	0.04
14	2 mins.	14	0.09	0.09
16	2 mins.	16	0.14	0.14
18	2 mins.	18	0.22	0.22
20	2 mins.	20	0.28	0.28
22	2 mins.	22	0.36	0.36
24	2 mins.	24	0.44	0.44
26	2 mins.	26	0.53	0.53
28	2 mins.	28	0.64	0.65
30	2 mins.	30	0.76	0.77
32	2 mins.	32	0.88	0.90
34	2 mins.	34	1.00	1.02
36	2 mins.	36	1.14	1.17
38	2 mins.	38	1.30	1.32
40	2 mins.	39	1.45	1.49
42	2 mins.	41	1.64	1.69
44	2 mins.	43	1.84	1.88
46	2 mins.	45	2.04	2.08
48	2 mins.	47	2.28	2.34
50	2 mins.	48	2.53	2.60
52	2 mins.	50	2.82	2.88
54				



Company Name:
Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales.
NP9 5FA

Engineers Name:
Peter Sobek

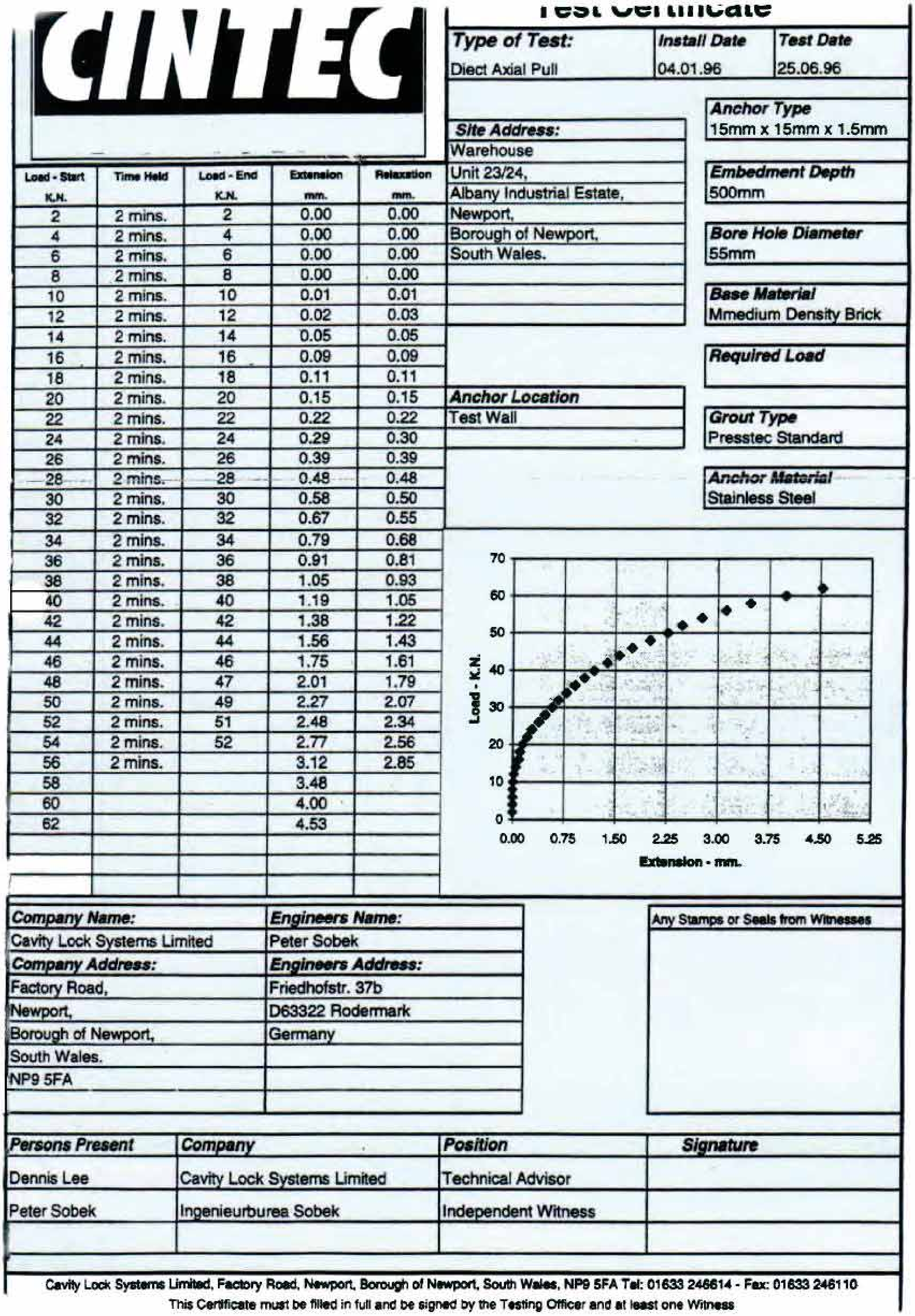
Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurburea Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test: Diect Axial Pull

Install Date 04.01.96

Test Date 25.06.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Type 15mm x 15mm x 1.5mm

Embedment Depth 500mm

Bore Hole Diameter 55mm

Base Material Mmedium Density Brick

Required Load

Anchor Location Test Wall

Grout Type Presstec Standard

Anchor Material Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.00	0.00
10	2 mins.	10	0.01	0.01
12	2 mins.	12	0.02	0.03
14	2 mins.	14	0.05	0.05
16	2 mins.	16	0.09	0.09
18	2 mins.	18	0.11	0.11
20	2 mins.	20	0.15	0.15
22	2 mins.	22	0.22	0.22
24	2 mins.	24	0.29	0.30
26	2 mins.	26	0.39	0.39
28	2 mins.	28	0.48	0.48
30	2 mins.	30	0.58	0.50
32	2 mins.	32	0.67	0.55
34	2 mins.	34	0.79	0.68
36	2 mins.	36	0.91	0.81
38	2 mins.	38	1.05	0.93
40	2 mins.	40	1.19	1.05
42	2 mins.	42	1.38	1.22
44	2 mins.	44	1.56	1.43
46	2 mins.	46	1.75	1.61
48	2 mins.	47	2.01	1.79
50	2 mins.	49	2.27	2.07
52	2 mins.	51	2.48	2.34
54	2 mins.	52	2.77	2.56
56	2 mins.		3.12	2.85
58			3.48	
60			4.00	
62			4.53	

Company Name:
Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales.
NP9 5FA

Engineers Name:
Peter Sobek

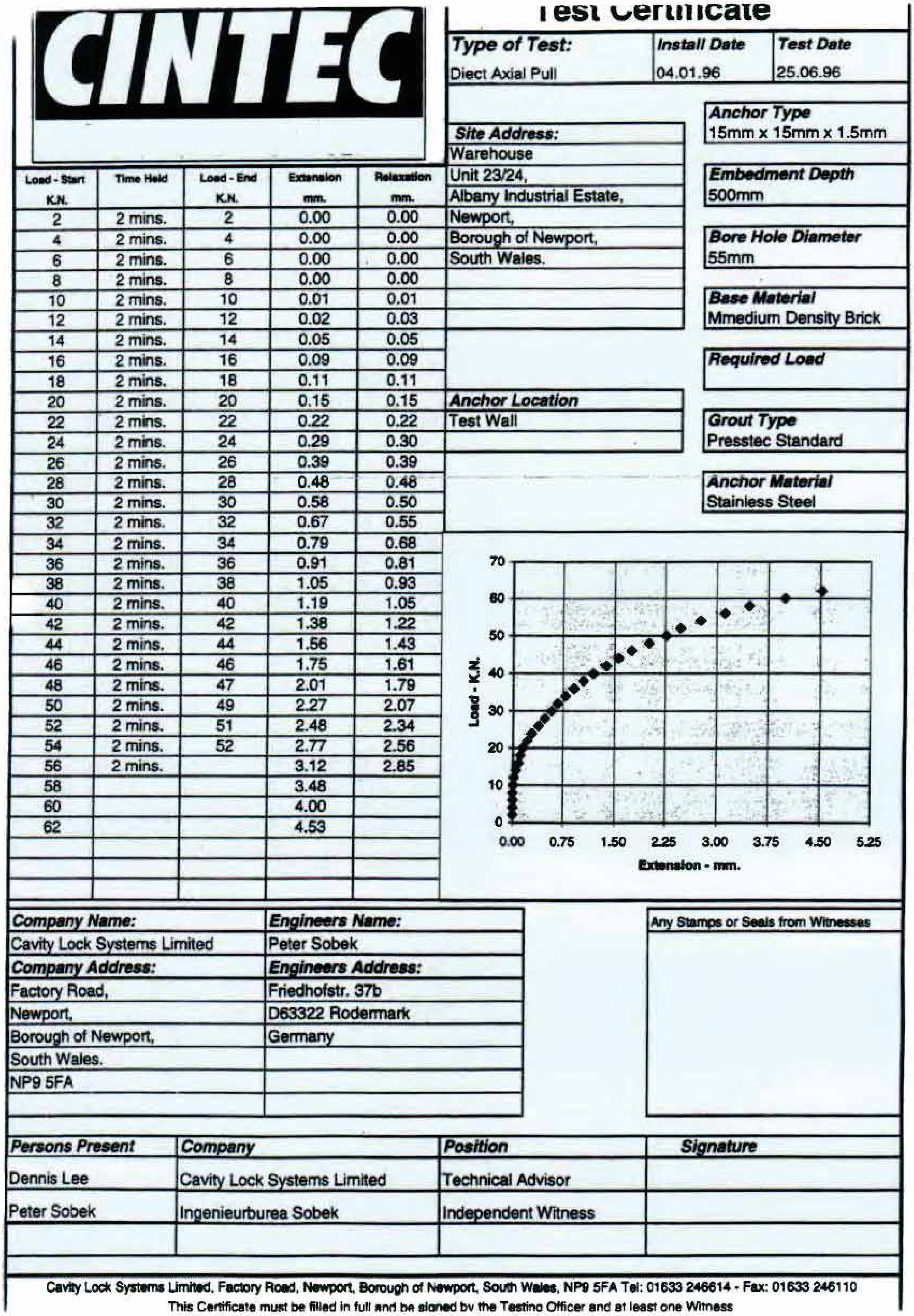
Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurburea Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Diect Axial Pull	04.01.96	25.06.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
15mm x 15mm x 1.5mm

Embedment Depth
500mm

Bore Hole Diameter
55mm

Base Material
Mmedium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	2 mins.	2	0.00	0.00
4	2 mins.	4	0.00	0.00
6	2 mins.	6	0.00	0.00
8	2 mins.	8	0.00	0.00
10	2 mins.	10	0.01	0.01
12	2 mins.	12	0.02	0.03
14	2 mins.	14	0.05	0.05
16	2 mins.	16	0.09	0.09
18	2 mins.	18	0.11	0.11
20	2 mins.	20	0.15	0.15
22	2 mins.	22	0.22	0.22
24	2 mins.	24	0.29	0.30
26	2 mins.	26	0.39	0.39
28	2 mins.	28	0.48	0.48
30	2 mins.	30	0.58	0.50
32	2 mins.	32	0.67	0.55
34	2 mins.	34	0.79	0.68
36	2 mins.	36	0.91	0.81
38	2 mins.	38	1.05	0.93
40	2 mins.	40	1.19	1.05
42	2 mins.	42	1.38	1.22
44	2 mins.	44	1.56	1.43
46	2 mins.	46	1.75	1.61
48	2 mins.	47	2.01	1.79
50	2 mins.	49	2.27	2.07
52	2 mins.	51	2.48	2.34
54	2 mins.	52	2.77	2.56
56	2 mins.		3.12	2.85
58			3.48	
60			4.00	
62			4.53	

Company Name:
Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales.
NP9 5FA

Engineers Name:
Peter Sobek

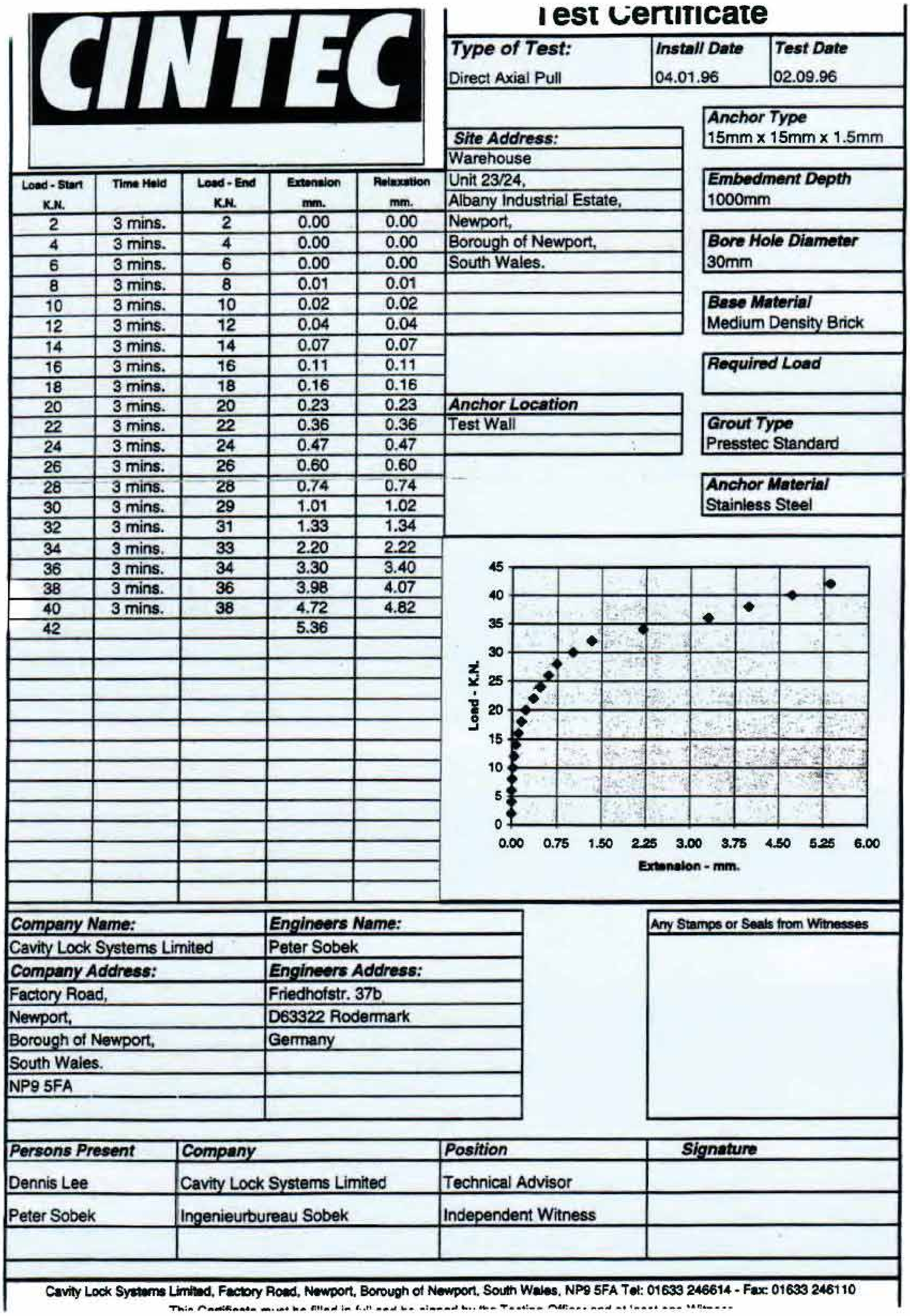
Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurburea Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Direct Axial Pull	04.01.96	02.09.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
15mm x 15mm x 1.5mm

Embedment Depth
1000mm

Bore Hole Diameter
30mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	3 mins.	2	0.00	0.00
4	3 mins.	4	0.00	0.00
6	3 mins.	6	0.00	0.00
8	3 mins.	8	0.01	0.01
10	3 mins.	10	0.02	0.02
12	3 mins.	12	0.04	0.04
14	3 mins.	14	0.07	0.07
16	3 mins.	16	0.11	0.11
18	3 mins.	18	0.16	0.16
20	3 mins.	20	0.23	0.23
22	3 mins.	22	0.36	0.36
24	3 mins.	24	0.47	0.47
26	3 mins.	26	0.60	0.60
28	3 mins.	28	0.74	0.74
30	3 mins.	29	1.01	1.02
32	3 mins.	31	1.33	1.34
34	3 mins.	33	2.20	2.22
36	3 mins.	34	3.30	3.40
38	3 mins.	36	3.98	4.07
40	3 mins.	38	4.72	4.82
42			5.36	

Company Name:
Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales.
NP9 5FA

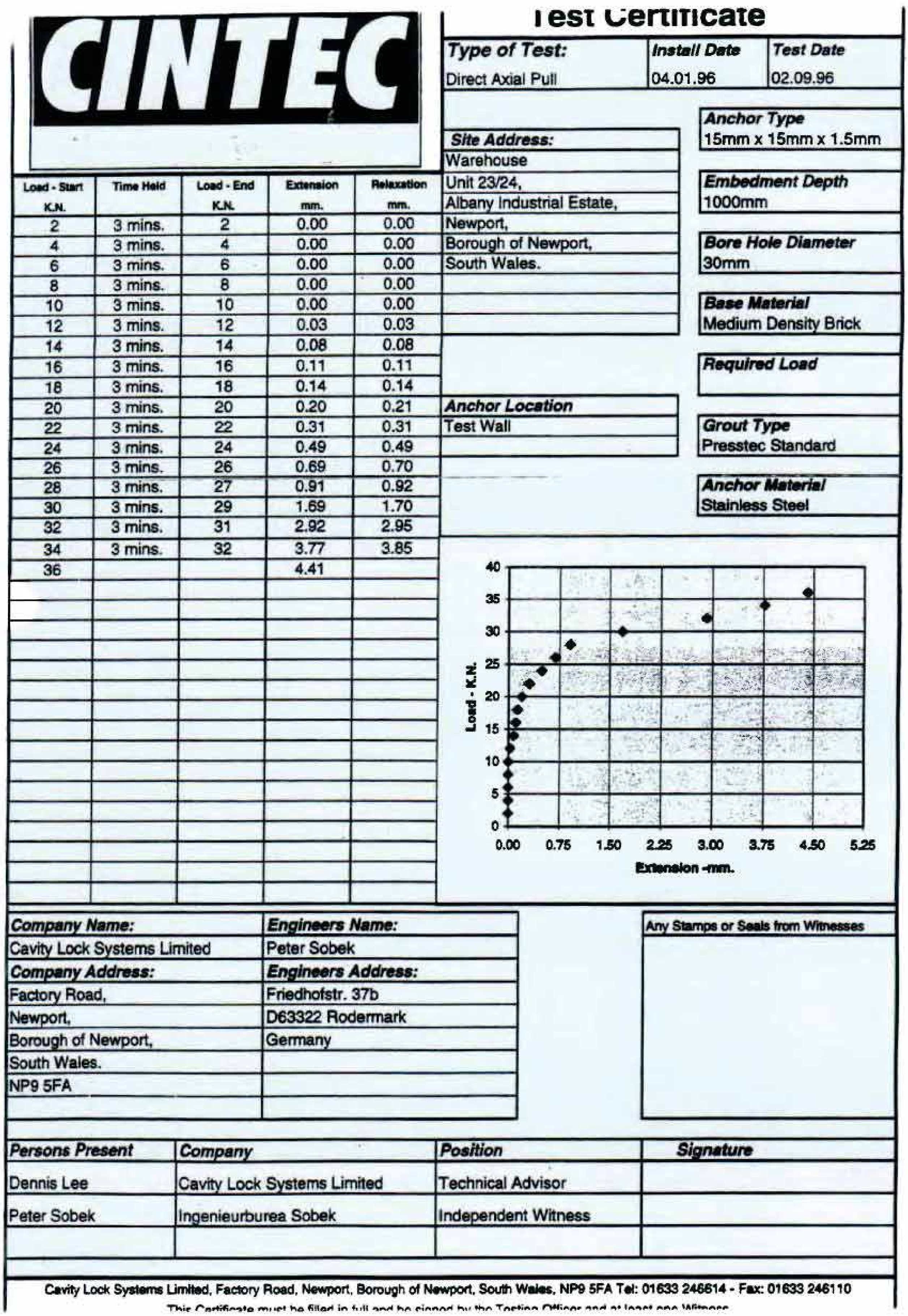
Engineers Name:
Peter Sobek

Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110



CINTEC

Test Certificate

Type of Test:
Direct Axial Pull

Install Date
04.01.96

Test Date
02.09.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
15mm x 15mm x 1.5mm

Embedment Depth
1000mm

Bore Hole Diameter
30mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	3 mins.	2	0.00	0.00
4	3 mins.	4	0.00	0.00
6	3 mins.	6	0.00	0.00
8	3 mins.	8	0.00	0.00
10	3 mins.	10	0.00	0.00
12	3 mins.	12	0.03	0.03
14	3 mins.	14	0.08	0.08
16	3 mins.	16	0.11	0.11
18	3 mins.	18	0.14	0.14
20	3 mins.	20	0.20	0.21
22	3 mins.	22	0.31	0.31
24	3 mins.	24	0.49	0.49
26	3 mins.	26	0.69	0.70
28	3 mins.	27	0.91	0.92
30	3 mins.	29	1.69	1.70
32	3 mins.	31	2.92	2.95
34	3 mins.	32	3.77	3.85
36			4.41	

Company Name:
Cavity Lock Systems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales.
NP9 5FA

Engineers Name:
Peter Sobek

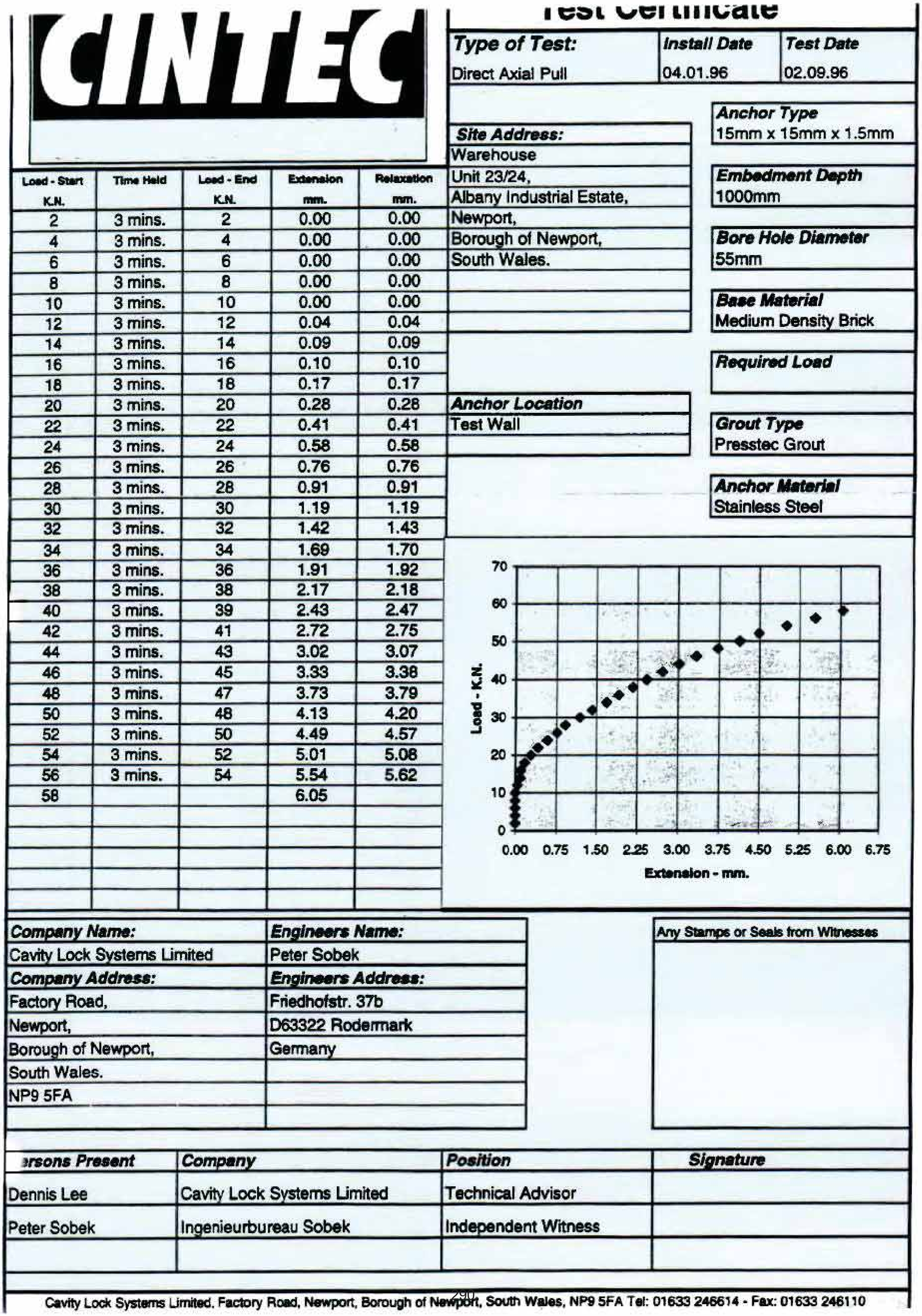
Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurburea Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



Test Certificate

Type of Test:	*Install Date*	*Test Date*
Direct Axial Pull	04.01.96	02.09.96

Anchor Type
15mm x 15mm x 1.5mm

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Embedment Depth
1000mm

Bore Hole Diameter
55mm

Base Material
Medium Density Brick

Required Load

Anchor Location
Test Wall

Grout Type
Presstec Grout

Anchor Material
Stainless Steel

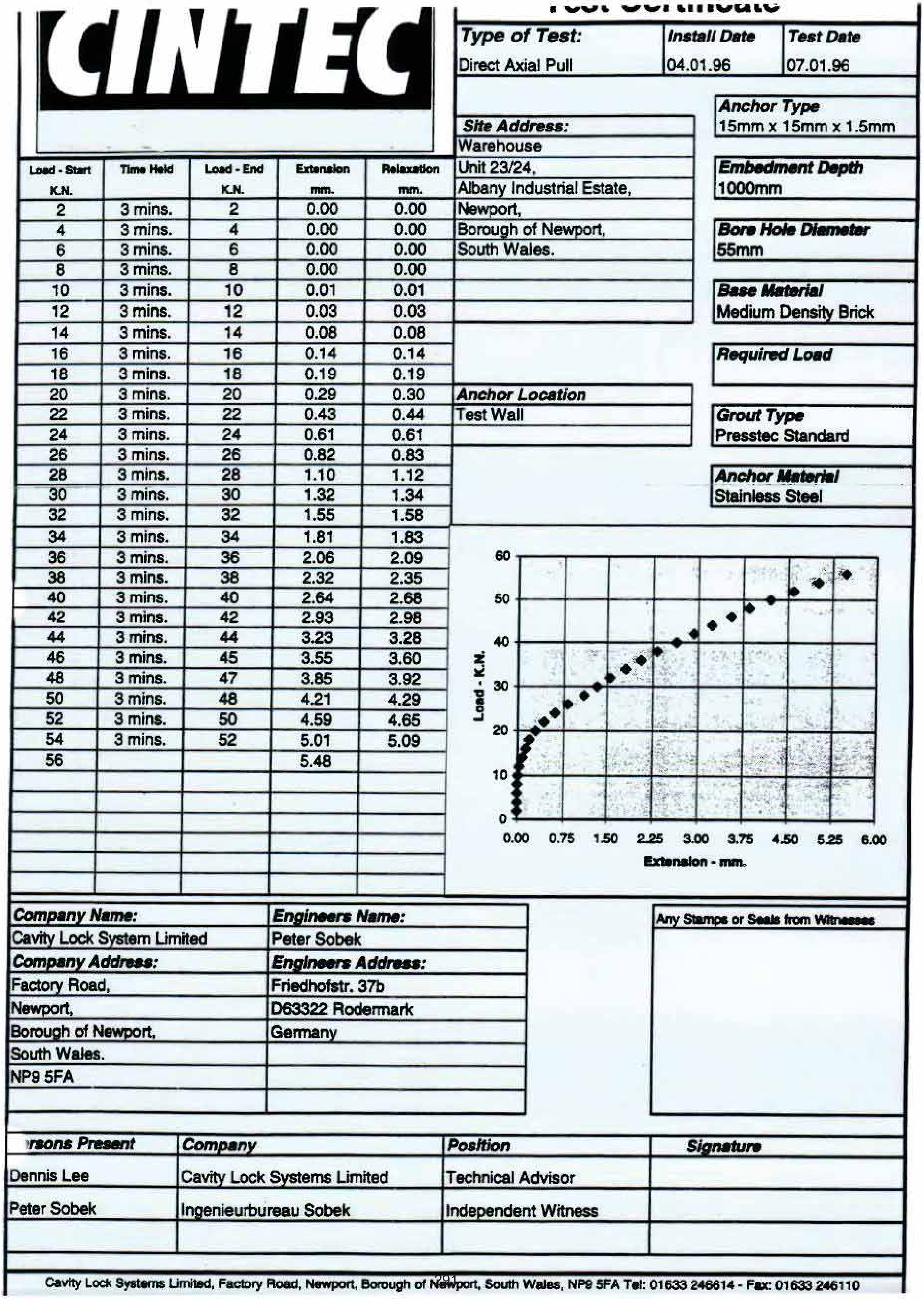
Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	3 mins.	2	0.00	0.00
4	3 mins.	4	0.00	0.00
6	3 mins.	6	0.00	0.00
8	3 mins.	8	0.00	0.00
10	3 mins.	10	0.00	0.00
12	3 mins.	12	0.04	0.04
14	3 mins.	14	0.09	0.09
16	3 mins.	16	0.10	0.10
18	3 mins.	18	0.17	0.17
20	3 mins.	20	0.28	0.28
22	3 mins.	22	0.41	0.41
24	3 mins.	24	0.58	0.58
26	3 mins.	26	0.76	0.76
28	3 mins.	28	0.91	0.91
30	3 mins.	30	1.19	1.19
32	3 mins.	32	1.42	1.43
34	3 mins.	34	1.69	1.70
36	3 mins.	36	1.91	1.92
38	3 mins.	38	2.17	2.18
40	3 mins.	39	2.43	2.47
42	3 mins.	41	2.72	2.75
44	3 mins.	43	3.02	3.07
46	3 mins.	45	3.33	3.38
48	3 mins.	47	3.73	3.79
50	3 mins.	48	4.13	4.20
52	3 mins.	50	4.49	4.57
54	3 mins.	52	5.01	5.08
56	3 mins.	54	5.54	5.62
58			6.05	

Company Name:	*Engineers Name:*
Cavity Lock Systems Limited	Peter Sobek
Company Address:	*Engineers Address:*
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

ersons Present	*Company*	*Position*	*Signature*
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110



CINTEC

Type of Test:	**Install Date**	**Test Date**
Direct Axial Pull	04.01.96	07.01.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test Wall

Anchor Type
15mm x 15mm x 1.5mm

Embedment Depth
1000mm

Bore Hole Diameter
55mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

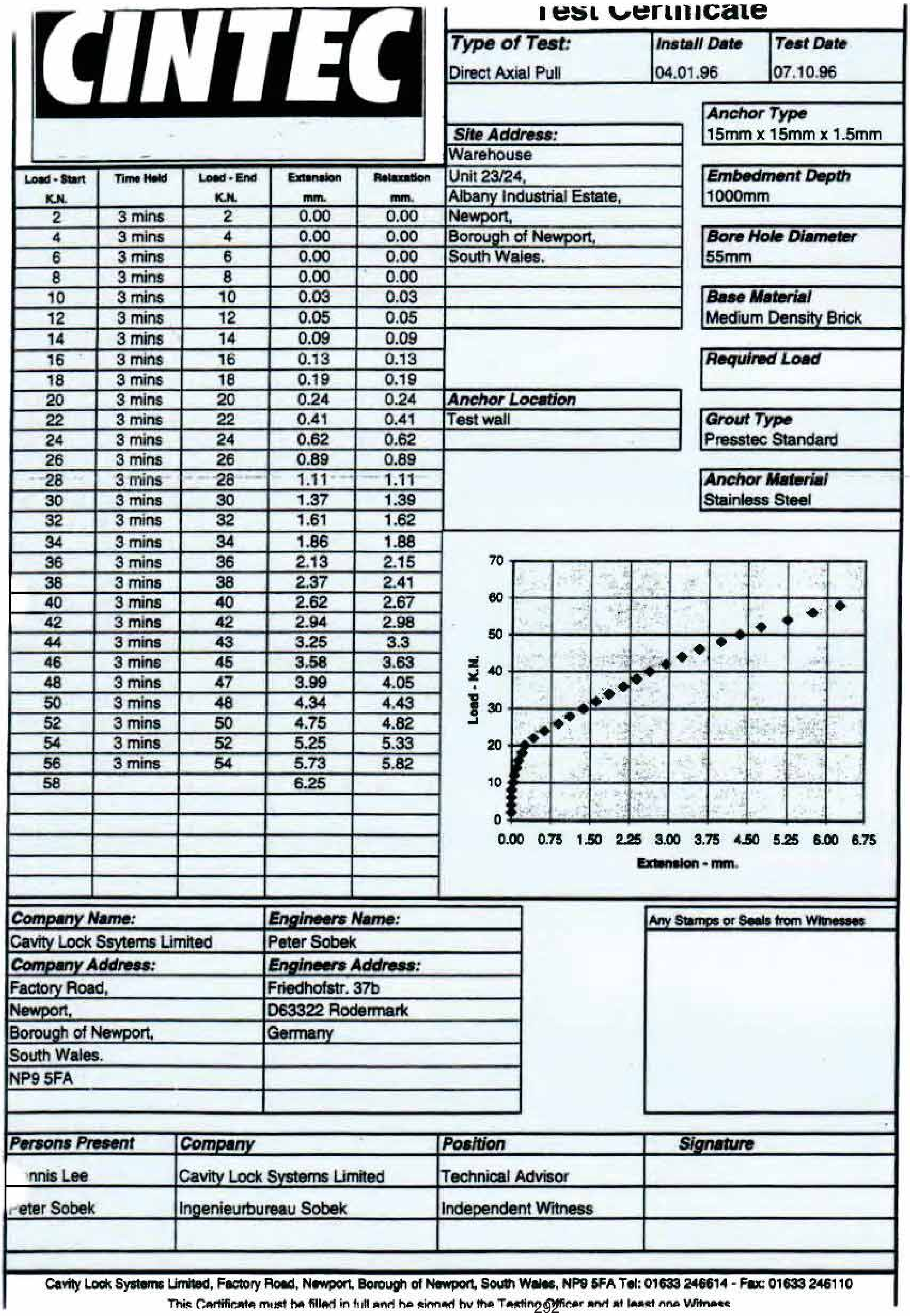
Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	3 mins.	2	0.00	0.00
4	3 mins.	4	0.00	0.00
6	3 mins.	6	0.00	0.00
8	3 mins.	8	0.00	0.00
10	3 mins.	10	0.01	0.01
12	3 mins.	12	0.03	0.03
14	3 mins.	14	0.08	0.08
16	3 mins.	16	0.14	0.14
18	3 mins.	18	0.19	0.19
20	3 mins.	20	0.29	0.30
22	3 mins.	22	0.43	0.44
24	3 mins.	24	0.61	0.61
26	3 mins.	26	0.82	0.83
28	3 mins.	28	1.10	1.12
30	3 mins.	30	1.32	1.34
32	3 mins.	32	1.55	1.58
34	3 mins.	34	1.81	1.83
36	3 mins.	36	2.06	2.09
38	3 mins.	38	2.32	2.35
40	3 mins.	40	2.64	2.68
42	3 mins.	42	2.93	2.98
44	3 mins.	44	3.23	3.28
46	3 mins.	45	3.55	3.60
48	3 mins.	47	3.85	3.92
50	3 mins.	48	4.21	4.29
52	3 mins.	50	4.59	4.65
54	3 mins.	52	5.01	5.09
56			5.48	

Company Name:	**Engineers Name:**
Cavity Lock System Limited	Peter Sobek
Company Address:	**Engineers Address:**
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

rsons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110



CINTEC

Test Certificate

Type of Test:	***Install Date***	***Test Date***
Direct Axial Pull	04.01.96	07.10.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test wall

Anchor Type
15mm x 15mm x 1.5mm

Embedment Depth
1000mm

Bore Hole Diameter
55mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2	3 mins	2	0.00	0.00
4	3 mins	4	0.00	0.00
6	3 mins	6	0.00	0.00
8	3 mins	8	0.00	0.00
10	3 mins	10	0.03	0.03
12	3 mins	12	0.05	0.05
14	3 mins	14	0.09	0.09
16	3 mins	16	0.13	0.13
18	3 mins	18	0.19	0.19
20	3 mins	20	0.24	0.24
22	3 mins	22	0.41	0.41
24	3 mins	24	0.62	0.62
26	3 mins	26	0.89	0.89
28	3 mins	28	1.11	1.11
30	3 mins	30	1.37	1.39
32	3 mins	32	1.61	1.62
34	3 mins	34	1.86	1.88
36	3 mins	36	2.13	2.15
38	3 mins	38	2.37	2.41
40	3 mins	40	2.62	2.67
42	3 mins	42	2.94	2.98
44	3 mins	43	3.25	3.3
46	3 mins	45	3.58	3.63
48	3 mins	47	3.99	4.05
50	3 mins	48	4.34	4.43
52	3 mins	50	4.75	4.82
54	3 mins	52	5.25	5.33
56	3 mins	54	5.73	5.82
58			6.25	

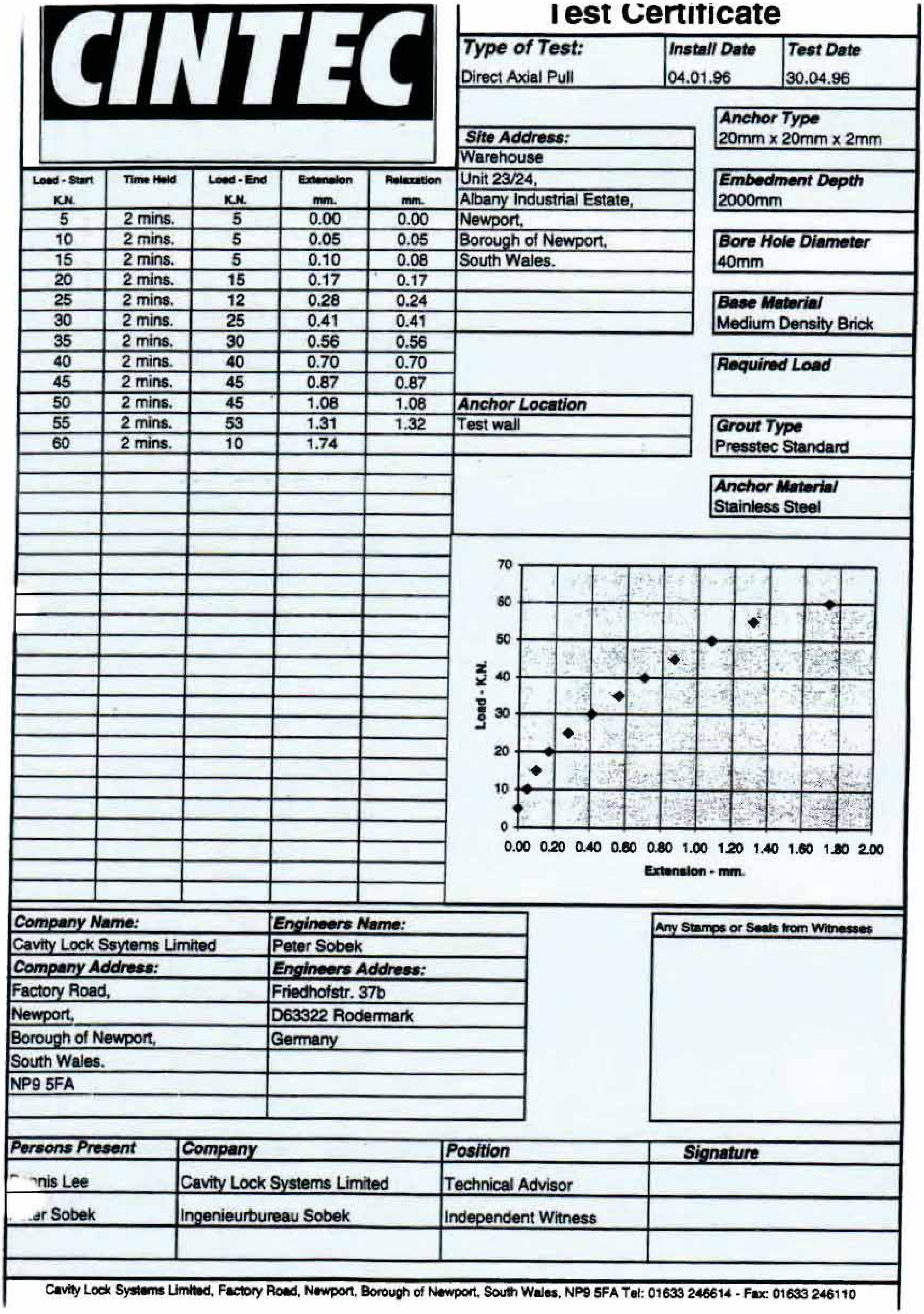
Company Name:	***Engineers Name:***
Cavity Lock Ssytems Limited	Peter Sobek
Company Address:	***Engineers Address:***
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

Persons Present	***Company***	***Position***	***Signature***
nnis Lee	Cavity Lock Systems Limited	Technical Advisor	
eter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110

This Certificate must be filled in full and be signed by the Testing Officer and at least one Witness



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Direct Axial Pull	04.01.96	30.04.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Type
20mm x 20mm x 2mm

Embedment Depth
2000mm

Bore Hole Diameter
40mm

Base Material
Medium Density Brick

Required Load

Anchor Location
Test wall

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
5	2 mins.	5	0.00	0.00
10	2 mins.	5	0.05	0.05
15	2 mins.	5	0.10	0.08
20	2 mins.	15	0.17	0.17
25	2 mins.	12	0.28	0.24
30	2 mins.	25	0.41	0.41
35	2 mins.	30	0.56	0.56
40	2 mins.	40	0.70	0.70
45	2 mins.	45	0.87	0.87
50	2 mins.	45	1.08	1.08
55	2 mins.	53	1.31	1.32
60	2 mins.	10	1.74	

Company Name:
Cavity Lock Ssytems Limited

Company Address:
Factory Road,
Newport,
Borough of Newport,
South Wales.
NP9 5FA

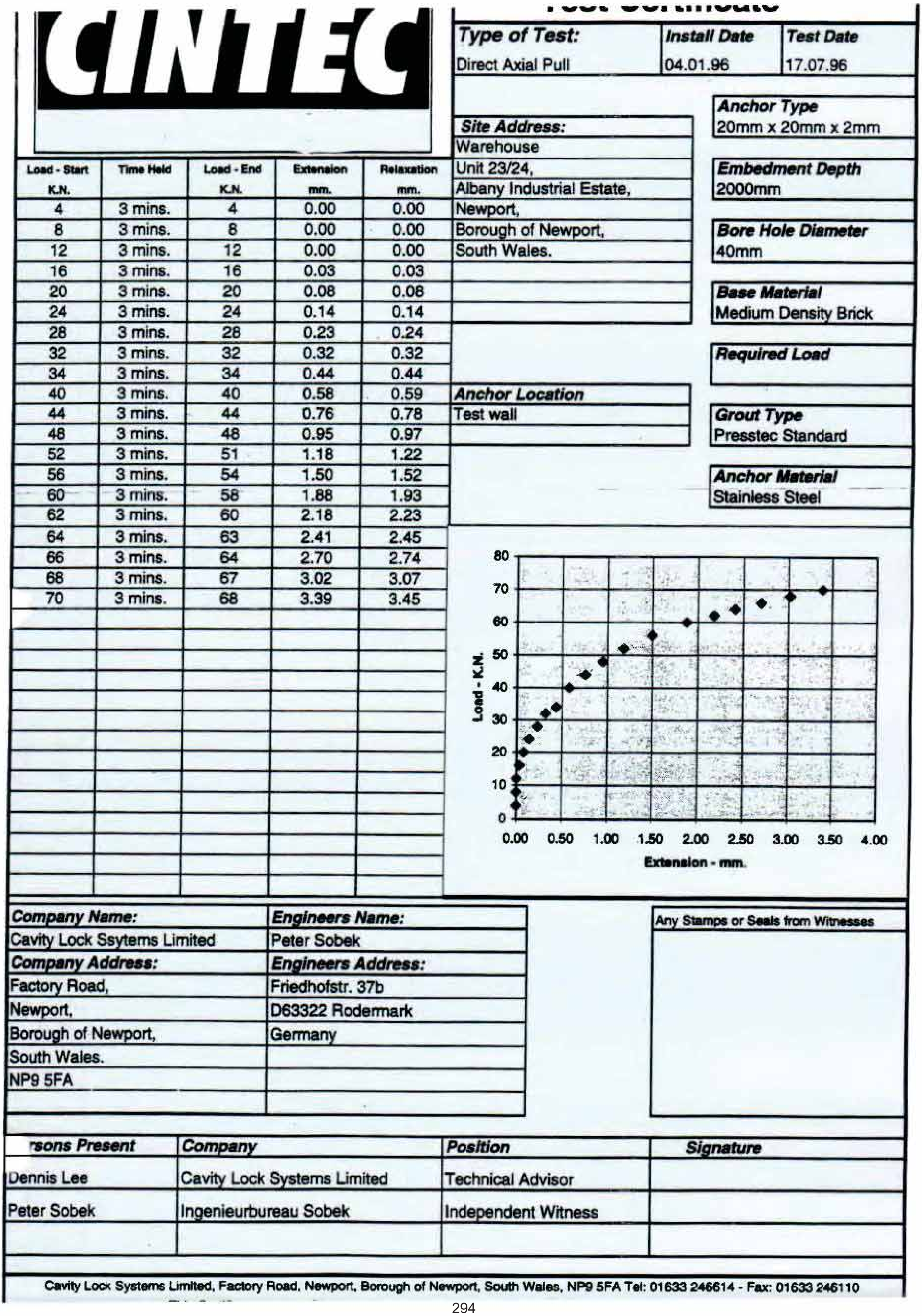
Engineers Name:
Peter Sobek

Engineers Address:
Friedhofstr. 37b
D63322 Rodermark
Germany

Any Stamps or Seals from Witnesses

Persons Present	Company	Position	Signature
nis Lee	Cavity Lock Systems Limited	Technical Advisor	
er Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110



CINTEC

Test Certificate

Type of Test:	Install Date	Test Date
Direct Axial Pull	04.01.96	17.07.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test wall

Anchor Type
20mm x 20mm x 2mm

Embedment Depth
2000mm

Bore Hole Diameter
40mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

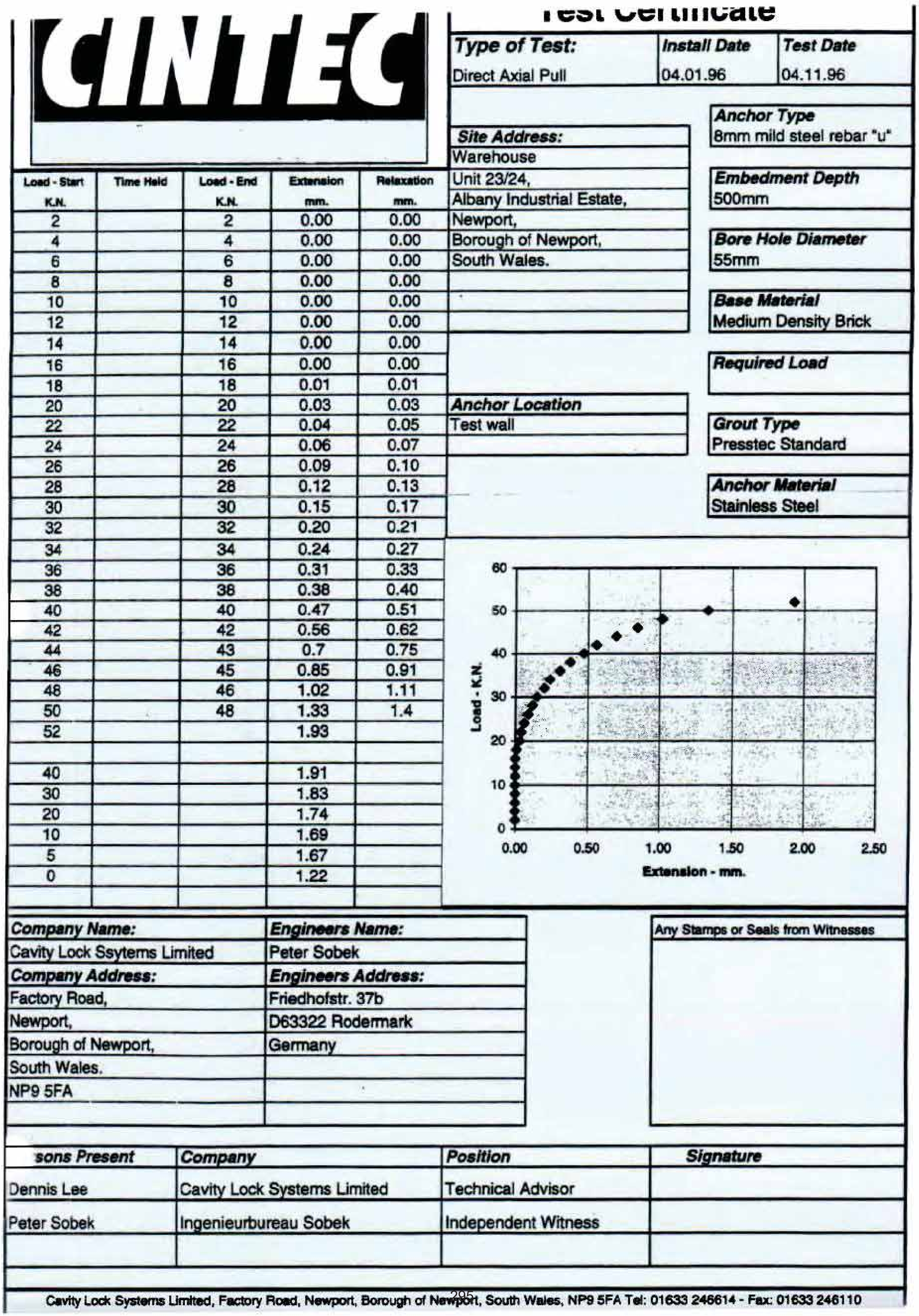
Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
4	3 mins.	4	0.00	0.00
8	3 mins.	8	0.00	0.00
12	3 mins.	12	0.00	0.00
16	3 mins.	16	0.03	0.03
20	3 mins.	20	0.08	0.08
24	3 mins.	24	0.14	0.14
28	3 mins.	28	0.23	0.24
32	3 mins.	32	0.32	0.32
34	3 mins.	34	0.44	0.44
40	3 mins.	40	0.58	0.59
44	3 mins.	44	0.76	0.78
48	3 mins.	48	0.95	0.97
52	3 mins.	51	1.18	1.22
56	3 mins.	54	1.50	1.52
60	3 mins.	58	1.88	1.93
62	3 mins.	60	2.18	2.23
64	3 mins.	63	2.41	2.45
66	3 mins.	64	2.70	2.74
68	3 mins.	67	3.02	3.07
70	3 mins.	68	3.39	3.45

Company Name:	Engineers Name:
Cavity Lock Ssytems Limited	Peter Sobek
Company Address:	**Engineers Address:**
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

rsons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110



CINTEC

Test Certificate

Type of Test:	**Install Date**	**Test Date**
Direct Axial Pull	04.01.96	04.11.96

Site Address:
Warehouse
Unit 23/24,
Albany Industrial Estate,
Newport,
Borough of Newport,
South Wales.

Anchor Location
Test wall

Anchor Type
8mm mild steel rebar "u"

Embedment Depth
500mm

Bore Hole Diameter
55mm

Base Material
Medium Density Brick

Required Load

Grout Type
Presstec Standard

Anchor Material
Stainless Steel

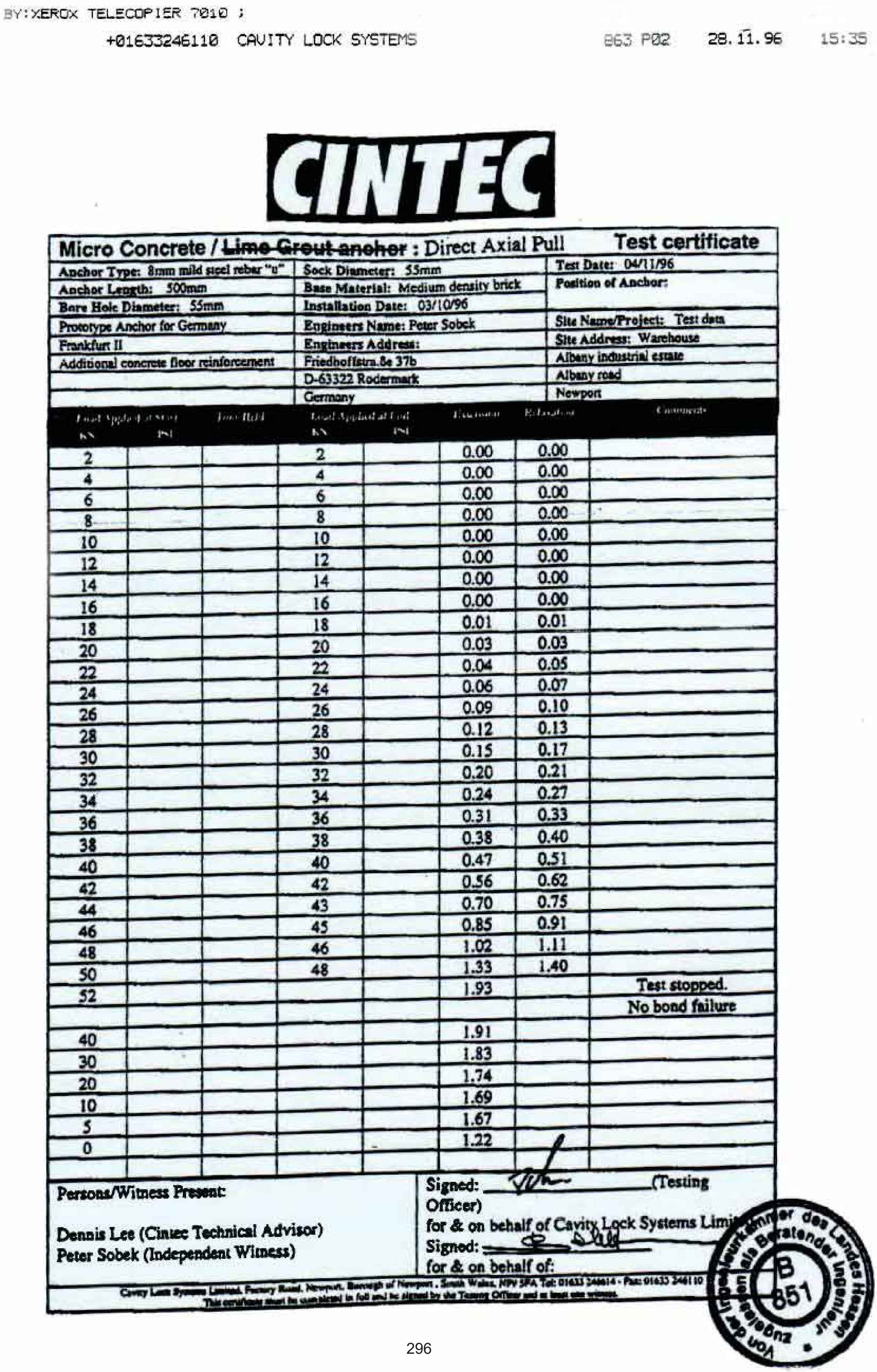
Load - Start K.N.	Time Held	Load - End K.N.	Extension mm.	Relaxation mm.
2		2	0.00	0.00
4		4	0.00	0.00
6		6	0.00	0.00
8		8	0.00	0.00
10		10	0.00	0.00
12		12	0.00	0.00
14		14	0.00	0.00
16		16	0.00	0.00
18		18	0.01	0.01
20		20	0.03	0.03
22		22	0.04	0.05
24		24	0.06	0.07
26		26	0.09	0.10
28		28	0.12	0.13
30		30	0.15	0.17
32		32	0.20	0.21
34		34	0.24	0.27
36		36	0.31	0.33
38		38	0.38	0.40
40		40	0.47	0.51
42		42	0.56	0.62
44		43	0.7	0.75
46		45	0.85	0.91
48		46	1.02	1.11
50		48	1.33	1.4
52			1.93	
40			1.91	
30			1.83	
20			1.74	
10			1.69	
5			1.67	
0			1.22	

Company Name:	**Engineers Name:**
Cavity Lock Ssytems Limited	Peter Sobek
Company Address:	**Engineers Address:**
Factory Road,	Friedhofstr. 37b
Newport,	D63322 Rodermark
Borough of Newport,	Germany
South Wales.	
NP9 5FA	

Any Stamps or Seals from Witnesses

sons Present	Company	Position	Signature
Dennis Lee	Cavity Lock Systems Limited	Technical Advisor	
Peter Sobek	Ingenieurbureau Sobek	Independent Witness	

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110



BY:XEROX TELECOPIER 7010 ;

+01633246110 CAVITY LOCK SYSTEMS 863 P02 28.11.96 15:35

CINTEC

Micro Concrete / ~~Lime Grout anchor~~ : Direct Axial Pull — Test certificate

Anchor Type: 8mm mild steel rebar "u"	**Sock Diameter:** 55mm	**Test Date:** 04/11/96
Anchor Length: 500mm	**Base Material:** Medium density brick	**Position of Anchor:**
Bore Hole Diameter: 55mm	**Installation Date:** 03/10/96	
Prototype Anchor for Germany	**Engineers Name:** Peter Sobek	**Site Name/Project:** Test data
Frankfurt II	**Engineers Address:**	**Site Address:** Warehouse
Additional concrete floor reinforcement	Friedhofstra.ße 37b	Albany industrial estate
	D-63322 Rodermark	Albany road
	Germany	Newport

Load Applied at Start KN	PSI	Time Held	Load Applied at End KN	PSI	Extension	Relaxation	Comments
2			2		0.00	0.00	
4			4		0.00	0.00	
6			6		0.00	0.00	
8			8		0.00	0.00	
10			10		0.00	0.00	
12			12		0.00	0.00	
14			14		0.00	0.00	
16			16		0.00	0.00	
18			18		0.01	0.01	
20			20		0.03	0.03	
22			22		0.04	0.05	
24			24		0.06	0.07	
26			26		0.09	0.10	
28			28		0.12	0.13	
30			30		0.15	0.17	
32			32		0.20	0.21	
34			34		0.24	0.27	
36			36		0.31	0.33	
38			38		0.38	0.40	
40			40		0.47	0.51	
42			42		0.56	0.62	
44			43		0.70	0.75	
46			45		0.85	0.91	
48			46		1.02	1.11	
50			48		1.33	1.40	
52					1.93		Test stopped.
							No bond failure
40					1.91		
30					1.83		
20					1.74		
10					1.69		
5					1.67		
0					1.22		

Persons/Witness Present:

Dennis Lee (Cintec Technical Advisor)
Peter Sobek (Independent Witness)

Signed: ____________(Testing Officer)
for & on behalf of Cavity Lock Systems Limi
Signed: ____________
for & on behalf of:

Von der Ingenieurkammer des Landes Hessen zugelassen als Beratender Ingenieur
B 851

Cavity Lock Systems Limited, Factory Road, Newport, Borough of Newport, South Wales, NP9 5FA Tel: 01633 246614 - Fax: 01633 246110
This certificate must be completed in full and be signed by the Testing Officer and at least one witness.

CINTEC
NORTH AMERICA

Tel 1-410-761-0765
1-613-225-3381
Fax 1-613 224-9042

E mail solutions@cintec.com

www.cintec.com