Grip-Tite®

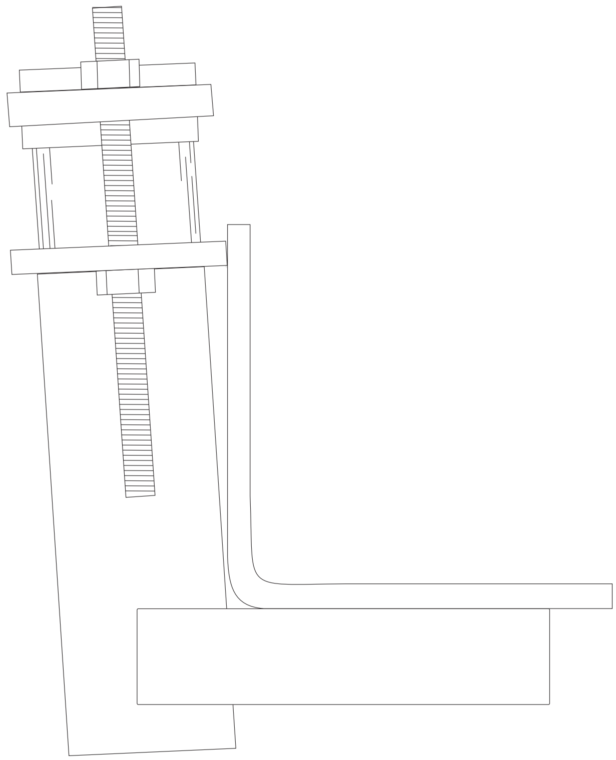
Foundation Pier System

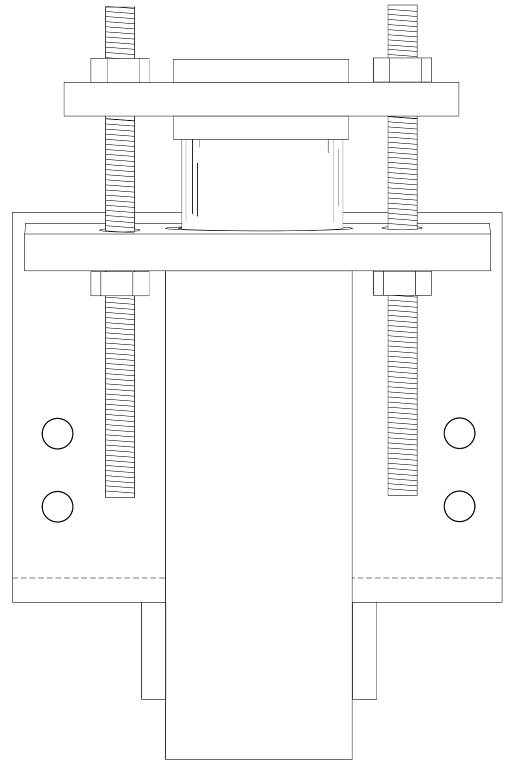
TECHNICAL REPORT

Grip-Tite® MANUFACTURING CO., INC.

P.O. BOX 111 • WINTERSET, IOWA 50273-0111 • TEL (515) 462-1313 • FAX (515) 462-3465

GRIP-TITE® FOUNDATION PIER SYSTEM





BRACKET ASSEMBLY Part No. FP3BA

TUBE: 3 7/8” OD x 3 1/8” ID x 10” long DOM mechanical steel tubing conforming to ASTM 513 - Type 5 / Grade 1026. Minimum Tensile Strength 80,000 psi / Minimum Yield Strength 70,000 psi

ANGLE BRACKET: 0.5” thick flat plate conforming to ASTM A-36 Hot Rolled Steel bent to form a 90 degree angle with equal sides of approximately 8”. Minimum Tensile Strength 58,000 psi / Minimum Yield Strength 36,000 psi

BRACKET SUPPORT STRAP : 0.375” thick x 2” wide x 21.25” flat bar conforming to ASTM A-36 Hot Rolled Steel which is bent into a “horse-shoe” shape around the bracket tube.. Minimum Tensile Strength 58,000 psi / Minimum Yield Strength 36,000 psi

TOP PLATE: 0.75” thick x 5.5” wide by 9.5” long conforming to ASTM A-36 Hot Rolled Steel. Minimum Tensile Strength 58,000 psi / Minimum Yield Strength 36,000 psi

CAP PLATE: 1.0” thick x 4.0” wide by 8.5” long conforming to ASTM A-36 Hot Rolled Steel. Minimum Tensile Strength 58,000 psi / Minimum Yield Strength 36,000 psi

WELD: E71T1 Minimum Tensile Strength 71,000 psi - performed by AWS certified welders

THREADED ROD: 3/4” diameter x 12” long ASTM A311 - Class B / Grade 7 Zinc Plated. Minimum Tensile Strength 133,000 psi / Minimum Yield Strength 115,000 psi

PROJECT NUMBER: 3618 200-8742.1 **PAGE:** 1 of 2
DATE: July 20, 2000

Patzig Testing Laboratories
3922 Delaware Avenue
Des Moines, Iowa 50313-2597

REPORT OF LOAD TESTING

Prepared for:
Grip-Tite Co., Inc.
Attn: Mike Johnson
115 W. Jefferson Street
P.O. Box 111
Winterset, IA 50273-0111

Client Purchase Order Number: Mike Johnson

Prepared by:

Brian S. Escherich
Job Manager
Mechanical/Metallurgical Dept.
Phone: (515) 266-5101

Reviewed by:

Timothy B. Cox, P.E.
Product Service Manager
Mechanical/Metallurgical Dept.

The test results contained in this report pertain only to the samples submitted for testing and not necessarily to all similar products.

INTRODUCTION:

This report presents the results of load tests performed on house support piers. This work was requested by Mike Johnson of Grip-Tite Manufacturing Co., Inc. The samples were received on June 22, 2000 with the work conducted on July 19, 2000.

SAMPLE DESCRIPTION:

A total of 1 sample was received. The sample was described as an all-steel pier bracket for 3" tube (new design-robotically welded). Major design details consist of 0.5-inch X 8 X 8-inch flat plate bent 90° as the bracket and 0.75-inch thick top plate with a 1.0-inch thick cap plate. Threaded rod to hold cap to top plate was ¾-10 grade 7 with 3/4 inch grade 8 nuts.

TESTING PROCEDURE:

The sample was attached to a fixture inverted from its normal position. A three inch diameter solid round bar was used to apply the load directly to the cap at a rate of approximately 12,000 to 24,000 lbs./minute with inspections and data recorded at 20,000, 30,000, and finally at the point when the samples would no longer accept additional loads. Deflection readings were taken from a dial indicator measuring the relative travel between the ram and the crosshead. (Some of the deflection may have been movement of the fixture rather than the sample)

TEST RESULTS:

LOAD OF CAP AT 4" BETWEEN PLATES		
INCHES OF DEFLECTION	**DESCRIPTION OF FAILURE**	**PEAK LOAD (LBS)**
0.130	None	20,000
0.155	None	30,000
Not recorded	Bolt stretch	96,700

NOTE - The bolt stretch for sample = 0.24" RIGHT and 0.24" LEFT.

DISPOSITION OF SAMPLES:

Samples were returned to Mike Johnson at completion of testing.

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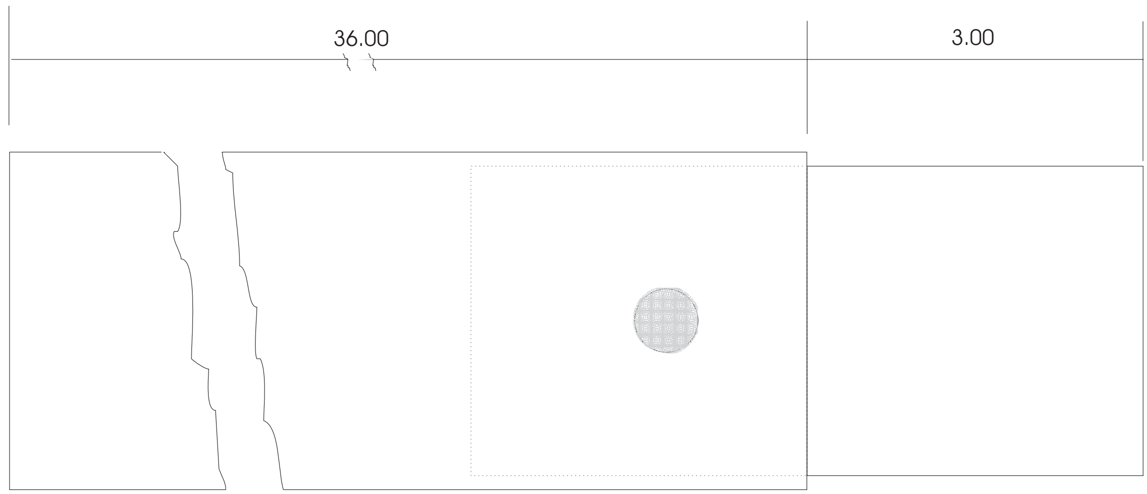
GRIP-TITE® FOUNDATION PIER SYSTEM



PIER TUBE WITH COUPLER Part No. FP3T
FRICTION COLLAR Part No. FP3FC

<u>TUBE:</u> 3" OD x .120 Wall High Strength / Low Alloy Hot Rolled Electric Weld. Minimum Tensile Strength 80,000 psi / Minimum Yield Strength 70,000 psi

<u>COUPLER:</u> 2.75" OD x .134 Wall DOM Mechanical Steel Tubing. Minimum Tensile Strength 80,000 psi / Minimum Yield Strength 70,000 psi

<u>FRICTION COLLAR:</u> 3.25" OD x .438 Wall DOM Mechanical Steel Tubing x 3.125" long. Minimum Tensile Strength 80,000 psi / Minimum Yield Strength 70,000 psi

PROJECT NUMBER: 3618 199-8240

DATE: December 23, 1999

Patzig Testing Laboratories
3922 Delaware Avenue
Des Moines, Iowa 50313-2597

REPORT OF LOAD TESTING
3 inch O.D. GRIP TITE TUBE

Prepared for:
Grip-Tite Co., Inc.
Attn: Mike Johnson
115 W. Jefferson Street
P.O. Box 111
Winterset, IA 50273-0111

Client Purchase Order Number: Mike Johnson

Prepared by:

Brian Escherich

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Job Manager
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Timothy Cox

Timothy B. Cox, P.E.
Product Service Manager
Mechanical/Metallurgical Dept.

The test results contained in this report pertain only to the samples submitted for testing and not necessarily to all similar products.

INTRODUCTION:

This report presents the results of load tests performed on three inch outside diameter tube. This work was requested by Mike Johnson of Grip-Tite Manufacturing Co., Inc. The samples were received and tested on December 21, 1999.

SAMPLE DESCRIPTION:

A total of 3 specimens were received. Each specimen was described as a Grip - Tite 3 inch O.D. tube with a nominal wall thickness of 0.120 inches by 3 feet long. Each 3 foot long section of tube had a coupler welded to the inside to fit to the inside of the adjoining pipe.

TESTING PROCEDURE:

Each specimen was placed vertically between two loading plates and loaded in compression at a rate of approximately 24,000 lbs./minute until the specimens would no longer accept additional loads.

TEST RESULTS:

SPECIMEN	PEAK LOAD (lbs.)
#2-Two 3' sections together	81,700
#3-One 3' section	96,100

NOTE - The columns would no longer accept additional load when buckling started. The tests were performed with a friction collar over the coupler at the base.

DISPOSITION OF SAMPLES:

Samples were returned to Mike Johnson at completion of testing.

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ULTIMATE COMPONENT CAPACITIES

CATALOG NUMBER	COMPONENT (PRODUCT) DESCRIPTION	ULTIMATE CAPACITY (pounds)
FP3BA	3" PIER BRACKET ASSEMBLY	96,700[1]
FP3T	3" PIER TUBE - 36" LONG W/COUPLER	96,100[1]

General Notes:

1. Test data by Stork (December 1999 and July 2000)
2. Actual Capacities may vary based on bracket assembly position against the foundation system and pier tube inclination.
3. Working and/or Allowable Capacities should be based on appropriate Safety Factors in accordance with standard design practices.

GRIP-TITE® FOUNDATION PIER SYSTEM

TECHNICAL SUPPORT DATA

FOUNDATION ENGINEERING by Peck, Hanson and Thornburn states the following under the heading "Action of Piles Under Loads":

A point-bearing pile surrounded by soil is sometimes erroneously regarded as a structural member that transfers its load like a column from the top of the pile to the bottom where it is delivered to the underlying rock or soil. This concept leads to the conclusion that the stresses in the pile should not exceed those that would be considered tolerable in a column of the same dimensions and materials. However, experience has amply demonstrated that structural failures of driven piles are so rare that the eventuality need seldom be considered in design. During load tests on piles, if structural failure of the pile itself occurs, it usually takes place at or above the ground surface where the projecting part of the pile is not surrounded by soil. Furthermore, both experience and theory have demonstrated that there is no danger that a point-bearing pile may buckle on account of inadequate lateral support, provided it is surrounded by even the very softest soils.

These observations lead to the conclusion that the capacity of a point-bearing pile depends almost entirely on the capacity of the material upon which the point finds its bearings, and on the degree to which the point of the pile has a satisfactory seat on the bearing material. It is obvious that the ultimate bearing capacity of the pile increases with increasing bearing area, whence it may be concluded that the capacity of piles with large point diameters is greater than that of piles with small point diameters. On the other hand, if the bearing stratum is at considerable depth or is overlain by moderately resistant material, it may not be possible to drive a large-diameter pile to a firm seat on the bearing stratum, whereas a more slender pile that displaces less soil may successfully reach the firm material and may have a higher capacity.

THIXOTROPHY

The Grip-Tite® Foundation Pier System carrying ability increases with time because of the concept of THIXOTROPHY, which is defined as "particles attempting to reoccupy the space from which they were removed.". Simply stated, the soil that is displaced by driving the pier tubes into the soil wants to reoccupy the space that is now taken up by the tubes. The soil grabs the pier tube wall which greatly increases the carrying ability because of this frictional support.

Even in very short periods of time THIXOTROPHY will affect the pier capacity. A pier started and driven at a given pressure that is left to sit overnight may require 50% to 100% more pressure to begin driving again the very next day. The additional pressure varies greatly due to varying soil types and conditions. While this frictional support is not used in support load calculations, it adds another significant safety factor to the system.

GRIP-TITE® FOUNDATION PIER SYSTEM

CORROSION INFORMATION

The United States Department of Commerce/National Bureau of Standards book entitled **NBS PAPERS ON UNDERGROUND CORROSION OF STEEL PILINGS** states the following in part:

Background

Data obtained by the National Bureau of Standards on the corrosion performance of steel piles driven into the ground in a wide variety of soil environments show that the strength and useful life of steel piles are not significantly affected by corrosion. These findings are in sharp contrast to those of earlier corrosion studies in which iron and steel specimens, such as pipe, that are buried under "disturbed" soil conditions exhibit varying amounts of corrosion.

Summary

Steel pilings which have been in service in various underground structures for periods ranging between 7 and 40 years were inspected by pulling piles at 8 locations and making excavations to expose pile sections at 11 locations. The conditions at the sites varied widely, as indicated by the soil types which ranged from well-drained sands to impervious clays, soil resistivities which ranged from 300 ohm-cm to 50,200 ohm-cm, soil *p*H which ranged from 2.3 to 8.6.

The data indicate that the type and amount of corrosion observed on the steel pilings driven into undisturbed natural soil, regardless of the soil characteristics and properties, is not sufficient to significantly affect the strength or useful life of pilings as load-bearing structures.

Moderate corrosion occurred on several piles exposed to fill soils which were above the water table level or in the water table zone. At these levels the pile sections are accessible if the need for protection should be deemed necessary.

It was observed that soil environments which are severely corrosive to iron and steel buried under disturbed conditions in excavated trenches were not corrosive to steel pilings driven in the undisturbed soil. The difference in corrosion is attributed to the differences in oxygen concentration. The data indicate that undisturbed soils are so deficient in oxygen at levels a few feet below the ground line or below the water table zone, that steel pilings are not appreciably affected by corrosion, regardless of the soil types or the soil properties. Properties of soils such as type, drainage, resistivity, *p*H or chemical composition are of no practical value in determining the corrosiveness of soils toward steel pilings driven underground. This is contrary to everything previously published on specimens exposed in disturbed soils and do not apply to steel pilings which are driven in undisturbed soils.

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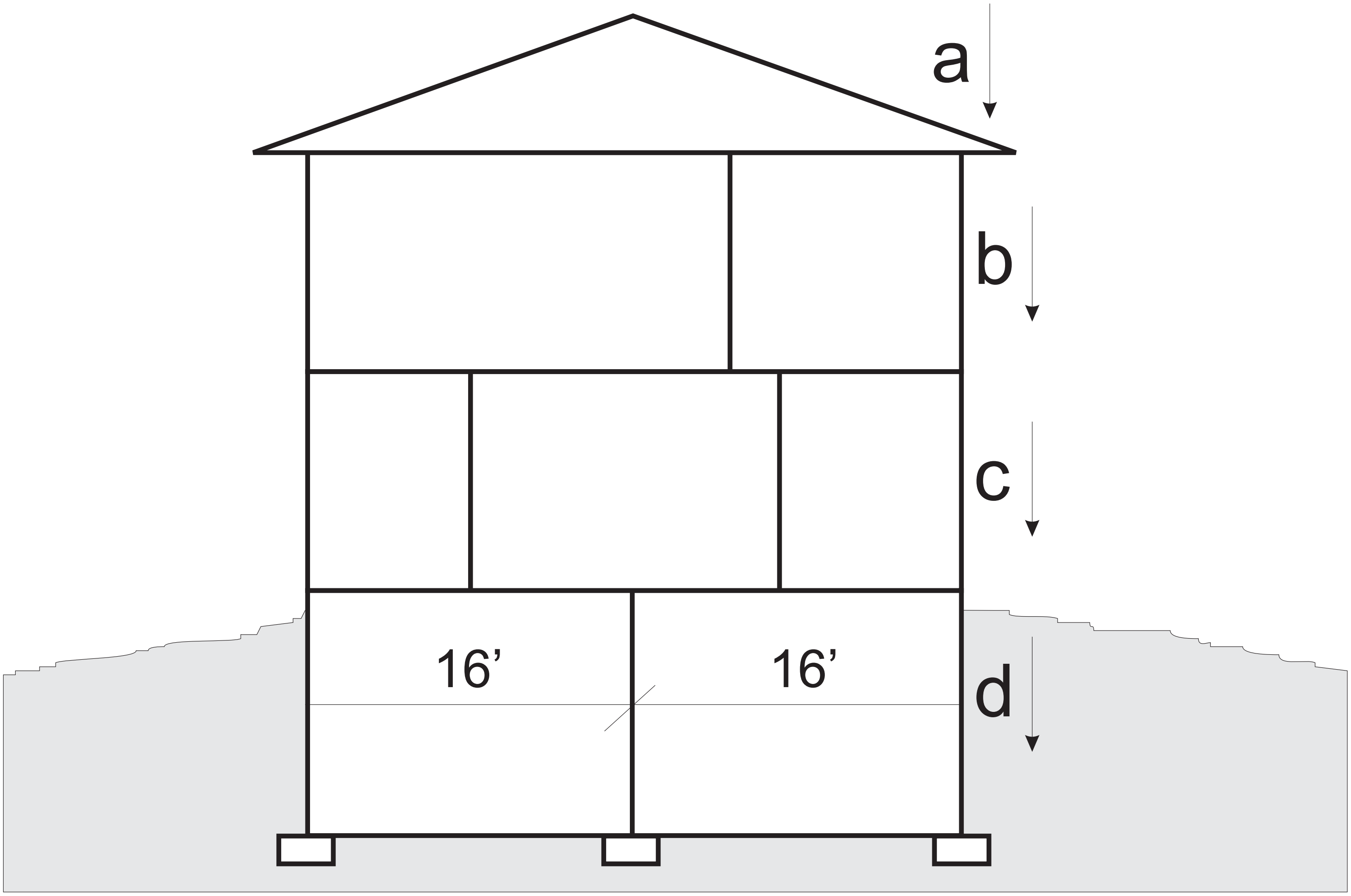
The National Association of Engineers (N.A.C.E.) publications titled “Corrosion Basics” makes these statements pertaining to corrosion and coatings:

NACE page 213	An obvious method of controlling corrosion is that of interposing a barrier between the threatened metal surface and the corrosive medium, *i.e.* some kind of coating. Since corrosion always requires the presence of an electrolyte (moisture) in contact with the metal, if a metal could be coated with a material which was absolutely waterproof and absolutely free from holes, all attack would be stopped. The coating, it should be noted, would not only need these two properties when it was applied, but the two properties would have to be permanent the coating would have to remain perfect in both respects.
NACE page 216	An important difference with steel piling is that a few pits or even holes have little effect on its structural strength. Consequently, much more corrosion can be tolerated than with pipelines. Piling is almost always bare, vertical, and hence subject to the same kinds of cells that attach oil well casings. Bonding often may be a problem because individual piles may not be interconnected electrically, a condition that makes both investigation and protection a problem.
NACE page 216	Galvanized steel is not normally installed underground. The thin zinc coating is quickly dissipated by galvanic action with any exposed steel.
NACE page 238	As soon as a pore or bare spot appears, the corrosion of the bare metal is accelerated.
NACE page 266	A coating may fail as a result of a large number of potentially adverse conditions. Some of these can be defined as mechanical, as when abrasion or impact removes the coating.

The above information shows clearly that coatings on steel piers does not effectively increase its life expectancy. It may in fact, due to abrading that can occur in coatings of steel drive piers, actually decrease its life expectancy. Please refer to the N.A.C.E. and N.B.S. publications for additional information.

LOADS ON WALL



a) ROOF	**16' @**	**40 psf = 640 plf**
b) FLOOR	**8' @**	**35 psf = 280 plf**
c) FLOOR	**8' @**	**55 psf = 440 plf**
d) WALL	**9' @**	**100 psf = 900 plf**
		2,260 plf
WALL VENEER (ie: brick)		**310 plf**
		2,570 plf

SOURCE: REPAIRING RESIDENTIAL WALLS, BRENT ANDERSON P.E., FRIDLEY, MN
WORLD OF CONCRETE 2000 SEMINAR 24-70