MODEL SPECIFICATION FOR PUSH PIER FOUNDATIONS

COMPRESSION APPLICATIONS

# SCOPE

## The work consists of designing, furnishing and installing push piers and load transfer devices used to support compressive loads according to the project Plans and these specifications.

## The parties and contract terms referred to in this specification are as follows:

### The Owner is the person or entity that owns the facility or will own the facility once it is completed. The Owner may have contractual agreements with, and be represented by, other parties such as engineers, architects or contractors that perform services under the direction of the Owner. Where Owner is used in this specification, it refers to the Owner or the Owner’s contracted representatives separate from the Installing Contractor.

### The Pier Designer is the individual or firm generally hired by the Installing Contractor to design the push piers.

### The Installing Contractor installs and tests (if necessary) the push piers, and possibly performs other tasks associated with the project.

### The Plans refer to the contract documents; including but not limited to the drawings and specifications for the project.

## The work may include push pier load testing.

## The Owner will be responsible for obtaining any right-of-way or easement access permits necessary for the push pier installation.

## Unless otherwise noted, the Installing Contractor shall provide all labor, tools, equipment and materials necessary to accomplish the work.

## The Owner will provide suitable access to the construction site for the Installing Contractor’s personnel and equipment.

## Unless specifically noted otherwise in the contract documents, the Owner will remove and replace any structures, utilities, pavements, landscaping or other surficial improvements in the work area as necessary to facilitate the work.

## The Owner will be responsible for overall construction oversight to preclude the development of unsafe conditions.

## Unless specifically noted otherwise in the contract documents, the Owner will be responsible for a horizontal field survey of the push pier locations prior to push pier installation and an elevation survey to determine final structural lift subsequent to push pier installation (if necessary).

## The work does not include any post-construction monitoring of pier performance unless specifically noted otherwise in the contract documents.

# references

## American Institute of Steel Construction (AISC)

### AISC 360: Specification for Structural Steel Buildings

## American Society for Testing and Materials (ASTM)

### ASTM A36: Carbon Structural Steel

### ASTM A123: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

### ASTM A500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

### ASTM A513: Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing

### ASTM A572: High-Strength Low-Alloy Columbian-Vanadium Structural Steel

### ASTM B633: Electrodeposited Coatings of Zinc on Iron and Steel

### ASTM D1143: Deep Foundations Under Static Axial Compressive Load

* 1. International Code Council Evaluation Services (ICC-ES)

### Acceptance Criteria 358 (AC358): Acceptance Criteria for Helical Pile Systems and Devices

### Acceptance Criteria 406 (AC406): Acceptance Criteria for Belled Segmented Pipe Foundation Systems and Devices

# DEFINITIONS

## The following terms apply to push piers used to support compressive loads.

### Allowable Stress Design: A structural and geotechnical design methodology that states that the summation of the actual estimated loads (nominal loads) must be less than or equal to the allowable design load (required strength).  Allowable loads are obtained by dividing a nominal resistance (strength) by an appropriate factor of safety.

### Bearing Stratum: The soil layer (or layers) that provide the push pier end bearing capacity.

### Design Loads: A generic and ambiguous term used to describe any load used in design. It is not specific to factored or unfactored loads or any particular design methodology. It is a term; therefore, that should be avoided when specifying load requirements. FSI recommends using the term service load, nominal load or factored load, as described herein, where applicable.

### Design Strength: A term used in structural design which is defined as the product of the nominal strength and the applicable resistance factor. An equivalent term typically used in geotechnical design is, also sometimes referred to as factored resistance (Load and Resistance Factor Design).

### External Sleeve: Hollow steel shaft section installed through the bracket assembly and around the pier starter tube to provide additional bending strength at and directly below the bracket.

### Factor of Safety: The ratio of the ultimate pier capacity or nominal resistance (strength) to the nominal or service load used in the design of any push pier component or interface (Allowable Stress Design).

### Factored Load: The product of a nominal load and an applicable load factor (Load and Resistance Factor Design).

### Factored Resistance: The product of a nominal resistance and an applicable resistance factor (Load and Resistance and Factor Design).

### Geotechnical Capacity: The maximum load or the load at a specified limit state, that can be resisted through the push piers interaction with the bearing soils (see also Ultimate Pier Capacity).

### Limit State: A condition beyond which a push pier component or interface becomes unfit for service and is judged to no longer be useful for its intended function (serviceability limit state) or to be unsafe (ultimate limit state (strength)).

### Load and Resistance Factor Design: A structural and geotechnical design methodology that states that the Factored Resistance (Design Strength) must be greater than or equal to the summation of the applied factored loads.

### Load Factor: A factor that accounts for the probability of deviation of the actual load from the predicted nominal load due to variability of material properties, workmanship, type of failure and uncertainty in the prediction of the load (Load and Resistance Factor Design).

### Load Test: A process to test the ultimate pier capacity and relation of applied load to pier head settlement by application of a known load on the push pier head and monitoring movement over a specific time period.

### Loads: Forces that result from the weight of all building materials, occupants and their possessions, environmental effects, differential movement, and restrained dimensional changes. Permanent loads are those loads in which variations over time are rare or of small magnitude. All other loads are variable loads (see also Nominal Loads).

### Mechanical Strength: The maximum load or the load at a specified limit state that can be resisted by the structural elements of a push pier.

### Net Deflection: The total settlement at the pier head minus the theoretical elastic deformation of the pier shaft during a load test.

### Nominal Loads: The magnitude of the loads specified, which include dead, live, soil, wind, snow, rain, flood and earthquakes (also referred to as service loads or working loads).

### Nominal Resistance: The pier capacity at a specified ultimate limit state (Load and Resistance Factor Design). See Ultimate Pier Capacity.

### Nominal Strength: A term used in structural design which is defined as the structure or member capacity at a specified strength limit state. See Ultimate Pier Capacity.

### Pier Tube: Hollow steel shaft sections that follow the starter tube section. The pier tubes have slip-fit internal couplings and are hydraulically advanced to the required bearing depth.

### Push Pier System: A hydraulically-driven retrofit deep foundation that utilizes high-strength round steel tube and a load-transfer bracket (retrofit bracket) to stabilize and/or lift sinking or settling foundations. The system uses the weight of the structure and any contributory soil load above the footings to create the reaction to hydraulically advance (push) the pier tubes.

### Resistance Factor: A factor that accounts for the probability of deviation of the actual resistance (strength) from the predicted nominal resistance (strength) due to variability of material properties, workmanship, type of failure and uncertainties in the analysis (Load and Resistance Factor Design).

### Safety Factor: The ratio of the ultimate pier capacity to the nominal or service load used for the design of any push pier component or interface (Allowable Stress Design).

### Service Load: See “Nominal Load” above.

### Starter Tube: The lead pier tube that is hydraulically driven to the bearing stratum to create end bearing resistance of the push pier system. The starter tube has a friction reduction collar at the pier tip to create a temporary annular space between the shaft and the surrounding soil during installation.

### Ultimate Pier Capacity: The push pier capacity based on the least capacity determined from applicable ultimate limit states for mechanical and geotechnical capacity.

# APPROVED PUSH PIER MANUFACTURERS

## Supportworks®, Inc., 11850 Valley Ridge Drive, Papillion, NE 68046; Phone: (800) 281-8545; Fax: (402) 393-4002.

## Due to the special requirements for design and manufacturing of push pier systems, the systems shall be obtained from Supportworks®, Inc., or other qualified manufacturer with an approved equivalent product. A request to substitute any other manufactured push pier product must be submitted to the Owner for review not less than seven (7) calendar days prior to the bid date. The request must include:

### Documentation of at least five years of production experience manufacturing push piers systems,

### Documentation that the manufacturer’s push pier systems have been used successfully in at least five engineered construction projects within the last three years,

### Product acceptance by the local building code official(s) having jurisdiction over the project, and/or

### Current ICC-ES or IAPMO product evaluation report or complete description of product testing and manufacturing quality assurance programs used to assess and maintain product quality and determine product mechanical strength and geotechnical capacity.

# acceptable products

## Push Pier System Models PP237, PP288, PP350 and PP400 manufactured in accordance with the requirements of Sections 5 and 6 of this specification.

## Model PP237 Push Pier System

### Starter and Pier Tube Sections: The central steel shaft of the starter and pier tube sections are 2.375-inch outer diameter by 0.154-inch nominal wall thickness hollow structural section in conformance with ASTM A500 Grade B or C with a minimum yield strength of 60 ksi and a minimum tensile strength of 70 ksi. The starter tube includes a 1.00-inch long factory-welded friction reduction collar manufactured from 2.875-inch outer diameter by 0.203-inch nominal wall thickness hollow structural section conforming to ASTM A53 Grade B, Type E & S with a minimum yield strength of 35 ksi and a minimum tensile strength of 60 ksi. The starter tube and pier tube shaft finishes are either plain steel or hot-dip galvanized in accordance with ASTM A123.

### Shaft Coupling Material: The shaft coupling material is factory crimped or plug-welded to one end of the tube section and consists of 2.00-inch outer diameter by 0.187-inch nominal wall thickness hollow structural section in conformance with ASTM A500 Grade B with a minimum yield strength of 42 ksi and a minimum tensile strength of 58 ksi. The pier tube shaft coupling finish is plain steel.

### External Sleeve: The central steel shaft of the external sleeve is 2.875-inch outer diameter by 0.203-inch wall thickness hollow structural section in conformance with ASTM A500 Grade B or C with a minimum yield strength of 60 ksi and a minimum tensile strength of 70 ksi. A 0.75-inch long collar, welded to one end is manufactured with 3.375-inch by 0.188-inch wall thickness hollow structural section conforming to ASTM A53 Grade B, Type E & S with a minimum yield strength of 35 ksi and a minimum tensile strength of 60 ksi. The external sleeve shaft finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### Bracket: Retrofit bracket PP238B is suitable for use with the PP237 push pier system. Bracket finishes are either plain steel or hot-dip galvanized in accordance with ASTM A123. Bracket hardware finishes are zinc coated in accordance with ASTM B633.

## Model PP288 Push Pier System

### Starter and Pier Tube Sections: The central steel shaft of the starter and pier tube sections are 2.875-inch outer diameter by 0.165-inch nominal wall thickness hollow structural section in conformance with ASTM A500 Grade C with a minimum yield strength of 50 ksi and a minimum tensile strength of 55 ksi. The starter tube includes a 1.00-inch long factory-welded friction reduction collar manufactured from 3.375-inch outer diameter by 0.188-inch nominal wall thickness hollow structural section conforming to ASTM A53 Grade B, Type E & S with a minimum yield strength of 35 ksi and a minimum tensile strength of 60 ksi. The starter tube and pier tube shaft finishes are triple coated in-line galvanized.

### Shaft Coupling Material: The shaft coupling material is factory crimped or plug-welded to one end of the tube section and consists of 2.50-inch outer diameter by 0.180-inch nominal wall thickness hollow structural section in conformance with ASTM A53 Grade B, Type E & S with a minimum yield strength of 35 ksi and a minimum tensile strength of 60 ksi. The pier tube shaft coupling finish is plain steel.

### External Sleeve: The central steel shaft of the external sleeve is 3.500-inch outer diameter by 0.216-inch wall thickness hollow structural section in conformance with ASTM A500 Grade B or C with a minimum yield strength of 50 ksi and a minimum tensile strength of 62 ksi. A 0.75-inch long collar, welded to one end, is manufactured with 4.000-inch by 0.226 wall thickness hollow structural section conforming to ASTM A53 Grade B, Type E & S with a minimum yield strength of 35 ksi and a minimum tensile strength of 60 ksi or the end of the external sleeve is trumpeted without a collar. The external sleeve shaft finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### Brackets: Retrofit brackets FS288B, FS288BL, FS288BV and FS288BFM are suitable for use with the PP288 push pier system. Bracket finishes are either plain steel or hot-dip galvanized in accordance with ASTM A123. Bracket hardware finishes are zinc coated in accordance with ASTM B633.

## Model PP350 Push Pier System

### Starter and Pier Tube Sections: The central steel shaft of the starter and pier tube sections are 3.50-inch outer diameter by 0.165-inch nominal wall thickness hollow structural section in conformance with ASTM A500 Grade C with a minimum yield strength of 50 ksi and a minimum tensile strength of 55 ksi. The starter tube includes a 1.00-inch long factory-welded friction reduction collar manufactured from 4.00-inch outer diameter by 0.226-inch nominal wall thickness hollow structural section conforming to ASTM A53 Grade B, Type E & S with a minimum yield strength of 35 ksi and a minimum tensile strength of 60 ksi. The starter tube and pier tube shaft finishes are triple coated in-line galvanized and the friction reduction collar shaft finish is plain steel.

### Shaft Coupling Material: The pier tube shaft coupling material is factory crimped or plug-welded to one end of the pier tube section and consists of 3.125-inch outer diameter by 0.180-inch nominal wall thickness hollow structural section in conformance with ASTM A53 Grade B, Type E & S with a minimum yield strength of 35 ksi and a minimum tensile strength of 60 ksi. The pier tube shaft coupling finish is plain steel.

### External Sleeve: The central steel shaft of the external sleeve is 4.00-inch outer diameter by 0.226-inch wall thickness hollow structural section in conformance with ASTM A500 Grade B or C with a minimum yield strength of 50 ksi and a minimum tensile strength of 62 ksi. Two (2) bent steel stop plates are factory welded to one end of the external sleeve. The plates are manufactured from 0.75-inch wide by 2.88-inch long by 0.25-inch thick plate conforming to ASTM A36 with a minimum yield strength of 36 ksi and a minimum tensile strength of 58 ksi. The external sleeve shaft finish is either plain steel or hot-dip galvanized in accordance with ASTM A123.

### Bracket: Retrofit bracket FS350BV is suitable for use with the PP350 push pier system. The bracket finish is either plain steel or hot-dip galvanized in accordance with ASTM A123. Bracket hardware finishes are zinc coated in accordance with ASTM B633.

## Model PP400 Push Pier System

### Starter and Pier Tube Sections: The central steel shaft of the starter and pier tube sections are 4.00-inch outer diameter by 0.226-inch nominal wall thickness hollow structural section in conformance with ASTM A500 Grade B or C with a minimum yield strength of 50 ksi and a minimum tensile strength of 62 ksi. The starter tube includes a 1.00-inch long factory-welded friction reduction collar welded to one end and is manufactured from 4.50-inch outer diameter by 0.237-inch nominal wall thickness hollow structural section conforming to ASTM A53 Grade B, Type E & S with a minimum yield strength of 35 ksi and a minimum tensile strength of 60 ksi. The starter shaft and pier tube shafts are either plain steel or hot-dip galvanized in accordance with ASTM A123.

### Shaft Coupling Material: The pier tube shaft coupling material is factory plug-welded to the pier tube sections and consists of 3.50-inch outer diameter by 0.216-inch nominal wall thickness hollow structural section in conformance with ASTM A500 Grade B with a minimum yield strength of 42 ksi and a minimum tensile strength of 58 ksi. The pier tube shaft coupling finish is plain steel.

### Bracket: Retrofit bracket FS400BV is suitable for use with the PP400 push pier system. The bracket finish is either plain steel or hot-dip galvanized in accordance with ASTM A123. Bracket hardware finishes are zinc coated in accordance with ASTM B633.

# design and performance requirements

## Push piers shall be designed to support the nominal compressive load(s) as shown on the project Plans.

## All structural steel pier components shall be designed within the limits provided by the American Institute of Steel Construction (AISC) Specification for Structural Steel Buildings (AISC-360). Either Allowable Stress Design (ASD) or Load and Resistance Factor Design (LRFD) are acceptable methods of analysis. Bracket testing in accordance with ICC-ES Acceptance Criteria 358 and/or Acceptance Criteria 406 may be considered as an acceptable means of establishing system capacities.

## Except where noted otherwise on the project Plans, all piers shall be installed to provide an ultimate pier capacity based on an ASD or LRFD analysis. For ASD, a minimum factor of safety of 1.5 applied to the service or nominal loading shall be required. Higher ASD factors of safety may be required based on the project Plans or at the direction of the Owner. When an LRFD analysis is required, the Owner shall provide applicable pier design information including but not limited to; factored loads, resistance factors and/or the required ultimate pier capacity.

## The required ultimate pier capacity shall be verified at each pier location by monitoring and recording final drive forces using the installation hydraulic pressure and the effective area of the drive cylinder. The maximum drive force shall not exceed the maximum drive force rating of the push pier system and installation tooling.

## Except where noted otherwise on the project Plans, each pier shall be designed to meet a corrosion service life of 50 years in accordance with ICC-ES AC358 and AC406.

## The pier design shall take into account pier buckling potential, soil stratification, and strain compatibility issues.

# qualifications of installing contractor and designer

## The Installing Contractor and Pier Designer shall submit to the Owner, a proposal including the documentation required in this Section. Work shall not begin until all the submittals have been received and approved by the Owner. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Installing Contractor.

## Evidence of Installing Contractor’s competence in the installation of push piers shall be provided to the Owner’s satisfaction and may include any or all of the following:

### Pier manufacturer’s certificate of competency in installation of push piers,

### A list of at least three projects completed within the previous three years wherein the Installing Contractor installed push piers similar to those shown in the project Plans. Such list to include names and phone numbers of those project representatives who can verify the Installing Contractor’s participation in those projects, and/or

### A letter from the pier manufacturer or manufacturer’s representative expressing ability and intent to provide on-site supervision of the pier installation.

## A listing of all safety violations lodged against the Installing Contractor within the previous three years and the current status or final resolutions thereof. Descriptions of safety improvements instituted within the previous three years may also be submitted, at the Installing Contractor’s discretion.

## Evidence of Pier Designer’s competence shall be provided to the Owner’s satisfaction and may include any or all of the following:

### Registration as a Professional Engineer or recognition by the local jurisdictional authority,

### A list of at least three projects completed within the previous three years wherein the Pier Designer designed push piers similar to those shown in the project Plans. The list shall include names and phone numbers of those project representatives who can verify the Pier Designer’s participation in those projects, and/or

### Recommendation from the pier manufacturer or manufacturer’s representative.

# pre-construction submittals

## Within 2 weeks of receiving the contract award, the Installing Contractor and/or Pier Designer shall submit the following push pier design documentation:

### Certification from the Pier Designer that the proposed piers meet the requirements of this specification.

### Qualifications of the Installing Contractor and Pier Designer per Section 7.

### Product designations for system components and ancillary products to be supplied at each push pier location.

### Individual pier nominal loads, factors of safety, LRFD load and resistance factors and required ultimate pier capacities, where applicable.

### Individual pier loading requirements (if any).

### Manufacturer’s published allowable system capacities for the pier assemblies, including load transfer devices.

### Calculated mechanical and theoretical geotechnical capacity of the proposed piers.

### Minimum final drive and lock-off force requirements.

### Structural lift requirements, if applicable

### Minimum and/or maximum embedment lengths or other site specific embedment depth requirements as may be appropriate for the site soil profiles.

### Pier location tolerance requirements.

### Load test procedures and failure criteria, if applicable.

### Copies of certified calibration reports for load test measuring equipment to be used on the project, if applicable. The calibrations shall have been performed within one year of the proposed starting date for push pier installation or as recommended by the equipment manufacturer.

### Provide proof of insurance coverage as stated in the general specifications and/or contract.

# pier installation

## Installing Contractor shall furnish and install all push piers per the project Plans and approved pier design documentation. In the event of conflict between the project Plans and the approved pier design documentation, the Installing Contractor shall not begin construction on any affected items until such conflict has been resolved.

## The Installing Contractor shall conduct their construction operations in a manner to insure the safety of persons and property in the vicinity of the work. The Installing Contractor’s personnel shall comply with safety procedures in accordance with OSHA standards and any established project safety plan.

## The Owner shall request marking of underground utilities by an underground utility location service as required by law, and the Installing Contractor shall avoid contact with all marked underground facilities.

## The portion of the construction site occupied by the Installing Contractor, his equipment and his material stockpiles shall be kept reasonably clean and orderly.

## Installation of push piers may be observed by representatives of the Owner for quality assurance purposes. The Installing Contactor shall give the Owner at least 24 hours’ notice prior to the pier installation operations.

## The push pier installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project. The push pier shall be positioned at the appropriate site survey location as determined from the plan drawings.

## Push pier installation procedures specified in the manufacturer’s technical literature and/or code agency approved evaluation report shall be followed.

# termination criteria

## The final drive force and any required pier length and embedment depth criteria as specified in the Pre-Construction Submittals shall be satisfied prior to terminating the pier installation. Push pier installation will be halted if excessive lift of the structure occurs prior to reaching the specified final drive force or pier length/depth criteria and the Owner will be notified of this occurrence prior to continuation of the work. The Owner shall be notified in the event any push pier fails to meet the production quality control termination criteria as specified on the Plans. In the event that the pier does not meet the production quality control termination criteria, the following remedies may be appropriate if approved by the Owner:

### If the installation fails to meet the minimum final drive force criterion at the specified embedment length:

#### Continue the installation to greater depths until the minimum final drive force criterion is met, provided that, if a maximum length constraint is applicable, continued installation does not exceed said maximum length constraint

### If the maximum drive force rating of the push pier system is achieved prior to satisfaction of a minimum embedment length criterion:

#### Terminate the installation at the depth obtained

#### Pre-drill to a depth that allows termination at or below the minimum embedment length

### If the installation reaches a specified maximum embedment length without achieving the minimum final termination force criterion:

#### De-rate the load capacity of the push pier based on the final drive force recorded at termination depth and install additional piers as necessary.

### If a push pier fails a production quality control criterion as described in this Section or for any reason other than described in this Section, any proposed remedy must be approved by the Owner prior to initiating its implementation at the project site.

# installation record submittals

## The Installing Contractor shall provide the Owner copies of individual push pier installation records within 24 hours after each installation is completed. Formal copies shall be submitted within 30 day from the completion of the push pier installation. These installation records shall include, but are not limited to, the following information:

### Date and time of installation

### Location of push pier and pier identification number

### Installed push pier model and configuration

### Total length and tip depth of installed pier

### Actual inclination of the pier

### Hydraulic pressure reading at the end of each tube section installed

### Final hydraulic pressure/force at the termination depth

### Lift and/or lock-off pressure/force readings

### Amount of lift achieved at each pier location (if applicable)

### Calculated geotechnical capacity based on final drive and lock-off force resistance

### Comments pertaining to interruptions, obstructions, or other relevant information

# field compression Load testing

## If field compression load testing is required, the Installing Contractor shall furnish all labor, equipment and pre-production push piers necessary to accomplish the testing as shown in the approved pier design documentation. Installing Contractor shall apply the specified loads for the specified durations and record the specified data, for the specified number of piers. No deviations from the test plan(s) will be allowed without explicit approval in writing from the Owner. Pier testing shall be in general accordance with the ASTM D1143 quick test method and the following criteria:

### Failure criteria shall be determined by the Owner prior to load testing

### The test pier shall have been installed to the required final drive force and then unloaded prior to start of test

### The reaction frame requirements in ASTM D1143 shall not apply. The test setup will include calibrated pressure gages with a calibrated hydraulic ram installed in-line with the bracket and pier shaft to enable using the existing structure’s weight as the reaction force during testing.

### An alignment load equal to 5% of the maximum anticipated test load may be applied prior to the start of the test to take out slack in the test equipment.

### Loading increments shall be in accordance with the ASTM D1143 quick test method with a maximum loading increment of 5% of the maximum anticipated test load and a minimum hold time of 4 minutes at each increment.

### The maximum test load shall not exceed the final pier drive force determined in Section 12.1.2.

### Upon completion of the maximum test load hold increment, the pier shall be unloaded in 5 to 10 even increments with minimum hold times of 4 minutes at each increment

## Installing Contractor shall provide the Owner, copies of raw field test data within 24 hours after completion of each load test. Formal test reports shall be submitted within 30 days following test completion. Formal test reports shall include the following information:

### Name of project and Installing Contractor’s representative(s) present during load testing.

### Name of manufacturer’s representative(s) present during load testing, if any.

### Name of third party test agency and personnel present during load testing, if any.

### Date, time, duration and type of the load test.

### Unique test identifier and map showing the test pier location.

### Pier model and installation information including drive pressure/force records of each pier tube, final drive pressure/force, drive tube quantities and lengths, final pier tip depth, installation date and total test pier length.

### Calibration records for applicable pier installation and test equipment

### Tabulated test results including cumulative pier head movement, loading increments and hold times

### Plots showing load versus deflection for each loading/unloading interval

# Cleanup

## Within one week of completion of the work, the Installing Contractor shall remove any and all material, equipment, tools, debris or other items belonging to the Installing Contractor or used under the Installing Contractor’s direction.