PIP STS02380
Application of ACI 336.1-01,
Specification for the Construction of
Drilled Piers
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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Scope

This Practice supplements ACI 336.1-01, Specification for the Construction of Drilled Piers. Together, this Practice and ACI 336.1-01 provide requirements for drilled pier construction.

The requirements of ACI 336.1-01, as modified and supplemented by this Practice, are adopted by this Practice for the construction of drilled piers. Common industry terminology may also refer to drilled piers as caissons or drilled shafts.

References

Applicable parts of the following Practice and industry standard shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

Process Industry Practices (PIP)
- PIP STS03001 - Plain and Reinforced Concrete Specification

Industry Codes and Standards

- American Concrete Institute (ACI)
  - ACI 336.1-01 - Specification for the Construction of Drilled Piers
- ASTM International (ASTM)
  - ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  - ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcements

Definitions

Terminology used in the additions and modifications to the requirements of ACI 336.1-01 presented in the Requirements section of this Practice is the same as terminology used in ACI 336.1-01 with the exception of the PIP terms “purchaser” and “owner” which are presented in one term in ACI 336.01 as “Owner”. PIP terminology and definitions that are considered equivalent to terminology used in ACI 336.1-01 are provided for reference below:

constructor: Party responsible for supplying materials, equipment, tools, supervision, and labor for installation of drilled piers in accordance with contract documents. The term constructor shall apply also to constructor’s subcontractor(s) and vendor(s). Referred to as “Contractor” in ACI 336.1-01.

contract documents: Any and all documents, including codes, studies, design drawings, specifications, sketches, practices, and data sheets, that purchaser or engineer of record has transmitted or otherwise communicated, either by incorporation or reference, and made part of the legal contract agreement or purchase order between purchaser and constructor. Referred to as “Contract Documents” in ACI 336.1-01.

engineer of record: Purchaser’s authorized representative with overall authority and responsibility for engineering design, quality, and performance of civil works, structures, foundations, materials, and
appurtenances described in contract documents. Engineer of record shall be licensed as defined by laws of the locality in which the work is to be constructed, and be qualified to practice in the specialty discipline required for the work described in contract documents. Referred to as “Owner’s Representative” in ACI 336.1-01.

gatechnical engineer: Professional engineer responsible for performing geotechnical investigation and/or geotechnical consulting during design and installation of drilled piers. Referred to as “Owner’s Representative-Geotechnical Engineer” in ACI 336.1-01.

owner: Party who has authority through ownership, lease, or other legal agreement over site, facility, structure or project wherein drilled piers will be installed. Referred to as “Owner” in ACI 336.1-01.

professional engineer: An engineer, other than engineer of record, licensed as defined by laws of the locality in which drilled piers are to be installed, and qualified to practice in the specialty discipline required for the work described in contract documents. Term is not specifically used in ACI 336.01-01 but is interpreted by PIP to be a required qualification of “Owner’s Representative-Geotechnical Engineer” in ACI 336.1-01.

purchaser: Party who awards contract to constructor. Purchaser may be owner or owner’s authorized agent. Referred to as “Owner” in ACI 336.1-01.

inspector: Party responsible for verifying quality of all materials, installations, and workmanship furnished by constructor and any subcontractors or vendors. Inspector shall be qualified by training and experience and hold certifications or documentation of their qualifications. Unless otherwise specified in contract documents, inspector shall be an independent party retained by purchaser. Referred to as “Owner’s Representative-Geotechnical Engineer” and “Testing agency” in ACI 336.1-01.

Requirements

This Requirements section describes the additions and modifications to the requirements of ACI 336.1-01. The numbering of headings and paragraphs in this section correspond to the numbering of ACI 336.1-01. Only the sections and paragraph, and corresponding numbering, of the revised requirements are included in this section. All provisions of ACI 336.1-01 that are not revised by this Practice shall remain in force for this Practice.

SECTION 1 - GENERAL REQUIREMENTS

1.1 Scope

1.1.1 Addition. Supplement as Follows:

These specifications also apply to drilled piers of diameters as small as 24 inches (600 mm). Drilled piers may be constructed using cased or uncased holes or slurry stabilized holes. The ability of the soils to maintain an open and essentially dry hole is the determining factor.
1.2 Definitions

Modification. To Read as Follows:

**Anchorage embedment** - Embedment of the anchorage system, such as anchors or threaded rods, used to fasten structural components to the piers.

Addition. Supplement as Follows:

**Rock** - Material that cannot be excavated with a conventional earth auger or underreaming tool and requires excavation with special rock augers, core barrels, air tools, or blasting.

1.6 Project conditions

1.6.3 Modification. To Read as Follows:

**Existing underground utilities**

If required by Contract Documents, Contractor shall locate in the field all existing underground structures and utilities which may obstruct his operations and determine if there are conflicts with the Work. Contractor shall report any conflicts to the Owner’s Representative. Contractor shall cease work in this area until the conflicts are resolved and approved by the purchaser.

1.6.4 Modification. To Read as Follows:

**Job conferences**

A pre-award conference and/or pre-construction conference should be held between the purchaser and the Contractor(s) to review project information and Contractor’s and purchaser’s respective scopes of work. Conference topics should include but not be limited to:

- safety requirements,
- site entry procedures,
- job schedules,
- available subsurface information,
- underground utility identification and location,
- surveying for location and elevation of drilled piers,
- special installation requirements,
- down-hole inspection requirements,
- handling design changes,
- reinforcing steel placement and alignment,
- electrical ground cable attachment,
- concrete, anchor bolt location and installation,
- action required if installation is required near existing foundations,
- excavated materials disposal,
- action required if suspected contaminated soil is encountered.
action required for disposal of ground water, load testing, concrete testing and inspection, required reports.

Contractor shall attend all pre-award, pre-construction, and other job conferences required by the Contract Documents or established by the purchaser.

1.8 Submittals by the Contractor

1.8.1.4 Modification. To Read as Follows:

Proposed concrete materials and mixture proportions conforming to the requirements of PIP STS03001. (2.4.1)

1.9 Addition. New Paragraph:

Regulatory requirements

Comply with Federal Standards and Instructions of the U.S. Occupational Safety and Health Administration (OSHA), including any additional requirements by state or local agencies that have jurisdiction where drilled piers are to be installed.

SECTION 2 - PRODUCTS

2.3 Reinforcing steel

2.3.1 Modification. To Read as Follows:

Reinforcing steel shall be deformed steel conforming to ASTM A615/A615M, Grade 60. Bars to be welded shall conform to ASTM A706/A706M.

2.4 Concrete

2.4.1 Modification. To Read as Follows:

Concrete and concrete work shall conform to PIP STS03001. Concrete materials and mixture proportion information shall be submitted in accordance with PIP STS03001.

2.4.2 Modification. To Read as Follows:

Concrete of the specified slump and strength shall be provided and placed. Concrete for use in the dry method (Section 3.2) shall have a maximum nominal aggregate size of 1 inch (25 mm). Concrete for use in the slurry displacement method (Section 3.7) shall have a maximum nominal aggregate size of 3/4 inch (19 mm).

2.4.8 Addition. New Paragraph:

Concrete shall have a 28-day compressive strength not less than 4000 psi (28 MPa).
SECTION 3 - EXECUTION

3.1 Tolerances

3.1.7 Modification. To Read as Follows:

Anchorage embedment tolerance

Install anchors embedded in the drilled pier shaft to the tolerances of PIP STS03001. If reinforcing is required to protrude from the drilled pier, limit the vertical and horizontal deviations of reinforcing steel protruding from the drilled pier shaft to within 0.5 inches (13 mm) of the specified location.

3.2 Dry method

3.2.3.1 Modification. To Read as Follows:

For drilled piers bearing on rock, explore bearing stratum with a probe hole to a minimum depth equal to 1.5 times the diameter of the bearing area or a maximum of 10 feet (3 m) below the bottom of each drilled pier.

3.2.3.2 Modification. To Read as Follows:

Direct down-hole inspection shall be avoided if practical by use of an indirect method approved by Owner's Representative-Geotechnical Engineer. Where it is determined that an indirect method is not practical, a safe direct method for personnel access to inspect the bottom of drilled piers with diameters 30 inches (750 mm) or larger may be used with approval of Owner's Representative-Geotechnical Engineer and Owner's Representative. See Section 3.2.4 for additional requirements.

3.2.3.5 Addition. New Paragraph:

If a drilled pier location is within three (3) diameters of the bearing area (center-to-center) of an adjacent new drilled pier, drilling shall commence only after concrete in the adjacent foundation has been in place for not less than 12 hours.

3.2.4 Modification. To Read as Follows:

Where a direct down-hole inspection method is used in lieu of an indirect method specified in Section 3.2.3.2, the following procedures shall be followed:

a. Check each drilled pier for toxic and explosive gas before personnel enters and while personnel are in-hole.

b. If gas is found, ventilate with forced air until safe for entry, or follow alternative procedures acceptable to the Owner’s Representative.

c. During hand belling or other operations necessitating entry into the shaft, provide gas-testing equipment and a protective cage, or temporary casing of proper diameter, length, and thickness, plus other safety equipment called for by federal, state, and local laws for inspection and testing of drilled piers and protection of workers.
3.3 Steel casing and liner

3.3.2.2 Modification. To Read as Follows:

Withdrawal of temporary casing is the Contractor’s option, provided the requirements in Section 3.6 and any additional requirements of the Owner’s Representative-Geotechnical Engineer are met.

3.5 Modification. To Read as Follows:

Concrete

Concrete work shall conform to PIP STS03001.

3.5.6 Modification. To Read as Follows:

Guide placement of free-fall concrete so as not to hit the reinforcement, hole sides, or anchor assemblies. Vibration of concrete free falling more than 20 feet (6 m) is not required.

3.6 Casing withdrawal

3.6.2 Modification. To Read as Follows:

Coordinate casing withdrawal with concrete placement so that the concrete pressure head exceeds the anticipated outside soil and water pressure above the bottom of the casing at all times during casing withdrawal. Additionally, the rate of casing withdrawal shall be such that the bottom edge of the casing remains at least 10 feet (3 m) below the top of the fresh concrete until the bottom of the casing reaches within 10 feet (3 m) of the top of drilled pier.