United States Department of the Interior

BUREAU OF MINES

SPOKANE RESEARCH CENTER
EAST 315 MONTGOMERY AVENUE
SPOKANE, WASHINGTON 99207-2291

TAKE PRIDE IN AMERICA

April 11, 1988

John Peshel
U.S. Nuclear Regulatory
Commission
Mail Stop 623-SS
Washington, DC 20555

Dear John:

Paul Richardson has sent some information to me in response to the February mailing of the abbreviated DOE Cross Index. His information is attached and is being sent to all 13 Board Members for their review. It includes a copy of an ADCI specification which represents an approach to a problem similar to ours. If we were to agree in favor of this approach before the May meeting, a small working group could get started in Las Vegas. This could save some time. In any event, I hope to discuss it at the board meeting.

The following is proposed based upon the contents of the ADCI specification and some discussion with Paul. Our specification could contain the four sections listed below. Examples of the first three sections can be found in the ADCI specification.

1. A general outline to assist the contractor or the sponsor in tailoring his specification or contract to meet the specific needs of the project.

2. Boiler-plate statements prepared by ourselves that are peculiar to our needs or otherwise contribute to its completeness.

3. References to existing specifications that are peculiar to our operation. Hopefully, about a dozen references would cover most of our requirements, but we can easily include more.

4. A reference to the DOE Cross Index to assist those who may want to specify unusual requirements through a standard specification not included in our specification.

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NHPA

This approach requires more work, may be more difficult to obtain a consensus on, and would have to be maintained by ourselves. However, it would seem that we could address our specific needs more directly and provide a simpler and, therefore, more useable format. I look forward to discussing this matter with you before the meeting.

Sincerely,

Paul F. Sands
Supv. General Engineer

Enclosure

PAUL RICHARDSON & ASSOCIATES, INC.
PLANNING & MANAGEMENT FOR DRILLED SHAFTS

March 16, 1988

Paul F. Sands
Chairman, Safety and
Standards Committee
USDI Bureau of Mines
Spokane Research Center
East 315 Montgomery Avenue
Spokane, Washington 99207-2291

Subject: ISDT Specifications And Standards-DOE Cross Index

Dear Paul,

I received your letter with the DOE Cross Index of Standards on February 21, 1988. The DOE Cross Index of Standards seems to me to be too broad as well as too inaccessible to meet the needs of the ISDT member organizations. In my opinion there needs to be a basic Standard that is unique to Shaft Drilling. The Standard needs to be formatted and assembled so that it addresses classification of shafts, standard bit sizes, standard casing sizes and such contractural requirements of record keeping and reporting. In addition the Standard would include Safety Standards that pertain directly to Shaft Drilling. Where applicable the Standard could incorporate information from the DOE Cross Index by reference.

For your information I am enclosing a copy of the Standards prepared and published by the ADSC for the Foundation Drilling Industry. The ADSC organization, which Paul Richardson And Associates, Inc. is a member, is very similar to ISDT and had many of the same problems. The enclosed Standards And Specifications have done much to eliminate some of the confusion and misunderstanding between client and contractor. In addition it has brought about some standardization in the types and sizes of foundation shafts allowing equipment to be used for mulitiple projects. This has resulted in some cost savings as well as improved performance by the contractors.

It is strongly recommended that copies of the ADSC Standard be distributed to all of the Directors and Officers for review and discussion at the May,1988 board meeting.

Sincerely,

Paul Richardson

Paul Richardson

Enclosure: A/S

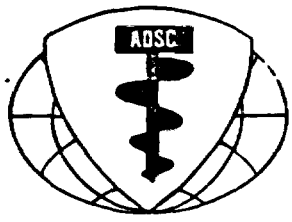
13521 LAURINDA WAY, SANTA ANA, CA 92705 (714) 832-0855

STANDARDS AND SPECIFICATIONS

FOR THE FOUNDATION DRILLING INDUSTRY

Revised June 1, 1987

ADSC:
The International Association of Foundation Drilling
P.O. Box 280379
Dallas, Texas 75228
(214) 681-5994



"DEFINITION OF A DRILLED FOUNDATION"

A drilled foundation is a machine and/or hand excavated shaft with the primary purpose of structural support. It is an open excavation, circular in cross section. A drilled foundation may be underreamed at the base to provide greater bearing area. The excavation is filled with concrete and may be reinforced with steel. It is a vertical shaft which has an angle of incidence with a horizontal plane which is greater than 45 degrees.

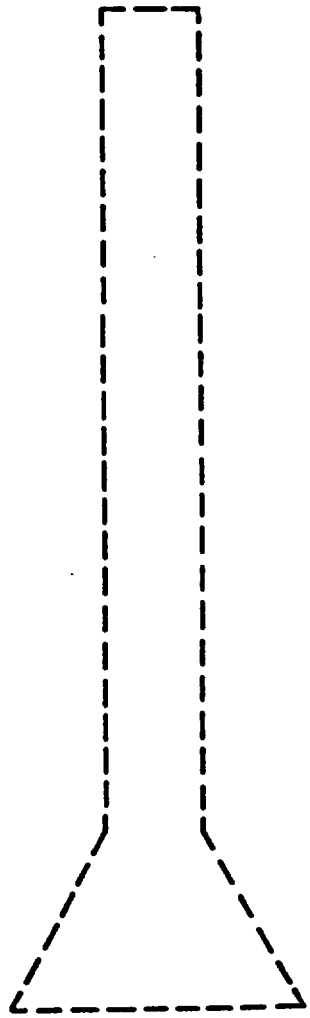


TABLE OF CONTENTS

STANDARDS:

SPECIFICATIONS:

ADSC: The International Association of Foundation Drilling

FOREWORD

The ADSC, after thorough investigation and study, has adopted these standards and specifications pertaining to foundation work performed by members of the Association. Revised June 1, 1987, these changes reflect technical improvement in the industry to insure better products.

The standards which include classification of drilled foundations, classification of rock excavation for pay purposes, standard sizes of casing and underreams and samples of on-site paperwork are the accepted practice of association members throughout the industry.

The specifications incorporate the 1985 Revised ACI (American Concrete Institute) "Standard Specification for the construction of End Bearing Drilled Piers." These specifications are equally adaptable to side shear design.

You will notice however that ACI refers to a drilled pier in lieu of a drilled foundation. We accept the terms as interchangeable and thank the ACI for their fine efforts in having written such a workable specification.

In the past the absence of standards and specifications has resulted in confusion, misunderstandings and wide variation in specifying, bidding and performing drilled foundation work. In many instances costs were higher than necessary because of special requirements which can now be eliminated since these standards are available. The ADSC believes the specifications and contract for a drilled foundation project should give the contractor as much leeway as practicable in the choice of equipment and methods. A performance type of specification,imposing no unnecessary restrictions but requiring an acceptable end result, will in the long run result in more competitive bids, lower bid prices, fewer disputes and claims for extras, and usually better foundations than would a tight specification that unnecessarily restricts the choice of contractors or impedes the work of the successful bidder.

The ADSC constantly strives to upgrade and perfect procedures which will offer the construction industry a superior and more economical product.

ADSC: The International Association of Foundation Drilling

Standards and Specifications Committee
JIM LEWIS — Chairman

STANDARDS

Item 1. CLASSIFICATION FOR DRILLED FOUNDATIONS

Type A Not cased. Not reinforced.
Type B Not cased. Reinforced.
Type C Temporary tool casing. Not reinforced.
Type D Temporary tool casing with permanent liner. Not reinforced.
Type E Temporary tool casing. Reinforced.
Type F Temporary tool casing with permanent liner. Reinforced.
Type G Permanent casing. Not reinforced.
Type H Permanent casing. Reinforced.

Underreamed Shafts - Add the letter U to the classification type of shaft.
Battered Shafts - Add the letter B to the classification type of shaft.
Underwater Concrete Placement - Add the letter W to the classification type of shaft:
NOTE: All types include concrete as specified. Safety regulations will be followed.

Item 2. SCHEDULED DIAMETERS FOR FOUNDATION DRILLING

Shaft Size Nominal Diameter	Types A—B	Types C—D—E—F—G—H		
	Diameter of Drilled Hole	Outside Diameter of Casing	Diameter of Drilled Hole for Casing	Diameter of Drilled Hole Extended thru Casing
		Minimum Recommendation		
12"	12"	Not Recommended		
14"	14"	Not Recommended		
16"	16"	Not Recommended		
18"	18"	18"	20"	16"
20"	20"	20"	22"	18"
24"	24"	24"	26"	22"
30"	30"	30"	32"	28"
36"	36"	36"	38"	34"
42"	42"	42"	44"	40"
48"	48"	48"	50"	46"
54"	54"	54"	56"	52"
60"	60"	60"	62"	58"
66"	66"	66"	68"	64"
72"	72"	72"	74"	70"
78"	78"	78"	80"	76"
84"	84"	84"	86"	82"
90"	90"	90"	92"	88"
96"	96"	96"	98"	94"

NOTE: Geological conditions in some areas may dictate sizes other than those indicated in the following schedule. Consult your local ADSC Contractor for recommendations.

Item 3. UNDERREAMED SHAFTS

A. Maximum base diameter of an underreamed shaft is recommended, for economical reasons and practicality, not to exceed three times the diameter of the shaft for a fully developed underream.

B. The fully extended underreamed angle recommended is 45 degrees when design and conditions permit.

C. The standard toe height for the underream is 3" for drilled shaft sizes 18" through 42" and 6" for sizes 48" and larger.

Item 4. TEMPORARY TOOL CASINGS FOR DRILLED FOUNDATIONS

A. Casings are regular grade steel, produced by electric seam welding, butt welding or spiral welding.

B. The outside diameter of casing for each size of drilled foundations is as listed in Item 2.

C. Available wall thickness for each standard casing is as follows:

Standard Tool Casings Outside Diameter	Standard Available Wall Thickness Range
18" thru 24"	Min. 1/4"; 9/32"; 5/16"; 3/8" Max.
30" thru 36"	Min. 5/16"; 3/8"; 7/16" Max.
42" thru 60"	Min. 3/8"; 7/16"; 1/2" Max.
66" thru 96"	Min. 13/32"; 7/16"; 9/16"; 3/4" Max.

D. Tolerances on the outside diameter and other dimensions of casings are the standard API tolerances applicable to regular steel line pipe.

Item 5. QUALIFICATIONS

A. Work must be accomplished by companies employing personnel experienced in drilled foundation work.

B. Experience must be relevant to anticipated subsurface materials, water conditions, shaft sizes, and special technique required.

C. Demonstrate to the satisfaction to the Owner's Representative the dependablitiy of equipment and techniques to be used.

Item 6. SUBSURFACE INVESTIGATION

All of the subsurface information available to owner, architect, structural engineer, or geotechnical engineer shall be made available to prospective bidders; and this shall include soil and rock samples from the subsurface exploration, preserved at natural moisture content and arranged so that they can be readily examined. The samples, of course, will have to be kept at some central location, such as the architect's office. It is recommended that the owner employ and pay for all geotechnical services required. A conflict of interest could occur if these services are provided and paid for by the contractor. The geotechnical report (or soil and foundation report), with complete boring logs, should be included in the plans and the specifications and considered a part of the contract documents.

CLASSIFICATION OF ROCK FOR PAY PURPOSES

CLASSIFICATION OF ROCK: Rock is defined as any material which cannot be drilled with a conventional earth auger and/or underreaming tool, and requires the use of special rock augers, core barrels, air tools, blasting and/or other methods of hand excavation. All earth seams, rock fragments, and voids included in the rock excavation area will be considered rock for the full volume of the shaft from the initial contact with rock for pay purposes.

ILLUSTRATION OF MEASUREMENT FOR CLASSIFIED ROCK

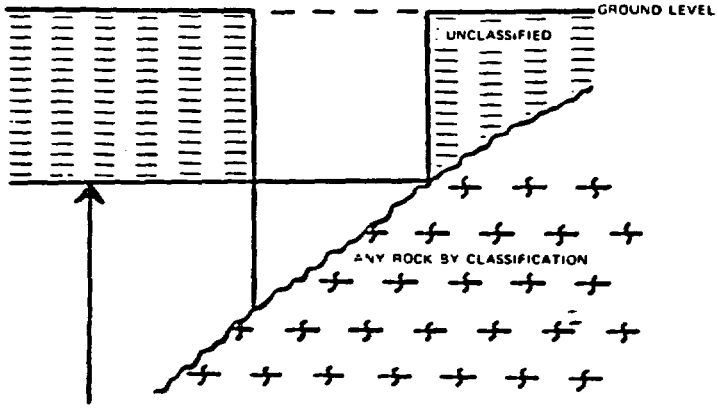


ILLUSTRATION OF A DRILLED FOUNDATION

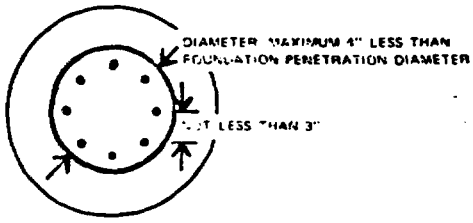
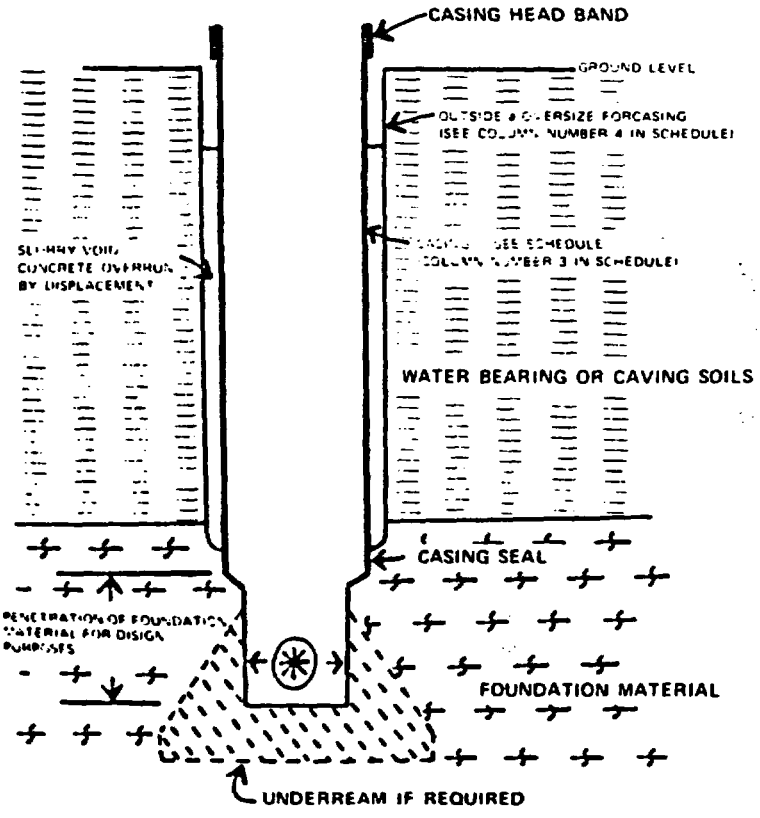
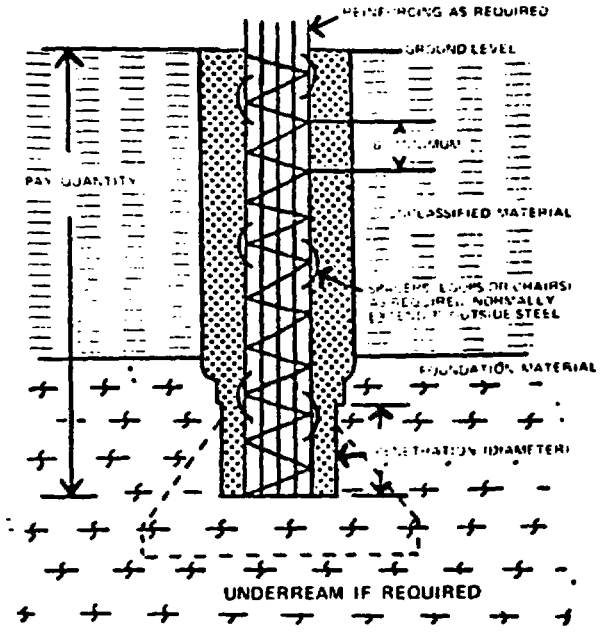


ILLUSTRATION OF A DRILLED FOUNDATION EXCAVATION





✱ SEE SCHEDULE FOR DIAMETER OF PENETRATION EXTENDED THRU CASING (COLUMN NUMBER 5 OF SCHEDULE)

DAILY REPORT FORM

DATE _____ GENERAL CONTRACTOR _____ JOB No. _____ LOCATION _____

Steel furnished by: _____ Driller _____ G.C.

Steel tied by: _____ Driller _____ G.C.

Concrete furnished by: _____ Driller _____ G.C.

Shaft	Bent No.	Shaft Size	Underream Size	Bottom Elev.	Top Elev.	Pay Depth	Steel Length	Casings Yes/No	Concrete Qty.	Other

REMARKS:

JOB FOREMAN

G.C. REP. / INSPECTOR

Single Shaft Record Report

ABC Contractors
123 Elm St.
Anytown, U.S.A
Phone: 234-5678

PROJECT _____ DAY _____

JOB NO. _____ DATE _____

DESIGN

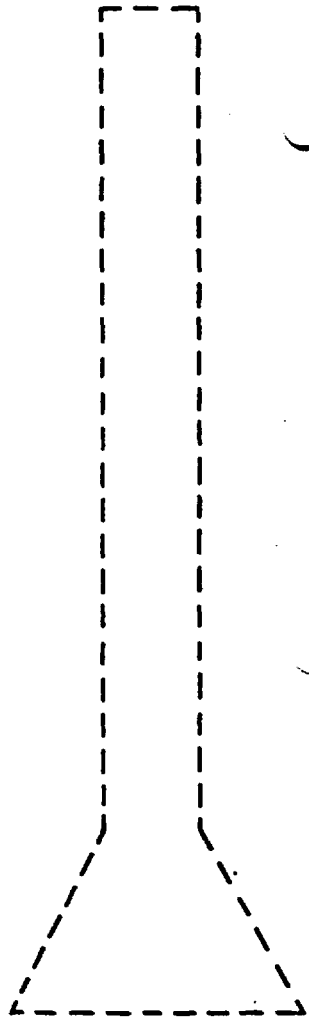
SHAFT LOCATION _____
TYPE/DIAMETER _____
TOP ELEVATION _____
BOTTOM ELEVATION _____
BELL DIAMETER _____
LENGTH _____

AZBUILT

DATE STARTED _____
COMPLETED _____
DIAMETER _____
TOP ELEVATION _____
BOTTOM ELEVATION _____
BELL DIAMETER _____
ADD OR DEDUCT _____
TOTAL LENGTH _____
ACTUAL CONCRETE _____

REMARKS

DRAWINGS (INCLUDE ELEVS, SIZE, SHAPE, CASING, & ALL OTHER PERTINENT INFORMATION)



APPROVED BY = OWNERS REPRESENTATIVE _____

GENERAL CONTRACTOR _____

ABC CONTRACTORS, INC. _____

OTHER _____

ACI STANDARD: STANDARD SPECIFICATION FOR THE CONSTRUCTION OF END BEARING DRILLED PIERS (ACI 336.1-79)

Revised 1985

by ACI Committee 336

Clyde N. Baker, Jr., Chairman

J.E. Bowles
Joseph P. Colaco
M.T. Davisson
S.V. DeSimone
John A. Focht, Jr.
M. Gaynor
John P. Gnaedinger
Edward S. Hoffman
Fritz Kramrisch
Ingvar Schousboe
Charles E. Smith
George Thon
Henry W. Wallace
Edward E. White
John J. Zils

This specification covers requirements for end bearing drilled pier construction. It includes delivery, handling, and storage of the casing, excavation, soil testing, placing of concrete and inspection.

Keywords: bearing capacity, concrete construction, excavation, foundation inspection, piers, placing, quality control, reinforced concrete, reinforcing steels, safety, soil mechanics, specifications, standards, tests, tolerances (mechanics).

FOREWORD

This foreward is included for explanatory purposes only: it does not form a part of Standard Specification ACI 336.1.

Standard Specification ACI 336.1 is a reference standard which the Architect/Engineer may cite in the project specification(s) for any building project, together with supplementary requirements for the specific project.

This specification is written in the section and three-part format of the Construction Specifications Institute, but with the numbering system modified to ACI requirements. The language is generally imperative and terse.

A specification checklist is included as a preface to, but not forming a part of, Standard Specification ACI 336.1. The purpose of this checklist is to assist the Architect/Engineers' designer(s) and specifier(s) to properly choose and specify the necessary supplementary requirements for the project specification(s).

Adopted as a standard of the American Concrete Institute in June 1979, in accordance with the Institute's standardization procedure. It was revised according to the expedite procedure effective March 1985.

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American Concrete Institute

PREFACE TO SPECIFICATION CHECKLIST

P1—Standard Specification ACI 336.1 is intended to be used essentially in its entirety, by citation in the project specification, to cover all usual requirements for end bearing drilled pier construction. Individual sections, parts, or articles should not be copied into project specifications since taking them out of context may change their meanings.

P2—Building codes set minimum requirements necessary to protect the public. Some of the requirements in this Standard Specification ACI 336.1 may be higher than some minimum building code requirements to assure the owner the level of quality and performance which he expects the structure to provide. However, adjustments to the needs of a particular project shall be made by the Architect/Engineer's designers and specifiers by reviewing each of the items indicated in this specification checklist and then including their decisions on each as mandatory requirements in the project specification.

P3—These mandatory requirements shall designate specific qualities, procedures, material, and performance criteria for which alternatives are permitted or for which provision is not made in Standard Specification ACI 336.1 if required.

P4—A statement such as the following will serve to make Standard Specification ACI 336.1 an official part of the contract requirements:

End bearing drilled pier construction shall conform to all requirements of

> "Standard Specification for the Construction of End Bearing Drilled Piers (ACI 336.1-79)," published by the American Concrete Institute, Detroit, Mich. except as modified by the requirements of this project specification.

P5—The specification checklist that follows is addressed to each item of ACI 336.1 that requires the designer/specifier to make a choice where alternates are indicated, or to add provisions where they are not indicated, or to take exceptions to ACI 336.1. The checklist consists of one column identifying sections, parts, and articles of ACI 336.1 and a second column of notes to the designer/specifier to indicate the action required of them.

SPECIFICATION CHECKLIST

Section/Part/Article of ACI 336.1	Notes to the Designer/Specifier
Section 1—General Requirements	
1.1 Scope	Indicate specific scope.
1.2 Definitions	Review; take exceptions, or add to, as required.
1.4 Reference standards	Review applicability of cited references and take exception if required. For Recommended Practice, specify as mandatory if applicable; if not applicable, take exception.
1.5 Project conditions	Review; take exceptions, or add to, as required. Especially note if a pre-job conference is required.
—Pricing	Pricing is not a part of the standard specification. But pricing forms of contract documents should provide for contract price based on drilled piers to dimensions and elevations shown. Changes in contract price due to additions to, or deductions from, work shown shall be on basis of unit prices in proposal.

SPECIFICATION CHECKLIST

Section 2.1—Materials and Construction	Notes to the Designer/Specifier
PART 2.1—GENERAL	
2.1.2 Submittals	To whom sent, for both Geotechnical Engineer and Contractor?
2.1.3.1 Geotechnical engineer testing	Specify extent and type of testing and inspection.
2.1.3.3 Testing agency	What is to be inspected, and extent and type?
2.1.4 Tolerances	Specify when greater tolerances are permitted, if any.
PART 2.2—MATERIALS	
2.2.1 Steel casing	Specify ASTM type and grade to use. State any exceptions to welding of teeth. Show on drawings, size, wall thickness, type, and design of permanent casing.
2.2.2 Reinforcing steel	Specify ASTM type and grade to use.
2.2.3 Concrete	Specify 28 day strength, additives (air entrainment, water reducing), slump limits, curing methods for tops of piers.
PART 2.3—CONSTRUCTION	
2.3.1.1 Excavation	Specify any special excavation procedures to be followed, such as use of drilling mud or temporary casing.
2.3.1.2 A Explore bearing stratum	Specify number or minimum percent of piers to be probed (applicable only when no danger of water blow-in from below through probe hole).
2.3.1.2 B Inspection and testing	Specify inspection and testing procedures to be followed (it is recognized that procedures vary in different parts of country depending on prevailing geology and experience.)
2.3.1.2. C Bells	Show bells on drawings.
2.3.1.5 Loose material	Specify limiting amount of loose material or water permitted in hole at time of concrete placement. Specify any other acceptability requirements.
2.3.1.6 Disposal of excavated material	Specify where.
2.3.2.1 Void space	Specify whether grouting is required of any annular void space outside of permanent casing.
2.3.2.2 Removal of casing	Specify removable or permanent casing.

SPECIFICATION CHECKLIST

Section/Part/Article of ACI 336.1	Notes to the Designer/Specifier
2.3.4.1 Dewatering	Specify specific dewatering criteria.
2.3.4.2 Approval to place concrete	Emphasize.
2.3.4.4 Free fall	Specify any special concrete placement procedures required.
2.3.4.9 Tremie concrete	Specify specific tremie procedures, such as: Minimum 7 to 9 in. slump, maximum 5/8 in. aggregate, continous tremie pipe, minimum pipe embedment in concrete at all times, continuous concrete placement, and static water level in hole prior to concrete placement. Specify coring or other special requirements of tremie concrete placement.
2.3.4.10 Concrete tests	Specify requirements for making test cylinders and for testing.

SECTION 1—GENERAL REQUIREMENTS

1.1—SCOPE

1.1.1 This standard specification covers requirements for end bearing drilled pier construction.

1.1.2 The provisions of this standard specification shall govern unless otherwise specified in the contract documents. In case of conflicting requirements, the contract documents shall govern.

1.2—DEFINITIONS

The following definitions cover the meanings of certain words and terms as used in this standard specification.

1.2.1 ***Acceptable or accepted***—Acceptable or accepted by the Architect-Engineer or Geotechnical Engineer.

1.2.2 ***Allowable service load bearing pressure***—The vertical pressure per unit area that may be applied to the bearing stratum at the level of the pier bottom. Allowable service load bearing pressure is normally selected by the Geotechnical Engineer on the basis of samples, tests, and applied soil mechanics, with due regard for the character of the loads to be applied and the settlements that can be tolerated.

1.2.3 ***Architect-Engineer***—The authority, such as the architect, the engineer, the architectural firm, the engineering firm, the contracting officer, or other agent of the owner issuing project specifications and drawings, and/or authorized by the owner to administer work under the project documents.

1.2.4 ***Bearing stratum***—The formations or layers of soil or rock that support the pier and the loads imposed on it.

1.2.5 ***Bell***—An enlargement at the bottom of the shaft for the purpose of spreading the load over a larger area.

1.2.6 ***Casing***—Protective steel casing usually of cylindrical shape, lowered into the excavated hole to protect workmen and inspectors entering the shaft from collapse or cave-in of the sidewalls and for the purpose of excluding soil and water from the excavation.

1.2.7 ***Contract documents***—Consist of the agreement, conditions of the contract, contract specifications, contract drawings, and all addenda thereto issued prior to the signing of the contract.

1.2.8 ***Contract drawings***—Drawings which accompany contract specifications and complete the descriptive information for drilled pier construction work required or referred to in the contract specifications.

1.2.9 ***Contractor***—The organization contracted with to carry out the work shown on the contract drawings and specifications.

1.2.10 ***Contract specifications***—The specifications which employ ACI 336.1 by reference and which serve as the instrument for making the mandatory and optional selections available under the specification.

1.2.11 ***End bearing drilled pier***—Cast-in-place foundation element with or without enlarged bearing area extending downward through weaker soils or water to a rock or soil stratum capable of supporting the loads imposed on or within it. A shaft diameter of 2½ ft. (0.76 m) is the lower limit for piers covered by these specifications.

1.2.12 ***Geotechnical engineer***—The specialized engineer retained by the owner reporting to the Architect-Engineer and with responsibilities as defined herein.

1.2.13 ***Testing laboratory***—The testing agency retained by the owner to perform required tests on the contract construction materials to verify conformance with specifications.

1.2.14 ***Owner***—Party that pays for approved work performed in accordance with drawings and contract specifications and receives the completed work.

1.2.15 ***Permitted***—Permitted by the Architect-Engineer.

1.2.16 ***Qualified***—Qualified by training and by experience on comparable projects.

1.2.17 ***Required***—Required by the contract documents.

1.2.18 ***Shaft***—Drilled pier above bearing surface exclusive of bell, if any.

1.2.19 ***Specified***—Defined in the contract documents.

1.2.20 ***Submitted***—Submitted to the Architect-Engineer for review.

1.3—NOTATION

The following abbreviations are defined for use in this standard specification.

1.3.1—ACI: American Concrete Institute
P.O. Box 19150
Detroit, Mich. 48219

1.3.2—ASTM: American Society for Testing and Materials
1916 Race Street
Philadelphia, Pa. 19103

1.3.3—AWS: American Welding Society
2501 N.W. 7th Street
Miami, Fla. 33125

1.3.4—ADSC: THE INTERNATIONAL ASSOCIATION OF FOUNDATION DRILLING
P.O. Box 280379
Dallas, Texas 75228

1.4—REFERENCE STANDARDS

1.4.1 The standards referred to in this Standard Specification ACI 336.1 are listed in Articles 1.4.2 through 1.4.4 of this Section, with their complete designation and title including the year of adoption or revision and are declared to be a part of this Standard Specification ACI 336.1 the same as if fully set forth herein, unless otherwise indicated in the contract documents.

1.4.2 ASTM standards

A 36-75 Standard Specification for Structural Steel

A 82-76 Standard Specification for Cold Drawn Steel Wire for Concrete Reinforcement

A 252-75 Standard Specification for Welded and Seamless Steel Pipe Piles

A 444-75 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process for Culverts and Underdrains

A 615-76a Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

A 616-76 Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

A 617-76 Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement

A 706-76 Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement

C 39-72 Standard Specification for Compressive Strength of Cylindrical Concrete Specimens

E 329-72 Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction

1.4.3 ACI standards

301-72 (revised 1975) Specifications for Structural Concrete for Buildings

318-77 Building Code Requirements for Reinforced Concrete

322-71 Building Code Requirements for Structural Plain Concrete

1.4.4 AWS standards

01.1 Structural Welding Code

012.1 Reinforcing Steel Welding Code

1.5—PROJECT CONDITIONS

1.5.1 ***Examination of site***—Visit (prior to submitting bid) to determine existing surface conditions.

1.5.2 ***Subsurface data***—A subsurface investigation has been made by____. Logs of borings and test data are available for Contractor's information and for his interpretation as to soil and water conditions that may be encountered at the site. Logs and test data are not represented as complete description of the site soil and water information but only display what was found in borings at the indicated locations. Contractor has the right to obtain additional information, if necessary in his judgment.

1.5.3 ***Existing underground utilities***—Locate all existing underground utilities and construction in the field by a qualified surveyor so as to determine any conflicts with the work. Should conflicts be determined, do not proceed with the work until the Architect-Engineer specifies method(s) to eliminate the conflict.

1.5.4 ***Pre-job conference***—The contract documents will specify if a pre-job conference is required among the Architect-Engineer, the Contractor(s), and the Geotechnical Engineer to review special requirements for the work.

SECTION 2—MATERIALS AND CONSTRUCTION

PART 2.1—GENERAL

2.1.1-DESCRIPTION

This section covers requirements for materials and construction for end bearing drilled piers, and includes the following:

2.1.1.1. Excavation and casing, dewatering, gas testing and probing.

2.1.1.2 Reinforcing steel.

2.1.1.3 Concrete

2.1.2—SUBMITTALS

2.1.2.1.—*Geotechnical Engineer*—Will submit test reports to Architect-Engineer and to Contractor concerning allowable service load bearing pressures, elevations, dimensions and alignment.

2.1.2.2.—*Contractor*—Submit the following:

a. Reinforcing steel shop drawings

b. Certified mill test reports for reinforcing steel

c. Evidence that proposed materials and mix designs conform to all requirements of "Specifications for Structural Concrete for Buildings (ACI 301-72) (Revised 1975)," except as modified by these specifications

d. Detailed procedures for casing removal, if any.

e. Detailed procedures for tremie concrete, if any.

f. Notification to Architect-Engineer to permit in-place inspection of reinforcing steel prior to placing concrete

g. Testing laboratory reports for concrete tests during construction

h. Reports of actual location, alignment, elevations, and dimensions of drilled piers

i. Reports of materials quantities, if specified

2.1.3—QUALITY ASSURANCE

2.1.3.1—*Geotechnical Engineer*—Will provide inspection of all phases of drilled pier construction, and request additional soil or rock testing if needed.

2.1.3.1 A (ADSC)—Prompt inspection and approval of drilled foundations must be made by Owner's Authorized Agent prior to placement of materials. Subsequent inspection of the placement of materials should be prompt to permit removal, as an option, in the event of rejection. Inspect from the top if practical. Where practical, all work should avoid any unnecessary risk of putting a man in the hole.

2.1.3.2 *Contractor*

a. Provide the services of a qualified surveyor for performing all surveys and layouts and to determine vertical and horizontal alignments.

b. Protect reinforcing steel from contamination.

2.1.3.3—*Testing laboratory*—Will provide services conforming to the requirements of ASTM E 329, for sampling, testing, inspection, and reporting with respect to casing, reinforcing, and concrete.

2.1.4—CONSTRUCTION TOLERANCES

2.1.4.1 Bottom elevation of drilled piers as shown are estimated from soil boring data. Geotechnical Engineer will determine actual final bearing level during excavation.

2.1.4.2—*Maximum permissible variation of location*—1/24th of shaft diameter or 3 in., whichever is less.

2.1.4.2. A (ADSC)—Variation not to exceed 3 inches.

2.1.4.3 *Concrete shafts out of plumb* — Use the following tolerances:

Category A. For unreinforced shafts extending through materials offering no or minimal lateral restraint (i.e., water, normally consolidated organic soils, and soils that might liquefy during an earthquake) — 12.5 percent of shaft diameter.

Category B. For unreinforced shafts extending through materials offering lateral restraint (soils other than those indicated in Category A) — not more than 1.5 percent of the shaft length.

Category C. For reinforced concrete shafts — Out of plumb tolerance as determined by the engineer based on the structural properties of the shaft and lateral restraint properties of the medium penetrated. See project specification.

2.1.4.3 A (ADSC)—Where penetration of rock is required, 2% vertical tolerance is allowed.

2.1.4.3 B (ADSC)—Install battered drilled shafts within 5% of the length from specified inclination.

2.1.4.3 C (ADSC) - For reinforced concrete shafts out of plumb tolerance shall be 2% of the shaft length or as determined by the engineer based on the structural properties of the shaft and lateral restraint properties of the medium penetrated. See project specification.

2.1.4.4 If the tolerances of Articles 2.1.4.2 and 2.1.4.3 are exceeded, furnish and pay for corrective design and construction that may be required.

2.1.4.5—*Concrete cut-off elevation tolerance*—Plus 1 in. to minus 3 in.

2.1.4.6 (ADSC)—Where drilling mud is used and cut-off elevation is below grade, these tolerances may be too stringent.

2.1.5—DELIVERY, HANDLING, AND STORAGE OF PERMANENT CASING

2.1.5.2 Deliver casing to site in undamaged condition.

2.1.5.2 Handle and protect casing to maintain round within ±2 percent.

PART 2.2—MATERIALS

2.2.1—STEEL CASING

2.2.1.1 ASTM A 252, Grade 2, or ASTM A 36, or ASTM A 444 corrugated steel, as specified, or as shown on the contract drawings.

2.2.1.2 Furnish 100 percent penetration welds for vertical joints in noncorrugated permanent casings.

2.2.1.3 For permanent casing requiring hardened steel teeth for seating into rock, face weld teeth with AWS electrodes.

2.2.2 *Reinforcing steel* — ASTM A 615 and Supplementary Requirements (S1), A 617 or A 706 as specified or as shown on the contract drawings. Also ASTM A 616 (as specified or as shown on the contract drawings) except that all bars shall be bend tested and shall meet the bend test requirements of axle steel reinforcing bars (ASTM A 617), Grade 60; and the bar markings rolled into the surface of the bars shall include the letter R to designate rail steel meeting these requirements.

2.2.3—*Concrete*—Concrete work shall conform to all requirements of "Specifications for Structural Concrete for Buildings (ACI 301-72) (Revised 1975)," except the following:

Sections 3.83, 3.84, and 3.85	Chapter 9
Chapter 4	Chapter 10
Section 5.4	Chapter 11
Sections 6.2, 6.3, 6.4, and 6.5	Chapter 12
Section 7.4	Chapter 13
	Chapter 14
	Chapter 15

2.2.4—*Sand-cement grout*—As specified for filling annular void outside permanent casing.

PART 2.3—CONSTRUCTION

2.3.1—EXCAVATION, SOIL TESTING, AND INSPECTION

2.3.1.1 Excavate drilled piers to dimensions and required elevations shown on contract drawings. Maintain sidewall stability during drilling. If drawings call for an allowable service load bearing pressure, extend excavation to suitable material.

2.3.1.2. Determine suitability of supporting material for drilled piers, as follows:

a. Explore bearing stratum to depth equal to the diameter of the bearing area below the bottom of the drilled pier with probe hole when directed by the Geotechnical Engineer.

a. 1 (ADSC) when required by contract specifications.

b. Inspection and testing at the bottom of each pier will be by the Geotechnical Engineer.

c. Excavate for drilled pier bells (if required) immediately upon confirmation of the allowable service load bearing value by the Geotechnical Engineer.

d. If test results indicate the stratum is not capable of providing the required service load bearing pressure, notify the Architect-Engineer for a determination of adjustments to be made. These may include, but not be limited to, advancing the shaft length as directed by the Geotechnical Engineer and repeating the above steps, or enlarging the bell diameter as determined by the Architect-Engineer for the appropriate bearing pressure as determined by the Geotechnical Engineer.

2.3.1.3 Provide gas testing equipment, protective cage, or temporary casing of proper diameter, length, and thickness and other safety equipment called for by law for inspection and testing of drilled piers and to protect workmen during hand belling or other operations necessitating entry into shaft.

2.3.1.4 Check each drilled pier for toxic and explosive gases prior to personal entering. If gas is found, ventilate with forced air until safe for entry.

2.3.1.5 Remove from bottom of drilled piers, loose material or free water in quantities sufficient to cause settlement or affect concrete strength as determined by the Geotechnical Engineer. Excavate pier bottoms to a level plane. If bottoms are sloping rock, excavate to a level plane or step with maximum step height less than one-quarter the width or diameter of the bearing area.

2.3.1.6 Remove excavated material from site or as otherwise directed by the Architect-Engineer.

2.3.2—STEEL CASING

2.3.2.1 Provide steel casing for shaft excavation where required. Provide casing of sufficient strength to withstand handling stresses, concrete pressure, and surrounding earth and/or fluid pressures. Make diameter of excavation in relation to diameter of casing, such as to create a minimum of void space outside of casing. Provide permanent casing with minimum outside diameter equal to nominal outside diameter of shaft.

2.3.2.1 A (ADSC)—Provide temporary casing with minimum outside diameter equal to normal outside diameter of drilled foundations.

2.3.2.2 Casing may be removed at option of Contractor unless otherwise specified. If casing is removed during or after concreting, follow special requirements specified in Article 2.3.4.

2.3.3—REINFORCING STEEL

2.3.3.1 Place reinforcement for drilled piers in accordance with the contract documents.

2.3.3.2 Use reinforcement at time of placement which is free of mud, oil, or other coatings that adversely affect bond.

2.3.3.3 Reinforcement with rust, scale, or a combination of both may be used provided the minimum dimensions, including height of deformations and weight of wire brushed specimens, are not less than required by applicable ASTM specifications. Architect-Engineer will determine acceptability of such reinforcement.

2.3.3.4 Use metal reinforcement without kinks or nonspecified bends. Straighten or repair bars in a manner that will not damage the bars or adjacent construction.

2.3.3.5 Place bars as shown on contract drawings with cover of not less than 3 in. where exposed to soil.

2.3.3.6 Make splices in reinforcement as shown on contract drawings unless otherwise accepted.

2.3.3.7 Provide clear distance between bars of not less than 1½ times the bar diameter nor 1½ times the maximum aggregate size provided concrete can be vibrated and not less than 3 times the bar diameter nor 3 times the maximum aggregate size if concrete cannot be vibrated (see Section 2.3.4.7).

2.3.3.7 A (ADSC)—Reinforcing Steel (If required)

a. A reinforcing cage shall be designed as a structural element and braced to retain its configuration throughout the placing of concrete and the extraction of the casing from the shaft. Job limitations may require some reinforcing to be assembled in place.

b. The longitudinal rebar area required by the design shall be made up of bars of the largest practical size, to increase the rigidity of the cage. The horizontal steel shall be either spiral caging or a series of horizontal hoops, at the designers option. Where spiral hooping or lateral ties are used, spacing shall not be less than 6". Longitudinal rebars shall have a minimum spacing of 3".

2.3.4—CONCRETE

2.3.4.1 Dewater drilled pier excavation prior to placing concrete. Perform pumping in a manner that will not create ground loss problems that might adversely affect this and existing adjacent structures as determined by the Geotechnical Engineer. If during pumping excessive water inflow is noted, use alternative means to reduce inflow such as extending casing, outside deep wells, or grouting, or other acceptable means. If water seepage still is considered by the Geotechnical Engineer to be excessive for safe removal, follow procedure specified in Article 2.3.4.9.

2.3.4.2 Obtain permission of Architect-Engineer prior to placing concrete.

2.3.4.2A (ADSC)—If a water problem exists, the drilling contractor shall be permitted, at his option, to go directly to the underwater concrete placement method.

2.3.4.3 Place concrete immediately after completion of excavation and after Geotechnical Engineer has verified allowable service load bearing capacity. Do not leave uncased or belled excavations open overnight.

2.3.4.4 Free fall concrete may be used provided it is directed through a hopper, or equivalent, such that fall is vertical down center of shaft without hitting sides or reinforcing. Vibrate top 5 ft. of concrete, but only after casing has been pulled or when casing is permanent.

2.3.4.4 A (ADSC) — Concrete properly designed with a minimum 5 in. slump does not require vibrating.

2.3.4.5 Place concrete in pier in one continuous operation. If a construction joint is unavoidable, level, roughen, and clean surface prior to recommencement of concrete placement. Provide reinforcing dowels or a shear key when required by the Architect-Engineer.

2.3.4.6 If casing is withdrawn, the Geotechnical Engineer will provide inspection during the removal of casing and placing of concrete. Withdraw casing only as shaft is filled with concrete. Maintain adequate head of concrete to balance outside soil and water pressure above the bottom of the casing at all times during withdrawal. Specific procedures that the Contractor will follow to accomplish this objective shall be submitted for approval.

2.3.4.7 Where casing is removed, provide specially designed concrete with a minimum slump of 5 in. and with a retarder to prevent arching of concrete (during casing pulling) or setting of concrete until after casing is pulled. Check concrete level prior to, during, and after pulling casing. Do not vibrate concrete internally if casing is pulled. (However, a casing vibratory extractor is permitted.) Pull casing while concrete is still fluid and plastic and before initial set.

2.3.4.7 A (ADSC)—During casing extraction, upward movement of the steel should not exceed 6". Downward movement should not exceed 6" per 20 feet shaft length.

2.3.4.8 When casing is left in place, fill void space between casing and shaft excavation with concrete or fluid grout by means of grout pipe and pump pressure as required.

2.3.4.9 For placing concrete under water, where permitted, use tremie pipe or concrete pumping with special procedures as specified or accepted.

2.3.4.10—***Concrete tests***—Take one set of four cylinders per drilled pier but not more than one set per truck, or less than required by ACI 318-77. Test one sample at 7 days and two at 28 days; keep one sample in reserve for testing in the event of a low break.

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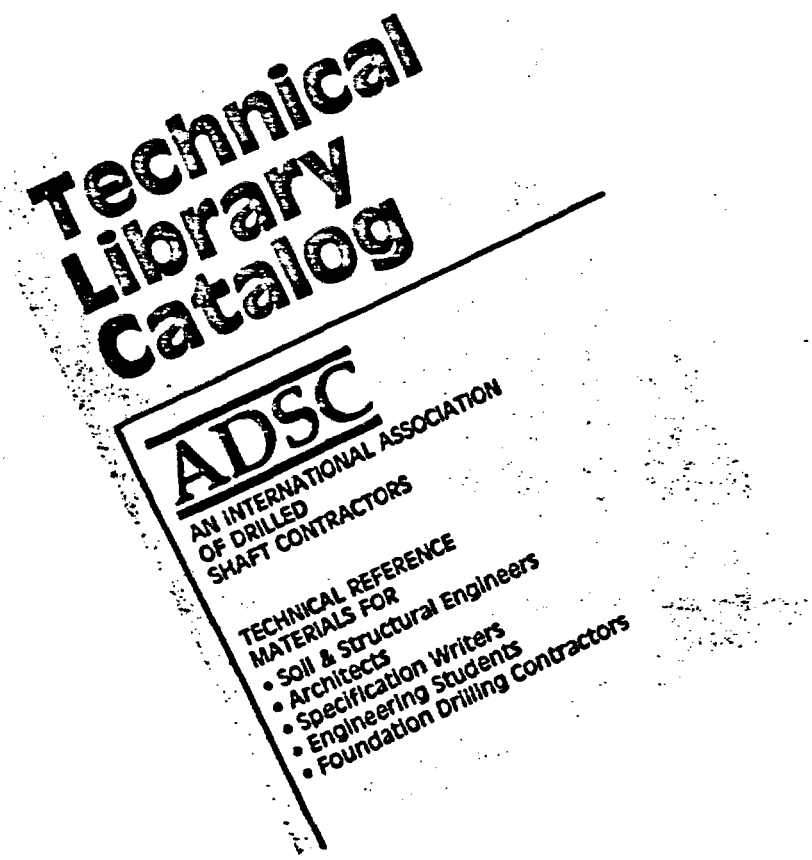

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