

**CONTEC**Comissão de Normalização  
Técnica**SC-04**

Civil Construction

**Presentation of Designs of Foundations and  
Concrete Structures**

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**1<sup>st</sup> Amendment**

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This is the 1<sup>st</sup> Amendment to PETROBRAS N-1784 REV. C and it is used to alter the text of the Standard in the parts indicated below:

NOTE 1 The new page with the performed amendment is placed in its corresponding position.

NOTE 2 The amended pages, indicated the date of the amendment, are placed at the end of this standard, in chronological order, and shall not be used.

**CONTENTS OF THE 1<sup>st</sup> AMENDMENT - 04/2014**

- Section 2

Exclusion of ABNT NBR ISO 10209-2.

# Presentation of Designs of Foundations and Concrete Structures

## Procedure

This Standard replaces and cancels its previous revision.

The CONTEC - Authoring Subcommittee provides guidance on the interpretation of this Standard when questions arise regarding its contents. The Department of PETROBRAS that uses this Standard is responsible for adopting and applying the sections, subsections and enumerates thereof.

**Technical Requirement:** A provision established as the most adequate and which shall be used strictly in accordance with this Standard. If a decision is taken not to follow the requirement ("non-conformity" to this Standard) it shall be based on well-founded economic and management reasons, and be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by imperative nature.

**Recommended Practice:** A provision that may be adopted under the conditions of this Standard, but which admits (and draws attention to) the possibility of there being a more adequate alternative (not written in this Standard) to the particular application. The alternative adopted shall be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by verbs of a nonmandatory nature. It is indicated by the expression: **[Recommended Practice]**.

Copies of the registered "non-conformities" to this Standard that may contribute to the improvement thereof shall be submitted to the CONTEC - Authoring Subcommittee.

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the section, subsection and enumerate to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

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## CONTEC

Comissão de Normalização  
Técnica

## SC - 04

Civil Construction

## Introduction

*PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting specialized of Technical Collaborators from Company and its Subsidiaries), are commented by Company Units and its Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of technicians from the same specialty, representing the various Company Units and its Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the Company Units and its Subsidiaries). A PETROBRAS Technical Standard is subject to revision at any time by its Authoring Subcommittee and shall be reviewed every 5 years to be revalidated, revised or cancelled. PETROBRAS Technical Standards are prepared in accordance with PETROBRAS Technical Standard [N-1](#). For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.*

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## Foreword

This Standard is the English version (issued in 01/2013) of PETROBRAS N-1784 REV. C 11/2011. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

## 1 Scope

1.1 This Standard sets out the conditions that can be required for presentation of designs of direct and deep foundations, and prestressed and reinforced concrete structures.

1.2 This Standard does not apply to designs of offshore structure foundations.

1.3 For presentation of offshore foundation designs, PETROBRAS [N-2001](#) shall be complied with

1.4 This Standard applies to onshore and offshore concrete structure designs.

1.5 This Standard applies to procedures initiated as of their editing date.

1.6 This Standard contains Technical Requirements and Recommended Practices.

## 2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

PETROBRAS [N-381](#) - Execução de Desenhos e Outros Documentos Técnicos em Geral;

PETROBRAS [N-1644](#) - Construção de Fundações e de Estruturas de Concreto Armado;

PETROBRAS [N-1710](#) - Codificação de Documentos Técnicos de Engenharia;

PETROBRAS [N-2001](#) - Projeto e Execução de Fundação para Estrutura Marítima;

PETROBRAS [N-2064](#) - Emissão e Revisão de Documentos de Projeto;

ABNT [NBR 6118](#) - Projeto de Estruturas de Concreto;

ABNT [NBR 6120](#) - Cargas para o Cálculo de Estruturas de Edificações;

ABNT [NBR 6122](#) - Projeto e Execução de Fundações;

ABNT [NBR 6123](#) - Forças Devidas ao Vento em Edificações;

ABNT [NBR 7187](#) - Projeto de Pontes de Concreto Armado e de Concreto Protendido;

ABNT [NBR 7191](#) - Execução de Desenhos para Obras de Concreto Simples ou Armado;

ABNT [NBR 7808](#) - Símbolos Gráficos para Projetos de Estruturas;

ABNT [NBR 8196](#) - Desenho Técnico - Emprego de Escalas

ABNT [NBR 8403](#) - Aplicação de Linhas em Desenhos - Tipos de Linhas - Larguras das Linhas;

ABNT [NBR 8404](#) - Indicação do Estado de Superfícies em Desenhos Técnicos;

ABNT [NBR 8681](#) - Ações e Segurança nas Estruturas;

ABNT [NBR 9062](#) - Projeto e Execução de Estruturas de Concreto Pré-Moldado;

ABNT [NBR 10067](#) - Princípios Gerais de Representação em Desenho Técnico;

ABNT [NBR 10126](#) - Cotagem em Desenho Técnico.

**NOTE** For documents referred in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

### **3 Terms and Definitions**

For purposes of this Standard, the terms and definitions of standards contained in Section 2 are applied.

## **4 General Conditions**

### **4.1 Design Documents**

4.1.1 To prepare and show designs of foundations and concrete structures, besides what is written in this Standard, the prescriptions set out in the Standards related in Section 2 shall be complied with.

4.1.2 The project shall be made of the following documents:

- a) descriptive memorandum;
- b) calculation report;
- c) drawings;
- d) technical specification.

4.1.3 All design documents shall adopt the standards of the International System of Units.

### **4.2 Descriptive Memorandum**

4.2.1 It shall have the following elements:

- a) summary;
- b) product description;
- c) specification of materials to be used;
- d) recommendations for execution;
- e) specifications for execution control;
- f) recommendations for protecting treatment of foundations and concrete structures in an aggressive environment;
- g) list of constituent documents of design and standards used.

NOTE For foundation design, the descriptive memorandum shall have the field bearing test schedule.

4.2.2 In the design description, it shall be presented the reason for adopted solutions, considering local conditions, the way aesthetic, structural, economic, and durability aspects were complied.

### **4.3 Calculation Report**

It shall be presented in a clear and legible way, and have at least the following related topics.

- a) it shall briefly describe the type of foundation and adopted structure, the analysis used, the design standards for which the loading, sizing, and checking calculations are performed;
- b) it shall be shown sizes of provisional or constructive structures, such as: shoring, containments, among others, required to perform the main structures;
- c) for numerical analysis, the methods and programs used shall be informed;
- d) it shall be listed the standard numbers and titles, technical articles and design documents from other subjects, adopted bibliographies, and others;
- e) the physical and mechanical strength properties of materials shall be informed;
- f) the geometric properties of elements from foundations and structures shall be indicated.

#### **4.3.1 Foundations**

##### **4.3.1.1 Loads**

The calculations of loads acting on the foundations described below shall be shown:

- a) dead load of the structure;
- b) loads acting on structure;
- c) land thrust;
- d) negative attrition;
- e) dynamic loads;
- f) pipelines and equipment.

##### **4.3.1.2 Load Combinations**

Worst-case load combinations for foundations shall be indicated.

##### **4.3.1.3 Geotechnical Sizing**

It shall have:

- a) allowable pressure on ground;
- b) calculation method used for geotechnical sizing of deep foundations;
- c) calculation of lengths adopted for deep foundations;
- d) safety coefficients used.

##### **4.3.1.4 Structural Sizing**

It shall have:

- a) diagram of momentums acting on stakes;
- b) calculation of structural sizing.

#### **4.3.1.5 Displacements and Repressions**

Calculations of displacements, repressions and differential repressions shall be presented according to guidance from ABNT [NBR 6122](#).

#### **4.3.1.6 Dynamic Effects**

In foundations subject to dynamic loads, the maximum vibration amplitudes and relevant vibration modes shall be shown.

#### **4.3.1.7 Annexes**

It shall have:

- a) tables and abacuses used in sizing and other checks;
- b) theories and equations, not present in bibliography and technical standards, used in sizing or checks;
- c) data input and output reports;
- d) reports of geotechnical investigation used as reference.

### **4.3.2 Concrete Structures**

#### **4.3.2.1 Loads**

The calculations of loads acting on the structures described below shall be shown:

- a) dead load;
- b) usage overloads;
- c) wind;
- d) dynamic loads;
- e) pipelines and equipment;
- f) temperature range.

#### **4.3.2.2 Load Combinations**

Worst-case load combinations for structural analysis shall be indicated.

#### **4.3.2.3 Structural System**

It shall have schematic drawings of the structure or of its parts, showing:

- a) supports (external connections);
- b) numbering and distance among nodes;
- c) designation of structural elements with symbols different from numbering of nodes;
- d) internal joints (discontinuities of displacements, ball and socket joints);
- e) gap lengths, pillar heights, and other measures for perfect understanding of shape and size of the structure;
- f) main centerlines, with the same designations shown in drawing for execution of shapes;
- g) acting loads, with their numerical values; as an option, it is allowed to present loads in a separate scheme.

#### **4.3.2.4 Working Stresses**

It shall be shown:

- a) diagrams of working stresses of each load;
- b) envelopments of working stresses for moving loads;
- c) envelopments of working stresses for load combinations, including add-on or mitigation coefficients for analysis of ultimate limit states.

#### **4.3.2.5 Displacements**

The calculations of displacements in main sections of structure, considering critical load combinations, shall be indicated.

#### **4.3.2.6 Dynamic Effects**

In structures subject to dynamic loads, the maximum vibration amplitudes and relevant vibration modes shall be submitted.

#### **4.3.2.7 Structural Sizing and Checks**

It shall have:

- a) sizing of frames of parts, with checks of minimal arrangements established by the design standard(s);
- b) sizing of provisional structural elements, such as:
  - supports;
  - stays;
  - falseworks and other responsible works for global balance of structure, since constructive phase until its completion;
- c) sizing of accessory elements, such as:
  - anchor bolts;
  - parts built in the concrete;
  - support devices;
  - fenders, among others;
- d) checks of concrete ultimate resistances;
- e) checks of concrete tracking;
- f) checks of balance of the structure, or of its parts;
- g) check of maximum admissible displacements;
- h) check about possible resonance, for structures subject to dynamic loads;
- i) check of fatigue in frames of structural elements subject to working stress ranges; this checking is mandatory for bridges, including their accesses, placed in areas for loading or unloading of products, and for support beams of crane bridges.

#### **4.3.2.8 Annexes**

It shall have:

- a) tables and abacuses used in sizing of frames and other structural checks;
- b) theories and equations, not present in bibliography and technical standards, used in sizing or checks;
- c) if computer programs are used, identify them and inform the respective user licenses;
- d) data input and output reports, if a computer program is used.



## **4.4 Drawings**

### **4.4.1 Foundations**

4.4.1.1 During their preparation, the drawings shall comply with terms and definitions of the standards in Section 2.

4.4.1.2 The drawings shall have:

- a) drawing of location of foundations;
- b) drawings for execution of shapes;
- c) drawings for execution of frames.

NOTE 1 When explicitness is not harmed, location and shapes can be in the same drawing, as well as shapes and frames.

NOTE 2 An excavation plan for execution of direct foundation or pile cap shall be provided, if necessary.

4.4.1.3 The location shall be referring to the coordinate system, used in project design. When there is no coordinate system, the location shall refer to an existing landmark or building.

4.4.1.4 All levels shall be given regarding PETROBRAS Level Reference (RN) of the place of execution of foundations.

4.4.1.5 The land grader shall always be present in design of foundations.

4.4.1.6 The location drawing shall have the following elements for deep foundations:

- a) type;
- b) cross section;
- c) frame;
- d) details of mends;
- e) cut-off positions;
- f) Provided edge positions, with zoning on the plant, if they are variable;
- g) load capacity;
- h) acting loads, including horizontal and tensile loads;
- i) negative attrition value;
- j) numbering of blocks, and numbering of elements per block;
- k) location of probing and other geotechnical tests;
- l) indication of performance of tests to check integrity, where applicable;
- m) indication of checking program of performance of foundations (static load test, dynamic load test);
- n) number and title of location drawing of geotechnical investigations; of the presentation report of geotechnical investigations; of location drawing of the work; of plant of loads on foundations; and of calculation report, indicated in field "reference documents".

4.4.1.7 The location drawing shall have the following elements for direct foundations:

- a) acting loads;
- b) admissible pressure on land;
- c) foundation laying position;
- d) location of probing and geotechnical tests;
- e) Numbering of foundation elements;

- f) number and title of location drawing of geotechnical investigations; of the presentation report of geotechnical investigations; of location drawing of the work; of plant of loads on foundations; and of calculation report, indicated in field "reference documents".

4.4.1.8 The following elements from drawings of shapes shall be present:

- a) minimum compressive strength of concrete (fck), maximum water/cement ratio and minimum consumption of cement per m<sup>3</sup> of concrete;
- b) weak-mix concrete ballast thickness;
- c) volume of structural and weak-mix concrete;
- d) area of shapes;
- e) volume of excavation and backfilling;
- f) plan of concreting;
- g) details of expansion and retraction joints;
- h) location, quantity and details of fixation of anchor bolts and parts built in the concrete;
- i) number and title of location drawing of foundations, and of calculation report, indicated in field "reference documents";
- j) number and title of supplementary documents in field "general notes".

4.4.1.9 The following elements from drawings of frames shall be present:

- a) type of steels used;
- b) location and details of mends;
- c) frame table;
- d) shield coating.
- e) number and title of location drawing of shapes, and of calculation report, indicated in field "reference documents";
- f) number and title of supplementary documents in field "general notes".

#### **4.4.2 Concrete Structures**

4.4.2.1 The drawings shall have:

- a) drawings for execution of shapes;
- b) drawings for execution of frames;
- c) drawings for assembly.

**NOTE** When explicitness is not harmed, shapes and frames can be in the same drawing.

4.4.2.2 The drawings for execution of shapes shall have, at least:

- a) true North and design North, referring to the coordinate system defined by PETROBRAS;
- b) adopted RN;
- c) reference used for location when the coordinate system is not defined;
- d) location and orientation of pillars or other structural elements leaning on the foundation;
- e) identification of structural elements;
- f) plants, cuts and elevations of structural elements, required for the perfect understanding of its shape and size;
- g) constructive details (chamfers in edges of appearing elements, expansion, retraction and construction joints, counter-jibs, and others);
- h) location, quantity and details of accessory elements, such as:
  - anchor bolts;
  - parts built in the concrete;
  - support devices;
  - fenders, among others;
- i) list of materials of accessory elements, with description, quantity and mass;



- j) minimum compressive strength of concrete ( $f_{ck}$ ), maximum water/cement ratio and minimum consumption of cement per  $m^3$  of concrete;
- k) maximum characteristic size of coarse aggregate;
- l) volume of structural and weak-mix concrete, area of shapes;
- m) number and title of architecture drawings (when applicable), drawing of shapes of higher level, and of calculation report, indicated in field "reference documents";
- n) number and title of supplementary documents in field "general notes".

4.4.2.3 The drawings for execution of frames shall have, at least:

- a) types of steels used;
- b) location and details of mends;
- c) frame table and summary table;
- d) frame coatings;
- e) details of minimum bending radius of frames;
- f) number and title of drawing of corresponding shapes, indicated in field "reference documents";
- g) number and title of supplementary documents in field "general notes".

4.4.2.4 The drawings for assembly of elements from pre-molded structures shall have, at least:

- a) concreting phases;
- b) lifting sequences;
- c) temporary bracings;
- d) shoring;
- e) prestressed sequences for prestressed elements.

## 4.5 Technical Specification

### 4.5.1 Foundations

The technical specification shall have at least the following information:

- a) types of foundations used in design;
- b) size and location tolerances;
- c) considerations on backfilling and compression;
- d) execution control;
- e) methodology of stack cutting-off;
- f) checking criteria for integrity of stakes;
- g) checking criteria for performance of stakes;
- h) characteristic compression resistance of concrete ( $f_{ck}$ );
- i) maximum water/cement ratio;
- j) minimum consumption of cement per  $m^3$  of concrete;
- k) types and characteristics of additives for concrete;
- l) maximum characteristic size of aggregates;
- m) types and characteristics of steel for frames;
- n) conditions for receiving, handling and storing materials.

### 4.5.2 Concrete Structures

The technical specification shall have at least the following information:

- a) characteristic compression resistance of concrete ( $f_{ck}$ );
- b) required value of modulus of elasticity;
- c) maximum water/cement ratio;
- d) minimum consumption of cement per  $m^3$  of concrete;
- e) types and characteristics of additives for concrete;



- f) maximum characteristic size of aggregates;
- g) types and characteristics of adhesives;
- h) types and characteristics of graute;
- i) types and characteristics of expansion joints;
- j) finishing standard of concrete surfaces;
- k) description of shape system;
- l) types and characteristics of materials used in shapes;
- m) types and characteristics of steel for frames;
- n) types and characteristics of cordages;
- o) discrimination of accessory elements, such as: anchor bolts, parts built in concrete, support devices, fences, and others;
- p) conditions for receiving, handling and storing materials.

## INDEX OF REVISIONS

**REV. A**

There is no index of revisions.

**REV. B**

Affected Parts	Description of Alteration
	Revalidacion

**REV. C**

[illegible]

ABNT [NBR 8403](#) - Aplicação de Linhas em Desenhos - Tipos de Linhas - Larguras das Linhas;

ABNT [NBR 8404](#) - Indicação do Estado de Superfícies em Desenhos Técnicos;

ABNT [NBR 8681](#) - Ações e Segurança nas Estruturas;

ABNT [NBR 9062](#) - Projeto e Execução de Estruturas de Concreto Pré-Moldado;

ABNT [NBR 10067](#) - Princípios Gerais de Representação em Desenho Técnico;

ABNT [NBR 10126](#) - Cotagem em Desenho Técnico;

ABNT [NBR ISO 10209-2](#) - Documentação Técnica de Produto - Vocabulário - Parte 2: Termos Relativos aos Métodos de Projeção.

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- b) calculation report;
- c) drawings;
- d) technical specification.

4.1.3 All design documents shall adopt the standards of the International System of Units.

#### 4.2 Descriptive Memorandum

4.2.1 It shall have the following elements:

- a) summary;
- b) product description;
- c) specification of materials to be used;
- d) recommendations for execution;
- e) specifications for execution control;
- f) recommendations for protecting treatment of foundations and concrete structures in an aggressive environment;
- g) list of constituent documents of design and standards used.