

Presentation of Designs of 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

Foreword

PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting of Technical Collaborators specialists from PETROBRAS and its Subsidiaries), are commented by PETROBRAS Units and PETROBRAS Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of specialists from the same specialty, representing the various PETROBRAS Units and PETROBRAS Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the PETROBRAS Units and PETROBRAS 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.

Foreword

This Standard is the English version (issued in 03/008) of PETROBRAS N-1959 REV. C 03/2008, which is the Revalidation of PETROBRAS N-1959 REV. B 09/2002, the contents thereof not altered. 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 prescribes the conditions required for the presentation of designs of plain, reinforced and prestressed concrete structures.

1.2 This Standard is applicable to designs of onshore and offshore structures.

1.3 For the presentation of designs of onshore foundations and offshore foundations, PETROBRAS [N-1784](#) and PETROBRAS [N-2001](#) shall be met, respectively.

1.4 For the presentation of designs of structures intended for road building and paving which are molded directly on the ground, PETROBRAS [N-2133](#) shall be met.

1.5 This Standard is applied to designs started as of its date of issuance.

1.6 This Standard contains Technical Requirements and Recommended Practices.

2 Normative References

The following referenced documents are indispensable for the application of this Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

PETROBRAS [N-134](#) - Anchors for Use in Concrete;

PETROBRAS [N-381](#) - Execution of Drawing and Other General Technical Documents;

PETROBRAS [N-1644](#) - Construction of Reinforced Concrete Foundations and Structures;

PETROBRAS [N-1686](#) - Design and Construction of Firewall;

PETROBRAS [N-1689](#) - Design of Sleeper Top in Reinforced Concrete for Piping;

PETROBRAS [N-1690](#) - Design of Expansion Joints for Reinforced Concrete Dike;

PETROBRAS [N-1710](#) - Coding of Technical Engineering Documents;

PETROBRAS [N-1784](#) - Presentation of Foundations Design;

PETROBRAS [N-2001](#) - Design and Construction of Foundation for Offshore Structures;

PETROBRAS [N-2064](#) - Issuance and Revision of Design Documents;

PETROBRAS [N-2133](#) - Presentation of Roadway and Pavement Designs;

ABNT [NBR 6118](#) - Projeto e Execução de Obras de Concreto Armado;

ABNT [NBR 6119](#) - Cálculo e Execução de Lajes Mistas;

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

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

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

ABNT [NBR 7188](#) - Carga Móvel em Ponte Rodoviária e Passarela de Pedestre;

ABNT [NBR 7189](#) - Cargas Móveis para Projeto Estrutural de Obras Ferroviárias;

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

ABNT [NBR 7194](#) - Cálculo e Execução de Chaminés Industriais em Alvenaria e em Concreto Armado;

ABNT [NBR 7197](#) - Projeto de Estruturas de Concreto Protendido;

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

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

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

ABNT [NBR 9782](#) - Ações em Estruturas Portuárias, Marítimas ou Fluviais;

ABNT [NBR 10126](#) - Cotação de Desenho Técnico;

ABNT [NBR 10837](#) - Cálculo de Alvenaria Estrutural de Blocos Vazados de Concreto;

ABNT [NBR 12230](#) - SI - Prescrições para sua Aplicação;

ABNT [NBR 12655](#) - Concreto - Preparo, Controle e Recebimento.

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 the purposes of this Standard the definitions indicated in the standards contained in Section 2 are adopted.

4 GENERAL CONDITIONS

4.1 Design Documents

4.1.1 For the preparation and presentation of designs of concrete structures, besides the provisions in this Standard the conditions prescribed in the standards listed in Section 2 shall be followed.

4.1.2 The design shall be comprised of the following documents:

- a) descriptive memorandum;
- b) calculations sheet;
- c) drawings;
- d) technical specification.

4.1.3 All design documents shall adopt the standards of the International System of Measurement Units, in accordance with ABNT [NBR 12230](#).

4.2 Descriptive Memorandum

4.2.1 This document shall contain the following elements:

- a) table of contents;
- b) description of design;
- c) execution flow diagram (whenever applicable);
- d) list of documents comprising the design;
- e) list of the main standards used in design.

4.2.2 The description of the design shall contain justification for the solutions adopted, bearing in mind basic designs and local conditions, for compliance with aesthetic, structural, economic and durability needs.

4.3 Calculation Sheet

This document shall be presented in a clear and legible manner and contain, at least, the topics listed in the sequence of 4.3.1 to 4.3.5.

4.3.1 Objective

To briefly describe the structure and how it is analyzed (manually or through computer-based numerical modeling), as well as indicate the design standards according to which calculations for loadings, sizing and structural checks are made.

4.3.2 Reference Documents

Numbers and titles of standards, technical articles and design documents of other disciplines, bibliographies adopted and others shall be listed.

4.3.3 Structural Analysis

It shall contain the information given in 4.3.3.1 to 4.3.3.8.

4.3.3.1 Materials

The physical and mechanical resistance properties of materials shall be informed.

4.3.3.2 Geometric Properties

The relevant properties of the sections of structural elements shall be indicated.

4.3.3.3 Loadings

Calculations of loadings acting upon the structure such as those described below shall be presented:

- a) dead weight;
- b) overloads;
- c) wind;

- d) piping;
- e) temperature change and others.

4.3.3.4 Combinations of Loadings

The most unfavorable combinations of loadings for the structural analysis shall be indicated.

4.3.3.5 Structural System

It shall contain schematic drawings of the structure or parts thereof, indicating:

- a) supports (external connections);
- b) numbering of nodes, in case a computer program is used;
- c) designation of structural elements; if a computer program is used, the numbering of the elements shall be indicated in symbols differing from the numbering of nodes;
- d) internal articulations (displacement discontinuities, hinge joints);
- e) lengths of spans, heights of pillars and other measurements for a perfect understanding of the shape and dimensions of the structure; if a computer program is used, the distances between nodes shall also be indicated;
- f) major regulating lines, with the same designations shown on the formwork drawing;
- g) applied loadings, with their respective numerical values; loadings may be optionally presented on a separate diagram.

4.3.3.6 Applied Stresses

The following information shall be presented:

- a) diagrams of applied stresses of each loading, which are important for the sizing of structural elements;
- b) envelopes of applied stresses for live loads;
- c) envelopes of applied stresses of combinations of loadings, with increasing or reduction coefficients for analysis of ultimate limit states.

NOTE The diagrams and envelopes mentioned above shall contain the maximum values, the values corresponding to important sections such as support points, hinge joints and other areas and the values delimiting sharp (discontinuous) changes in the mentioned diagrams on the sections in which punctual loads or external bending moments are introduced.

4.3.3.7 Displacements

Calculations of displacements that are important for analysis of the structure shall be indicated. In case a computer program is used, displacements due to each loading shall be presented for important sections. Displacements due to combinations of loadings, including increasing or reduction coefficients for analysis of the serviceability limit states, shall be presented.

4.3.3.8 Dynamic Effects

In structures subjected to dynamic loadings, the maximum vibration amplitudes and relevant vibration modes shall be presented.

4.3.4 Sizing and Structural Checks

These documents shall contain:

- a) sizing of reinforcements of parts, checking the minimum conditions specified in the design standard(s);

- b) sizing of provisional structural elements, such as:
 - supports
 - stays
 - falsework, and other elements that are also responsible for the overall balance of the structure from the construction phase to its final completion;
- c) sizing of accessory elements, such as:
 - anchors;
 - parts embedded in concrete;
 - supporting devices;
 - fenders and other elements;
- d) ultimate strengths checks for concrete;
- e) cracking checks in concrete;
- f) balancing checks of structure or parts thereof;
- g) maximum allowable displacement checks;
- h) checks as to the possibility of resonance for structures subjected to dynamic loadings;
- i) fatigue checks in reinforcements of structural elements subject to variations of applied stresses; this check is mandatory for large and small bridges, including their accesses, situated in areas for loading and unloading of products and for supporting beams of gantries cranes.

4.3.5 Annexes

Annexes shall contain:

- a) tables and abacuses used for sizing reinforcements and other structural checks;
- b) theories and equations, which are not part of the bibliography and technical standards, used for sizing or checks;
- c) in case computer programs are used, these shall be identified and the respective licenses for use thereof shall be informed;
- d) data input and output reports in case a computer program is used.

NOTE The calculation sheet may cover the analysis, calculations, and structural checks of foundations. **[Recommended Practice]**

4.4 Drawings

4.4.1 Drawings shall include:

- a) formwork drawings;
- b) reinforcement drawings;
- c) assembly drawings.

4.4.2 Formwork drawings shall contain at least the following:

- a) true north and project north referring to the system of coordinates defined by PETROBRAS;
- b) level reference (RN) adopted;
- c) reference used for location when the system of coordinates is not defined;
- d) location and orientation of pillars or other structural elements supported by the foundation;
- e) identification of structural elements;
- f) plans, sections, and elevations of structural elements, needed for a perfect understanding of their shape and dimensions;
- g) construction details (chamfers on edges of exposed elements, expansion, retraction, and construction joints, cambers and other details);
- h) location, quantity, and detailing of accessory elements, such as:
 - anchors;
 - parts embedded in concrete;
 - supporting devices;

- fenders and other elements;
- i) list of materials of accessory elements containing description, quantity, and mass;
- j) minimum characteristic compressive strength (f_{ck}) of concrete, maximum water/cement ratio, and minimum cement consumption per m^3 of concrete; the water/cement ratio and f_{ck} shall be defined according to the conditions of aggressiveness to which the structures are exposed;
- k) maximum characteristic dimension of coarse aggregate;
- l) volume of structural and lean concrete, formwork area;
- m) numbers of drawings showing architectural details (where applicable) and location of foundations, of calculation sheet and other documents, indicated in the "reference documents" field;
- n) numbers of the corresponding reinforcement and formwork drawings of the upper level.

4.4.3 Reinforcement drawings shall contain at least the following information:

- a) types of steels used;
- b) location and details of splices;
- c) reinforcement table and summary chart;
- d) reinforcement coverings;
- e) detailing of minimum bending and curving radii of reinforcements;
- f) numbers of the corresponding formwork drawings, in the "reference documents" field.

4.4.4 The assembly drawings applicable to structures comprised of pre-cast elements shall contain at least the following information:

- a) concreting phases;
- b) hoisting sequences;
- c) temporary bridging arrangements;
- d) shoring arrangements;
- e) prestressing sequences for prestressed elements.

4.4.5 When clarity is not adversely affected, formwork and reinforcement may be presented on the same drawing. **[Recommended Practice]**

4.4.6 The designs of structural reinforcements or recoveries, which include formwork, reinforcement, and assembly, may be presented on the same drawing. **[Recommended Practice]**

4.5 Technical Specification

4.5.1 Where applicable, the technical specification shall contain at least the following information:

- a) characteristic compressive strength of concrete (f_{ck});
- b) maximum water/cement ratio;
- c) minimum consumption of cement per m^3 of concrete;
- d) types and characteristics of additives for concrete;
- e) maximum characteristic dimension of aggregates;
- f) types and characteristics of adhesives;
- g) types and characteristics of grout;
- h) types and characteristics of mastics for expansion joints;
- i) finish standard of concrete surfaces;
- j) description of formwork system;
- k) types and characteristics of materials used in moulds;
- l) types and characteristics of steel for reinforcement;
- m) types and characteristics of strands;
- n) description of accessory elements such as: anchors; parts embedded in concrete; supporting devices; fenders and others.

4.5.2 Each technical specification issued shall only consider designs of similar structures.

INDEX OF REVISIONS

REV. A

There is no index of revisions.

REV. B

Affected Parts	Description of Alteration
1.1 and 1.2	Revised
2	Revised
4	Revised

REV. C

[illegible]