

Earthwork Design

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.

"This Standard is exclusive property of Petróleo Brasileiro S. A. - PETROBRAS, internal application and PETROBRAS Subsidiaries and shall be used by its suppliers of goods and services under contracts or similar under the conditions established in Bidding, Contract, Agreement or similar.

The use of this Standard by other companies / organizations / government agencies and individuals is the sole responsibility of the users.."

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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 09/2013) of PETROBRAS N-1855 REV. D 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 establishes the required conditions for preparation of earthwork designs.

1.2 All documents shall be presented in a clear and legible way, observing the conditions established in PETROBRAS [N-381](#) and [N-1710](#), mentioning adopted codes and standards, and shall be signed by the professional responsible for preparing the design.

1.3 Applicable Federal, State and Municipal practices and standards shall be observed when preparing the design.

1.4 This Standard applies to procedures beginning from its issue date.

1.5 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 (Execution of Drawing and Other General Technical Documents).

PETROBRAS [N-1710](#) - Codificação de Documentos Técnicos de Engenharia (Engineering Technical Documents Coding).

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 document, the following terms and definitions are applicable.

3.1

deposit

natural deposit subjected to supply material for the intended purpose

3.2

waste disposal area

previously chosen places intended for disposal of materials resulting from deforesting, grubbing, soil scraping, land cleaning, rubbish, and special materials, as well as from excesses of cuts on the embankments

3.3**temporary drainage**

drainage which enables the construction of earthwork

3.4**definitive drainage of earthwork**

drainage which keeps the embanked area stable and in working conditions

3.5**definitive drainage**

drainage belonging to the pluvial runoff system of the operating unit

4 Earthwork Design Premises

4.1 The earthwork design shall involve the earthwork area of the design, disposal areas, borrow areas, service roads, and other impacted areas.

4.2 The earthwork design shall be developed aiming to establish favorable conditions for execution foundations and underground installations.

4.3 Geotechnical studies shall classify the various types of materials found in cuts or borrows, and select them to use in embankments.

4.4 To select earthwork materials, the mechanical and physical characteristics shall be assessed through field and laboratory tests.

4.5 The definition of embankment material shall consider the type of foundation to be performed.

4.6 To calculate the earthwork volume required, layer removed corresponding from to vegetation grubbing and land cleaning shall not be considered.

4.7 All factors affecting compaction or all Bulking factors, as per purpose and type of material used, shall be estimated, indicated in the design, and considered in calculation of earthwork volumes.

4.8 Macro-Drainage

4.8.1 The macro drainage design shall be prepared from the topography of original ground and the General Plant, and shall include the prediction of flood level for Return Period (PR) equal to 50 years and for (PR) = 100 years, with downstream influence, and side contributions/overflows using the original ground.

4.8.2 The effects of disposal on existing receiving water bodies shall be assessed, considering the considering stilling to basin for control fine particles. Rains for (PR) = 50 and 100 years shall be combined with maximum tide study for the same time periods. The study shall be compared with flood level of the region, measured with limnimetric scale or local research.