TECHNICAL REPORT

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Design using geosynthetics —

Part 9: Barriers

Design pour géosynthétiques —

Partie 9: Barrières

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 221, *Geosynthetics*.

A list of all parts in the ISO 18228 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The ISO 18228 series provides guidance for designs using geosynthetics for soils and below ground structures in contact with natural soils, fills and asphalt. The series contains 10 parts which cover designs using geosynthetics, including guidance for characterization of the materials to be used and other factors affecting the design and performance of the systems which are particular to each part, with ISO/TR 18228-1 providing general guidance relevant to the subsequent parts of the series.

The series is generally written in a limit state format and guidelines are provided in terms of partial material factors and load factors for various applications and design lives, where appropriate.

For each of the design considerations, the characteristics of the geosynthetics and the test methods normally used to quantify the properties of the geosynthetics are described. Some regional specific rules and regulations that normally apply to designs using geosynthetics in these regions are also mentioned.

This document contains recommendations and guidance for the design of geosynthetic barriers in geotechnical applications. The standard provides design guidance over various applications, design lives, material types, parameters and site-specific conditions. Professional judgement is needed in all designs. Be aware that national regulations might apply. This document is intended to assist in the process, by identifying parameters which are relevant.

Design using geosynthetic barriers (GBRs) takes into account the nature of the material in contact with the GBR, both underneath (the substrate), alongside and on top (the contained substances). As the primary function of a GBR is to retain or exclude fluids, primary issues in design relate to its ability to perform this function. Often, but not always, GBR materials are incorporated into structures with an extensive life expectancy and therefore the material's durability (its ability to continue to perform its primary function over time) is critical.

Balancing the combination of often conflicting performance criteria and different GBR materials to the proposed installation is always a complex matter. This inevitably comes down to professional judgement. This document does not set out to and cannot solve this potential conflict but seeks to assist the designer in identifying and clarifying the various components of the decision-making process by identifying existing standards for comparisons of individual parameters and giving some direction on prioritization in various applications as well as conflicting performance characteristics which may be encountered.

Design using geosynthetics —

Part 9:
Barriers

1 Scope

This document considers the guidance for geotechnical and civil engineers involved in the design of the barrier function.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10318-1, *Geosynthetics — Part 1: Terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 10318-1:2015 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
barrier
use of a geosynthetic to prevent or limit the migration of fluids

3.2
geosynthetic barrier
GBR
low-permeability geosynthetic material, used in geotechnical and civil engineering applications with the purpose of reducing or preventing the flow of fluid through the construction

3.3
geomembrane
GBR-P
polymeric geosynthetic barrier
factory-assembled structure of geosynthetic materials in the form of a sheet in which the *barrier* (3.1) function is essentially fulfilled by polymers

3.4
clay geosynthetic barrier
GBR-C
geosynthetic clay liner
factory-assembled structure of geosynthetic materials in the form of a sheet in which the *barrier* (3.1) function is essentially fulfilled by clay

3.5
bituminous geomembrane
bituminous geosynthetic barrier
GBR-B
factory-assembled structure of geosynthetic materials in the form of a sheet in which the *barrier* (3.1) function is essentially fulfilled by bitumen

4 Pictograms

4.1 Product and function

Graphical symbols and pictograms for geosynthetic barriers can be found in ISO 10318-2:2015.

4.2 Applications

4.2.1 Containment application, non-landfill (CA)

GBRs are used to inhibit the ingress of water and the uncontrolled escape of fluids in or out of the construction (see Figure 1). The minimum confining stress is typically of the order of 20 kN/m^2.

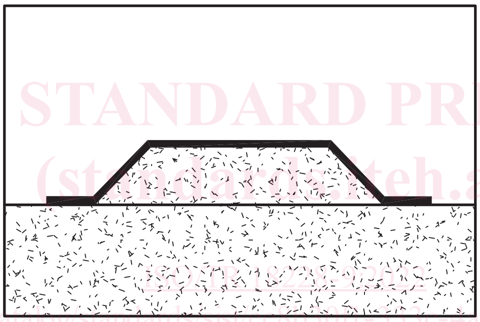

Figure 1 — Containment application, non-landfill (CA)

4.2.2 Chemical containment, non-landfill (CC)

The function of the GBR in this application is to contain any hazardous liquids or constituents within a construction. The typical confining stress is in the range of less than 50 kN/m^2, whereas the hydraulic gradient i is typically less than 500. See Figure 2.

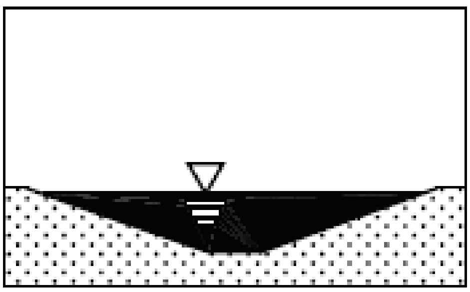

Figure 2 — Chemical containment, non-landfill (CC)

4.2.3 Construction waterproofing (CW)

The function of the GBR in this application is to inhibit the passage of water into the underground structures (other than tunnels and associated structures). The typical confining stress is less than 100 kN/m^2 and the gradient can be up to 400, however both can be much higher. See Figure 3.

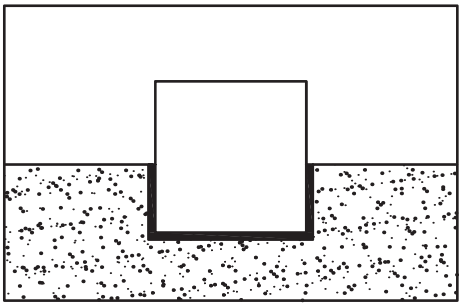

Figure 3 — Construction waterproofing (CW)

4.2.4 Landfill base lining (LBL)

GBRs are used to inhibit the ingress of groundwater and the uncontrolled escape of landfill leachate and/or gases in the construction of solid waste storage and disposal sites as base liners. The typical confining stress is in the range of 50 kN/m^2 to 1 000 kN/m^2, whereas the hydraulic gradient i is typically less than 50. See Figure 4.

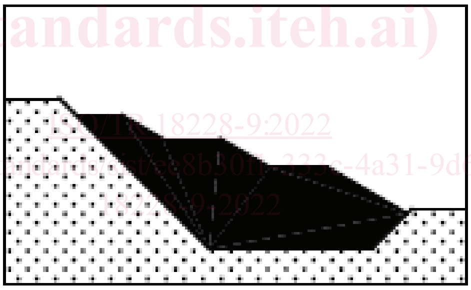

Figure 4 — Landfill base lining (LBL)

4.2.5 Landfills caps (LC)

GBRs are used to inhibit the ingress of water and the uncontrolled escape of fluids and/or gases in the construction of solid or industrial waste facilities. The typical confining stress is in the range of 10 kN/m^2 to 50 kN/m^2. See Figure 5.

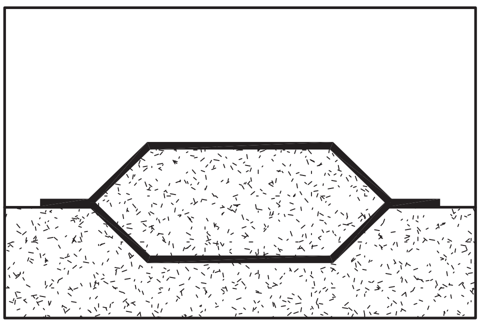

Figure 5 — Landfills caps (LC)

4.2.6 Secondary containment (SC)

The function of the GBR in this application is to contain any hazardous liquids or constituents resulting from storage silos or similar containment failures. The typical confining stress is in the range of less than 25 kN/m^2, whereas the hydraulic gradient i is typically less than 150. See Figure 6.

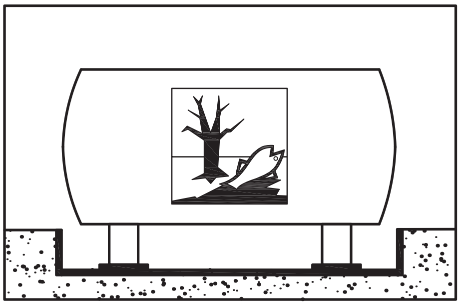

Figure 6 — Secondary containment (SC)

4.2.7 Transport infrastructure applications (TIA)

The function of the GBR in these applications is to inhibit any hazardous liquids or constituents resulting from vehicle, railway or airline traffic entering the sensitive location, mainly in infrastructure applications, such as roads, railways and airports. The typical confining stress is in the range of less than 50 kN/m^2, whereas the hydraulic gradient i is typically less than 50. See Figure 7.

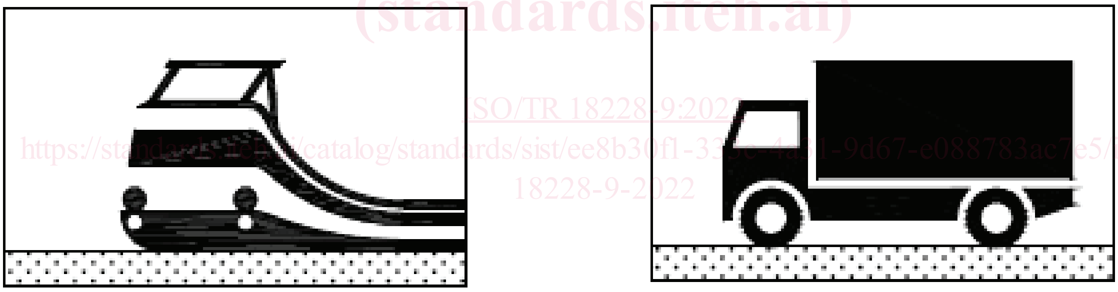

Figure 7 — Transport instrastructure application (TIA)

4.2.8 Tunnels (Tu)

The function of the GBR in this application is to inhibit the passage of water into the construction of tunnels and associated underground structures. The typical confining stress in a cut and cover application is in the range of less than 100 kN/m^2 and a gradient up to 400. In bored applications the confining stresses and gradients are typically much higher. See Figure 8.

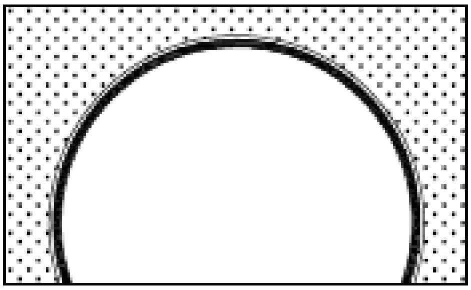

Figure 8 — Tunnels

4.2.9 Water retaining structure (WRS-e), e.g. balancing ponds, dams, dykes and canals (usually empty)

In applications with a temporary water level such as balancing ponds, dams, dykes and canals, GBRs are mostly used as the sole hydraulic barrier or in combination with an existing soil barrier. The function of the GBR is to reduce seepage through the system thereby reducing water loss and providing environmental protection. The typical confining stress is less than 50 kN/m^2, whereas the hydraulic gradient is typically higher than 100 and can reach many hundreds. See Figure 9.

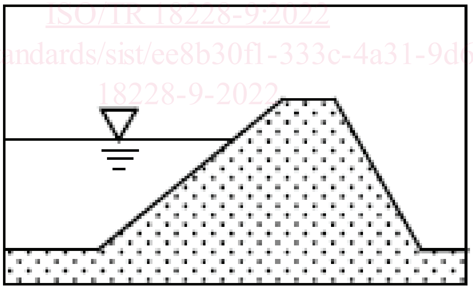

Figure 9 — Water retaining structure (WRS-e)

4.2.10 Water retaining structure (WRS-f), e.g. reservoirs, canals (usually full)

In applications where a constant water level is maintained such as canals, rivers and surface impoundments, GBRs are mostly used as the sole hydraulic barrier or in combination with an existing soil barrier (such as a clay core within a dam structure). The function of the GBR is to reduce seepage through the system thereby reducing water loss from the waterway or storage impoundment. Additionally, it is used to prevent the weakening of the internal structure of the dam. The typical confining stress is less than 50 kN/m^2, whereas the hydraulic gradient i is typically higher than 100 and can reach many hundreds. See Figure 10.