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Design using geosynthetics —

Part 6:
Protection

Conception utilisant des géosynthétiques —

Partie 6: Protection

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Foreword

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This document was prepared by Technical Committee ISO/TC *221*, *Geosynthetics*, Working group WG 6, *Design using geosynthetics*.

A list of all parts in the ISO/TR 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/TR 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 characterisation 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.

This document includes information relating to the use of geosynthetics in a protective function.

Design using geosynthetics —

Part 6:
Protection

1 Scope

This document provides general considerations to support design guidance for the evaluation of geosynthetics to fulfil a protective function to any surface or material placed in contact with the protective element.

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*

ISO 10318-2, *Geosynthetics — Part 2: Symbols and pictograms*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10318-1 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/

3.2 Symbols

For the purposes of this document, the symbols in ISO 10318-2 apply.

4 Concepts and fundamental principles

Geosynthetics for protection (protectors) are frequently incorporated with other geosynthetics and soil components in barrier systems. The objective of any barrier protector is to ensure that the stresses and strains encountered during the construction phase and operational life of a site pose no significant risk of damage to the barrier. The aim of the geosynthetic protection layer is to limit damage to the barrier caused by the drainage aggregate placed above the barrier (see Figure 1 and Figure 2). Designers would normally assess the potential for stresses and strains in the protector. This document covers the use of geosynthetics as a protection layer for barriers.

Figure 1 — Drainage aggregate in contact with protection geotextile

Figure 2 — Placement of drainage aggregate

The purpose of the protective layer is to:

— minimize the risk of barrier damage or puncture during construction i.e. placement of the aggregate drainage layer (dynamic loads) (static loads). The test methods described in Clause 4 don't cover this aspect of the design. Test pads using the actual geotextile grade, drainage aggregate and placement equipment are normally performed in order to assess the minimum aggregate placement thickness. Figure 3 shows barrier damage from a rounded river gravel due to trafficking with <150 mm cover; and

— minimize the localized strains in the barrier during the subsequent operation and life of the containment facility. Hence reducing the risk for future mechanical damage forming due to, for example, environmental stress cracking.

Figure 3 — Barrier damage due to construction traffic

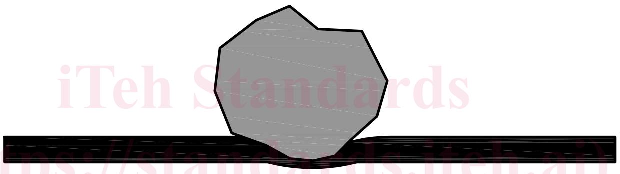

Figure 4 — Deformation without protection layer

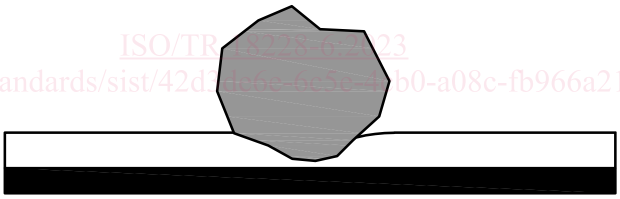

Figure 5 — Deformation with protection layer

A geosynthetic can provide some stress reduction (Figures 4 and 5) however, this layer alone would not normally be relied upon to reduce all stresses from the barrier. While strain minimization is desirable, designers would normally be aware that zero strain is unlikely to be achieved.

5 Design approaches for protection

Table 1 outlines some of the common issues designers normally consider in selecting the most effective geosynthetic for protection.

Table 1 — Issues considered by designers

Environment	Issue
Physical	— The likely stresses and strains imposed during the construction period. — The likely stresses and strains imposed by settlement and movement. — The likely stresses and strains imposed by the materials placed in contact with the geosynthetic, particularly any drainage stone. — The duration of exposure to ultraviolet light. — The likely temperatures expected adjacent to the geosynthetic and whether these are likely to have a damaging effect upon the material properties in any way. — The interface friction angles between the materials around the geosynthetics and the geosynthetics themselves, particularly on slopes.
Chemical	— The likely interaction between the geosynthetic and the material around the geosynthetic. It is usual for there to be little or no interaction. — The polymeric structure of the geosynthetic itself and whether it will be prone to degradation which would affect its ability to protect the barrier. The polymeric structure would normally be such as to cover the predicted life of the geosynthetic and barrier. — The effects of mineral precipitation on the geosynthetics performance.
Biological	— The effects of microbial growth on the polymer of the geosynthetic. — The effects of microbial growth on the characteristics of the geosynthetic.

Currently there are two main approaches regarding the design of protective geosynthetics: strain minimization and resistance to puncture.

Strain minimization considers whether the protective effect of a protection layer is sufficient if the load distribution is dispersed to such an extent that only slight indentations arise in the barrier. By limiting the strain of a barrier to within a strain limit, damage can usually be prevented in the microstructure of the material that would otherwise develop when strains exceed this limit. Excessive strain can sometimes develop into macroscopic stress cracks. Conversely, stress crack formation is impossible when deformations stay below this limiting strain, regardless of the stresses imposed.

A limiting value for the permissible deformation can be derived another way. Koch et al.[1] suggested that tensile stresses be considered. These arise from different deformation events, taking stress relaxation in the barrier into account. The stresses are then compared with the stress level that the HDPE material can tolerate over the long-term without stress crack formation (long-term pipe pressure tests).

Narejo[2] defined levels of protection against puncture for barriers under typical loading conditions as follows:

— Level I: typically applied to barrier systems for hazardous waste facilities. This level requires that the barrier system be designed such that less than 0,25 % localized strain (average strain over the

