



SLOVENSKI STANDARD

SIST EN 13491:2018

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Nadomešča:
SIST EN 13491:2013

Geosintetične zapore - Zahtevane lastnosti pri uporabi za zaščito pred tekočinami pri gradnji predorov in pripadajočih podzemnih konstrukcij

Geosynthetic barriers - Characteristics required for use as a fluid barrier in the construction of tunnels and associated underground structures

Geosynthetische Dichtungsbahnen - Eigenschaften, die für die Anwendung beim Bau von Tunneln und damit verbundenen Tiefbauwerken erforderlich sind

Barrières géosynthétiques - Caractéristiques requises pour l'utilisation comme barrière contre les liquides dans la construction des tunnels et des structures souterraines

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ICS:

59.080.70	Geotekstilije	Geotextiles
93.060	Gradnja predorov	Tunnel construction

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EUROPEAN STANDARD

EN 13491

NORME EUROPÉENNE

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ICS 59.080.70; 91.100.50

Supersedes EN 13491:2013

English Version

Geosynthetic barriers - Characteristics required for use in the construction of tunnels and associated underground structures

Géomembranes et géosynthétiques bentonitiques -
Caractéristiques requises pour l'utilisation dans la
construction de tunnels et des structures souterraines
associées

Geosynthetische Dichtungsbahnen - Eigenschaften, die
für die Anwendung beim Bau von Tunneln und damit
verbundenen Tiefbauwerken erforderlich sind

This European Standard was approved by CEN on 23 October 2017.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

This document (EN 13491:2018) has been prepared by Technical Committee CEN/TC 189 “Geosynthetics”, the secretariat of which is held by NBN.

This document supersedes EN 13491:2013.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2018, and conflicting national standards shall be withdrawn at the latest by December 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

For relationship with Regulation (EU) No. 305/2011, see informative Annex ZA, which is an integral part of this document.

The main changes with respect to the previous edition are listed below:

- The list of normative references has been updated;
- In 3.1 three terms have been added;
- In 3.2 list of abbreviations has been updated;
- In 4.3, Table 1, has been modified to comply with the modified mandate M/386 (inclusion of elongation in separation and filtration functions) and has been technically revised, all H-coded characteristics have been replaced by “A”;
- Figures and keys have been revised;
- Clause 5 “Evaluation of conformity” has been superseded by new Clause 5 “Assessment and verification of constancy of performance (AVCP)”;
- Annex A “Factory production control – Factory production control scheme” has been deleted;
- Former Annex B “Durability” becomes Annex A, which has been totally revised;
- Annex ZA has been updated according to new template to fulfil requirements of CPR, also examples for CE-marking have been deleted.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document allows manufacturers to describe geosynthetic barriers on the basis of declared values for characteristics relevant to the intended use and if tested to the specified method. It also includes procedures for assessment and verification of constancy of performance (AVCP) including the factory production control.

This document can also be used by designers, end-users and other interested parties as a tool to define relevant and appropriate characteristics for specifications.

Tests for some non-mandated characteristics are still under study and will be included when the standard is revised.

The term “product” used in this document refers to a geosynthetic barrier, including polymeric geosynthetic barriers, clay geosynthetic barriers and bituminous geosynthetic barriers.

This document is part of a group of standards, addressing the requirements for geosynthetic barriers when used in a specific application.

Particular application cases can contain requirements about additional properties and – preferably standardized – test methods, if they are technically relevant and not conflicting with European Standards.

The design life of the product should be determined, since its function can be temporary, as construction expediency, or permanent, for the lifetime of the structure.

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1 Scope

This document specifies the characteristics of geosynthetic barriers, including polymeric geosynthetic barriers, clay geosynthetic barriers and bituminous geosynthetic barriers, when used as fluid barriers and separation layer in the construction of tunnels and associated underground structures, and the appropriate test methods to determine these characteristics.

The intended use of these products is to control the leakage of fluid through the construction.

This document is not applicable to geotextiles or geotextile-related products as defined in EN ISO 10318-1.

This document provides for the assessment and verification of constancy of performance (AVCP) of the product to this European Standard including factory production control procedures.

This document defines characteristics to be considered with regard to the presentation of performance.

This document does not cover applications where the geosynthetic barrier is to be in contact with water that has been treated for human consumption.

NOTE Where potable water is or can be in direct contact with the product, other relevant standards, requirements and/or regulations can be considered for the design.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1109:2013, *Flexible sheets for waterproofing - Bitumen sheets for roof waterproofing - Determination of flexibility at low temperature* [SIST EN 13491:2018](https://standards.iteh.ai/catalog/standards/sist/fa91d8f1-17cf-4d18-9c6f-8e90052896/sist-en-1109-2013)

EN 1296:2000, *Flexible sheets for waterproofing - Bitumen, plastic and rubber sheets for roofing - Method of artificial ageing by long term exposure to elevated temperature*

EN 1844:2013, *Flexible sheets for waterproofing - Determination of resistance to ozone - Plastic and rubber sheets for roof waterproofing*

EN 1849-1:1999, *Flexible sheets for waterproofing - Determination of thickness and mass per unit area - Part 1: Bitumen sheets for roof waterproofing*

EN 1849-2:2009, *Flexible sheets for waterproofing - Determination of thickness and mass per unit area - Part 2: Plastic and rubber sheets*

EN 12224:2000, *Geotextiles and geotextile-related products - Determination of the resistance to weathering*

EN 12225:2000, *Geotextiles and geotextile-related products - Method for determining the microbiological resistance by a soil burial test*

EN 12226:2012, *Geosynthetics - General tests for evaluation following durability testing*

EN 12310-1:1999, *Flexible sheets for waterproofing - Part 1: Bitumen sheets for waterproofing - Determination of resistance to tearing (nail shank)*

EN 12311-1:1999, *Flexible sheets for waterproofing - Part 1: Bitumen sheets for roof waterproofing - Determination of tensile properties*

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EN 12311-2:2013, *Flexible sheets for waterproofing - Determination of tensile properties - Part 2: Plastic and rubber sheets for roof waterproofing*

EN 13249:2016, *Geotextiles and geotextile-related products - Characteristics required for use in the construction of roads and other trafficked areas (excluding railways and asphalt inclusion)*

EN 13250:2016, *Geotextiles and geotextile-related products - Characteristics required for use in the construction of railways*

EN 13251:2016, *Geotextiles and geotextile-related products - Characteristics required for use in earthworks, foundations and retaining structures*

EN 13252:2016, *Geotextiles and geotextile-related products - Characteristics required for use in drainage systems*

EN 13253:2016, *Geotextiles and geotextile-related products - Characteristics required for use in erosion control works (coastal protection, bank revetments)*

EN 13254:2016, *Geotextiles and geotextile-related products - Characteristics required for the use in the construction of reservoirs and dams*

EN 13255:2016, *Geotextiles and geotextile-related products - Characteristics required for use in the construction of canals*

EN 13256:2016, *Geotextiles and geotextile-related products - Characteristics required for use in the construction of tunnels and underground structures*

EN 13257:2016, *Geotextiles and geotextile-related products - Characteristics required for use in solid waste disposals*

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EN 13265:2016, *Geotextiles and geotextile-related products - Characteristics required for use in liquid waste containment projects*

EN 14150:2006, *Geosynthetic barriers - Determination of permeability to liquids*

EN 14151:2010, *Geosynthetics - Determination of burst strength*

EN 14196:2016, *Geosynthetics - Test methods for measuring mass per unit area of clay geosynthetic barriers*

EN 14414:2015, *Geosynthetics - Screening test method for determining chemical resistance for landfill applications*

EN 14415:2004, *Geosynthetic barriers - Test method for determining the resistance to leaching*

CEN/TS 14416:2014, *Geosynthetic barriers - Test method for determining the resistance to roots*

CEN/TS 14417:2014, *Geosynthetic barriers - Test method for the determination of the influence of wetting-drying cycles on the permeability of clay geosynthetic barriers*

CEN/TS 14418:2014, *Geosynthetic Barriers - Test method for the determination of the influence of freezing-thawing cycles on the permeability of clay geosynthetic barriers*

EN 14575:2005, *Geosynthetic barriers - Screening test method for determining the resistance to oxidation*

EN 14576:2005, *Geosynthetics - Test method for determining the resistance of polymeric geosynthetic barriers to environmental stress cracking*

EN 16416:2013, *Geosynthetic clay barriers - Determination of water flux index - Flexible wall permeameter method at constant head*

EN ISO 527-1:2012, *Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1:2012)*

EN ISO 527-3:1995, *Plastics - Determination of tensile properties - Part 3: Test conditions for films and sheets (ISO 527-3:1995)*

EN ISO 527-4:1997, *Plastics - Determination of tensile properties - Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites (ISO 527-4:1997)*

EN ISO 1133-1:2011, *Plastics - Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics - Part 1: Standard method (ISO 1133-1:2011)*

EN ISO 1183-1:2012, *Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pycnometer method and titration method (ISO 1183-1:2012)*

EN ISO 1183-2:2004, *Plastics - Methods for determining the density of non-cellular plastics - Part 2: Density gradient column method (ISO 1183-2:2004)*

EN ISO 1183-3:1999, *Plastics - Methods for determining the density of non-cellular plastics - Part 3: Gas pycnometer method (ISO 1183-3:1999)*

EN ISO 3696:1995, *Water for analytical laboratory use. Specification and test methods (ISO 3696:1987)*

EN ISO 9863-1:2016, *Geosynthetics - Determination of thickness at specified pressures - Part 1: Single layers (ISO 9863-1:2016)*

EN ISO 9864:2005, *Geosynthetics - Test method for the determination of mass per unit area of geotextiles and geotextile-related products (ISO 9864:2005)*

EN ISO 10318-1:2015, *Geosynthetics - Part 1: Terms and definitions (ISO 10318-1:2015)*

EN ISO 10319:2015, *Geosynthetics - Wide-width tensile test (ISO 10319:2015)*

EN ISO 10773:2011, *Clay geosynthetic barriers - Determination of permeability to gases (ISO 10773:2011)*

EN ISO 11357-6:2013, *Plastics - Differential scanning calorimetry (DSC) - Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT) (ISO 11357-6:2008)*

EN ISO 12236:2006, *Geosynthetics - Static puncture test (CBR test) (ISO 12236:2006)*

EN ISO 13438:2004, *Geotextiles and geotextile-related products - Screening test method for determining the resistance to oxidation (ISO 13438:2004)*

ISO 34-1:2015, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces*

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ISO 11465:1993, *Soil quality — Determination of dry matter and water content on a mass basis — Gravimetric method*

ASTM D696, *Standard test method for coefficient of linear thermal expansion of plastics between -30 °C and 30 °C*

ASTM D1434, *Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting*

ASTM D4603, *Standard Test Method for Determining Inherent Viscosity of Poly(Ethylene Terephthalate) (PET) by Glass Capillary Viscometer*

ASTM D5890, *Standard test method for swell index of clay mineral component of geosynthetic clay liners*

ASTM D7409, *Standard Test Method for Carboxyl End Group Content of Polyethylene Terephthalate (PET) Yarns*

3 Terms, definitions and abbreviations**3.1 Terms and definitions**

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

3.1.1**product**

geosynthetic barrier, including polymeric, bituminous and clay barriers

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3.1.2**geosynthetic barrier**

barrier with at least one of whose components is made from a synthetic or natural polymer, in the form of a sheet, a strip or a three dimensional structure, used in contact with soil and/or other materials in geotechnical and civil engineering applications

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3.1.3**project specification**

document in which the works, functions, specific conditions and required material property values of the geosynthetic barrier are described

3.1.4**underground structure**

constructed void below ground which belongs to the tunnel construction

3.1.5**tunnel**

underground passageway, completely enclosed except for openings for entrance and exit, commonly at each end

3.1.6**moisture barrier**

barrier used to prevent the ingress of liquids and water vapours, without external hydrostatic pressure, to a tunnel or underground structure

3.1.7**pressure water barrier**

barrier used to prevent or reduce the ingress of water to an underground structure (which is not associated with a tunnel) when subject to external hydrostatic pressure

3.1.8**fluid barrier**

barrier used to prevent or reduce the ingress of water to an underground structure (which is not associated with a tunnel) when subject to external hydrostatic pressure

3.1.9**fluid**

gas, liquid and vapour in its pure phase as well as mixtures there of

[SOURCE: EN 764-1:2015+A1:2016, 04, 3.1.5]

3.1.10**rework material****RWM**

material that is generated in a process and capable of being reclaimed within the same process that generated it

[SOURCE: EN 13249:2016-10, 3.1.3]

3.1.11**post-consumer material****PCM**

material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose

Note 1 to entry: This includes returns of material from the distribution chain.

[SOURCE: EN 13249:2016-10, 3.1.4]

3.1.12**post-industrial material****PIM**

material diverted from the waste stream during a manufacturing process

[SOURCE: EN 13249:2016-10, 3.1.5]

3.2 Abbreviations

For the purposes of this document, the abbreviations given in EN ISO 10318-1 and the following apply:

CWFT: classification without further testing

EPDM: ethylene propylene diene monomer

EVA: ethylene vinyl acetate

FPO: flexible polyolefine

FPP: flexible polypropylene

GBR-P: polymeric geosynthetic barrier

GBR-B: bituminous geosynthetic barrier

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GBR-C: clay geosynthetic barrier

HP-OIT: high pressure – oxidation induction time

OIT: oxidation induction time

PE-HD: high density polyethylene

PE-LLD: linear low density polyethylene

PE-VLD: very low density polyethylene

PVC-P: flexible polyvinylchloride

4 Characteristics and corresponding methods of test

4.1 General

The main function of geosynthetic barriers used in the construction of tunnels and associated underground structures is to prevent or reduce the flow of fluid through the structure. Damage during installation has not been addressed in this document.

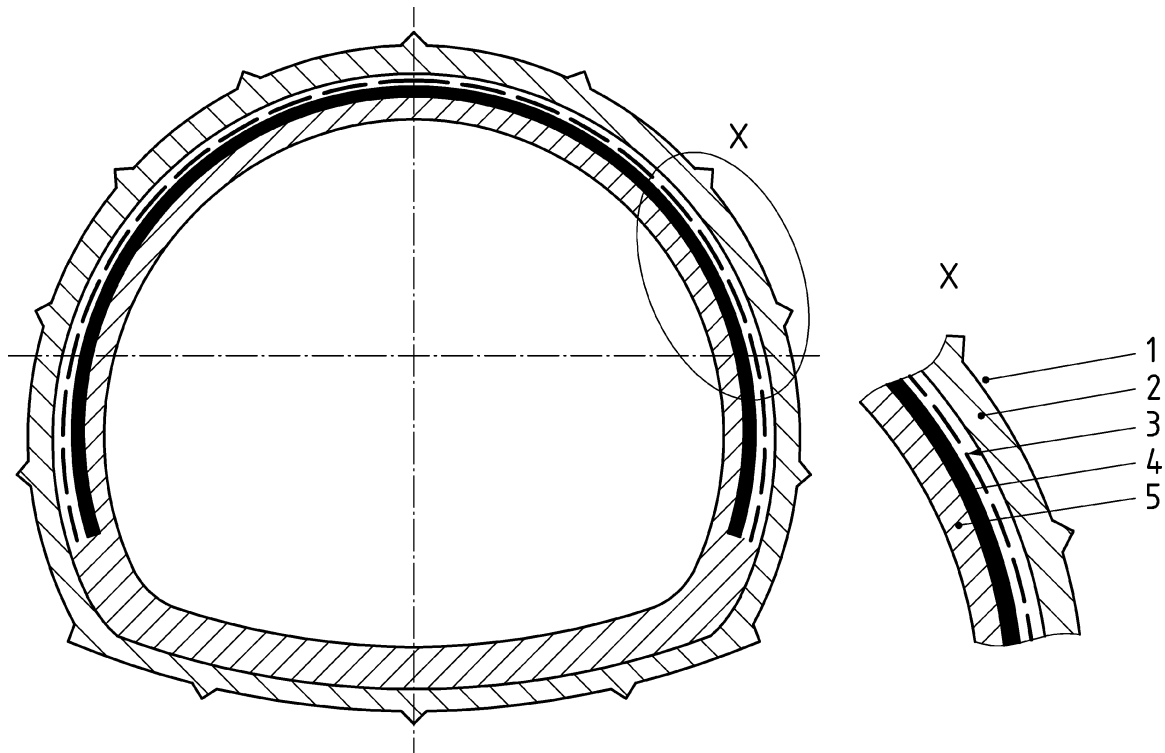
4.2 Types of application

4.2.1 General

It is not normally advisable to install a geosynthetic barrier on the downstream face of a dam. Special consideration should be given to any geosynthetic barrier installed on the downstream face of a dam. The applications described in this document do not include such situations.

4.2.2 Application 1: “Seepage water tunnel”

In these applications, the geosynthetic barrier is used as a stand-alone seepage (moisture) barrier. Figure 1 shows a typical cross-section.

**Key**

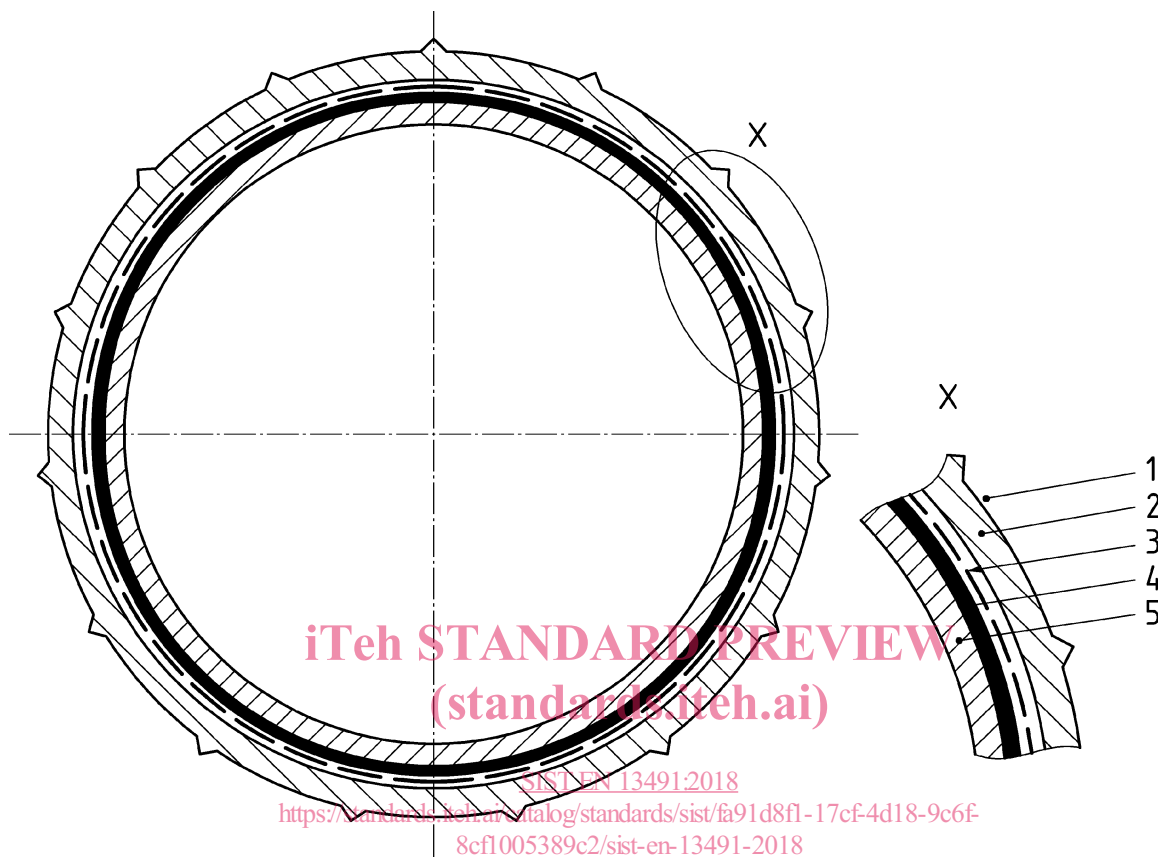
- 1 soil or rock drilled tunnel
 2 Shotcrete (optional)
 3 protection/drainage geosynthetic (optional)
 4 geosynthetic barrier
 5 concrete (optional with protection geosynthetic layer)

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Figure 1 — Geosynthetic barrier in a drilled seepage water tunnel

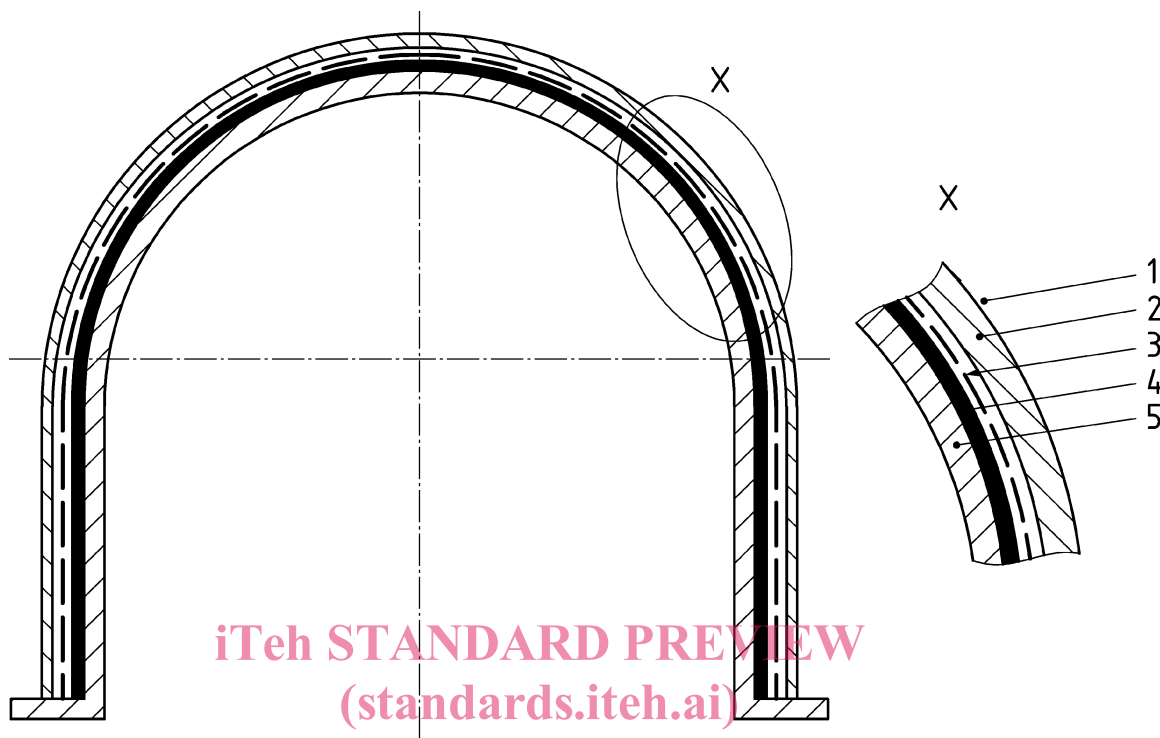
4.2.3 Application 2: “Pressurised water tunnel”

In these applications, the geosynthetic barrier is used as a barrier against pressurized water. Figure 2 shows a typical cross-section.



4.2.4 Application 3: “Cut and cover seepage water tunnel”

In these applications the geosynthetic barrier is used as a stand-alone seepage (moisture) barrier in a cut and cover design. Figure 3 shows a typical cross-section.



Key

- | | |
|--|---|
| | <u>SIST EN 13491:2018</u> |
| 1 soil | https://standards.iteh.ai/catalog/standards/sist/fa91d8f1-17cf-4d18-9c6f-8cfl005389c2/sist-en-13491-2018 |
| 2 concrete (optional) | 8cfl005389c2/sist-en-13491-2018 |
| 3 protection/drainage geosynthetic (optional) | |
| 4 geosynthetic barrier | |
| 5 concrete (optional with protection geosynthetic layer) | |

Figure 3 — Geosynthetic barrier in a cut and cover seepage water tunnel