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Design using geosynthetics —

Part 10: **Asphalt pavements**

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Contents

Page

Foreword

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

This document includes information relating to the asphalt pavements. Details of design methodology adopted in a number of regions are provided.

For more than 30 years roads have been built, maintained and operated using different types of geosynthetics used as asphalt interlayers incorporated within asphalt pavements. Amongst other benefits, these products are successful in mitigating reflective cracking in pavements, improving pavement performance, extending pavement service life, resulting in a reduced total cost of ownership and a reduced carbon footprint.

Many of these products are related to geosynthetics used in geotechnical engineering and these products have been adapted and adjusted for use as asphalt interlayers. A geosynthetic used as an asphalt interlayer is special in the sense that it is used mostly between an existing pavement and a new asphalt layer. The method of function of these products cannot be directly compared to, for example, concrete reinforcement nor to soil stabilization mechanics. Moreover, geosynthetics used as asphalt interlayers are one part of a system together with the tack or bond coat bonded in between two courses.

Design using geosynthetics —

Part 10:
Asphalt pavements

1 Scope

This document provides general considerations to support the design guidance to geotechnical and civil engineers involved in the design of structures in which a geotextile is used to fulfil the function of an asphalt interlayer. The key potential failure mechanisms are described, and guidance is proposed to select engineering properties.

The state of the art is however limited and does not commend any particular design method. This document can be used as a basis for further research on, for example, system selection, design, performance testing, creation of local guidelines.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
bond coat
tack coat
bituminous binder used to promote the adhesion between layers in the construction and maintenance of roads and paved areas

Note 1 to entry: In some countries a bond coat refers to a polymer modified bitumen while a tack coat refers to a regular bitumen. In this document bond coat is used.

3.2
flexible pavement
layers of asphalt or bituminous concrete layers overlying a base of granular material on a prepared subgrade

3.3
installation aid
product attached to a paving grid in order to support the installation process in different ways without providing any additional function (B, STR and R)

Note 1 to entry: An installation aid could consist of a light non-woven fabric, additional fibres in the apertures of the grid or a thin synthetic foil. An installation aid can improve contact of the product to the base thus achieving better adhesion during the paving process. A thin synthetic foil attached to a grid is sometimes used to decrease adhesion experienced during unrolling.

3.4
interlayer barrier
B
function provided by paving geotextiles saturated by bitumen, which act, in conjunction with a bitumen layer, as a barrier to the ingress of water and gasses, and thus prevent or delay the deterioration of the pavement

3.5
interlayer system
geosynthetic products bonded in between two pavement layers for asphalt pavement application

Note 1 to entry: These can be paving geotextile, paving grid or paving geocomposite.

3.6
paving geocomposite
product that combines a paving geotextile and a paving grid

3.7
paving geotextile
geotextile fabric adequately saturated with bitumen providing a stress relief function (STR) and acting as an interlayer barrier (B)

3.8
paving grid
product that has tensile elements which provides a reinforcement function (R) only

3.9
reflective cracking
vertical cracking through a pavement structure caused by stresses generated in the pavement foundations resulting from movements that propagate upwards or downwards through the pavement structure

3.10
reinforcement
R
function which is provided by tensile elements of a geosynthetic used as an asphalt interlayer to delay or prevent reflective cracking by the absorption of tensile forces

Note 1 to entry: Use of the stress-strain behaviour of a paving grid can improve the long-term mechanical properties of asphalt.

3.11
rigid pavement
hydraulically bound pavement on a granular subbase

3.12
semi-rigid pavement
intermediate state between flexible and rigid pavements

Note 1 to entry: Lean cement concrete, roller compacted concrete, soil cement and lime-pozzolanic concrete construction are examples of semi-rigid pavements.

3.13
stress relief
STR
function provided by an adequately bitumen-saturated interlayer (e.g. paving geotextile or composite paving grid) which allows for slight differential movements between the two layers and thus provides stress relief to delay or prevent reflective cracking

4 Design considerations

4.1 General

This clause provides an overview of the different types of geosynthetics used as asphalt interlayers, their functions, and their relation to the pavement design. These are crucial for differentiation of the products and their functions in the system, particularly for specification purposes. The corresponding system functions, related to each product type, are also described.

NOTE These functions do not occur in practice in their pure form and often overlap.

4.2 General design considerations

When working with a geosynthetic used as an asphalt interlayer system, the selection of the system components is crucial for a successful project outcome. Detailed information about the trafficked area is required and the expected performance of the chosen interlayer is usually clearly identified. For an economic comparison it is often reasonable to estimate the expected performance of a system with and without an interlayer. A comparison is normally be carried out over a period of time that demonstrates the efficiency of the interlayer.

A geosynthetic used as an asphalt interlayer can have very different characteristics depending on the method of manufacturing and the type(s) of raw material(s) used. Therefore, asphalt interlayers are not simply interchangeable.

The objectives of using a geosynthetic as an asphalt interlayer include:

— extension of maintenance and rehabilitation intervals;

— extension of service life; and

— reduction of whole-of-life costs.

A geosynthetic used as an asphalt interlayer in a system can provide the following positive effects by their different functions, or as a secondary effect of the function.

— Mitigation of reflective cracking through a reinforcing function and/or a stress relief function.

— Mitigation of water and gas ingress into the bound and unbound layers through their interlayer barrier function.

— Enhanced uniform layer adhesion.

— Optimizing the performance of bound layers above and below the interlayer through their functions.

— Structural improvement through the reinforcement and/or stress relief function.

Increased stiffness, structural improvement and mitigation of water ingress can improve the fatigue behaviour of the bound layers above the asphalt interlayer which again leads to the mitigation of reflective cracking (including top down cracking).

In an interlayer system, it is essential that the properties of each element be adapted to the specific objective of the measure to achieve the expected performance. Due to the temperature dependent visco-elastic properties of the asphalt and further elements of the system, the properties of the entire system alter with changes in temperature and loading. Therefore, any characteristics used in design normally take these variations into account.

4.3 Geosynthetics used as an asphalt interlayer: product types and system functions

4.3.1 General

Geosynthetics used as asphalt interlayers are one part of a system which are combined to provide positive outcomes. These systems usually consist of:

— the bound layer (flexible, rigid or semi-rigid) with an adequately prepared surface (milled or not-milled);

— a bituminous adhesive layer (type, quality and quantity according to each specific product);

— the geosynthetic used as an asphalt interlayer; and

— one or more layers of asphalt, a slurry seal overlaid with asphalt layers or a chip-seal (used, for example, when using a paving geotextile under a surface dressing).

In combination with the system, each product provides different valuable functions to the construction.

4.3.2 Asphalt interlayer functions

4.3.2.1 Reinforcing function (R)

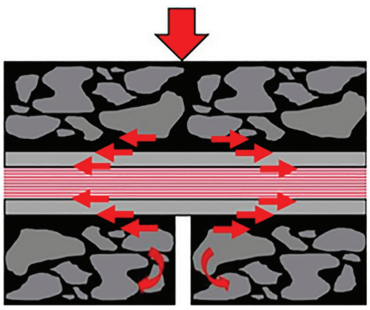
A new asphalt layer can be reinforced to mitigate the effects of reflective cracking using a paving grid or paving geocomposite. Therefore, the product is normally anchored in the system in such a way that it is able to absorb tensile forces. By absorbing tensile forces, the reinforcement can mitigate reflective cracking. Further, if applied in the tension zone of the bound structure, it can increase the stiffness and strength of the structure and lead to structural improvement of the asphalt layers. Both effects result in an improved fatigue resistance in comparison to an unreinforced structure with the same thickness.

In general, there are two different mechanisms of load transfer from the asphalt to the grid which provide reinforcement through (see Figure 1):

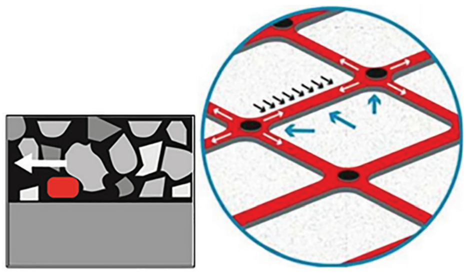
a) Adhesive shear bonding: The load transfer from the asphalt into the paving grid is achieved by the adhesion and friction between the asphalt and the surface of the grid.

b) Integral ribs and load transferring junctions by structural horizontal interlock: The load transfer from the asphalt into the paving grid is achieved by the anchorage of the paving grid in the asphalt matrix. This type of load transfer occurs in combination with adhesive shear bonding.

Both mechanisms of load transfer result in a strengthening or stiffening of the asphalt layers. To dissipate the forces, the interlayer normally has a certain anchorage length outside the tension zone. A minimum length of 0,5 m to each side of a crack is usually sufficient, though this does ultimately depend on the specific system and product.



a) Schematic illustration of load transfer "asphalt – grid" through adhesion



b) Schematic illustration of load transfer "asphalt – grid" through horizontal interlock

Figure 1 — Illustration of load transfer through adhesion and interlock

4.3.2.2 Interlayer barrier functions (B)

In asphalt road construction, an interlayer barrier is a layer which prevents the ingress of liquids (e.g. water) and gases (e.g. oxygen) into the bound and unbound layers of the structure below the barrier. This can be provided by a paving geotextile in conjunction with bitumen. When a paving geotextile is used, it is important to have a certain bitumen retention capacity. Furthermore, an adequate quantity of bitumen is needed to create a barrier with a sufficiently low permeability to mitigate aging and cracking of the surrounding pavement. Refer to Table 4 for suggested quantities to provide interlayer barrier function (see Figure 2).

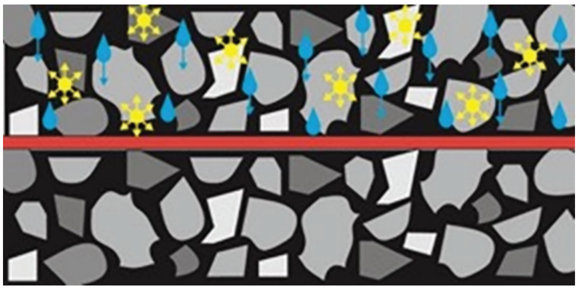


Figure 2 — Schematic representation of interlayer barrier function

The interlayer barrier can provide the following benefits:

— maintaining the structural stiffness and the bearing capacity of bound and unbound layers over a longer period of time;

— improvement of frost resistance and reduction of frost damage caused by freezing water in the structure, bound and unbound layers (e.g. bursting effect, formation of ice lenses, drenching during defrosting period);

— reduction in aging of the bitumen in asphalt layers surrounding the interlayer barrier caused by oxidation;

— slowdown of formation of embrittlement cracks below the interlayer barrier caused by oxidation.

4.3.2.3 Stress relief function (STR)

In asphalt road construction, stress relief function (see Figure 3) dissipates tensile strain, typically provided by the visco-elastic characteristics of bitumen. Bitumen exhibits a visco-elastic behaviour in the service temperature range, which means that when a load is applied to a bitumen film, there are three different deformation reactions: elastic deformation (reversible), delayed elastic deformation (reversible), and viscous deformation (irreversible). For a visco-elastic material it is typical that temperature and loading speed determine the elastic or viscous behaviour.

A paving geotextile will store and hold the applied bitumen in place over the long-term. Moreover, the paving geotextile assures a consistent and even layer thickness.

