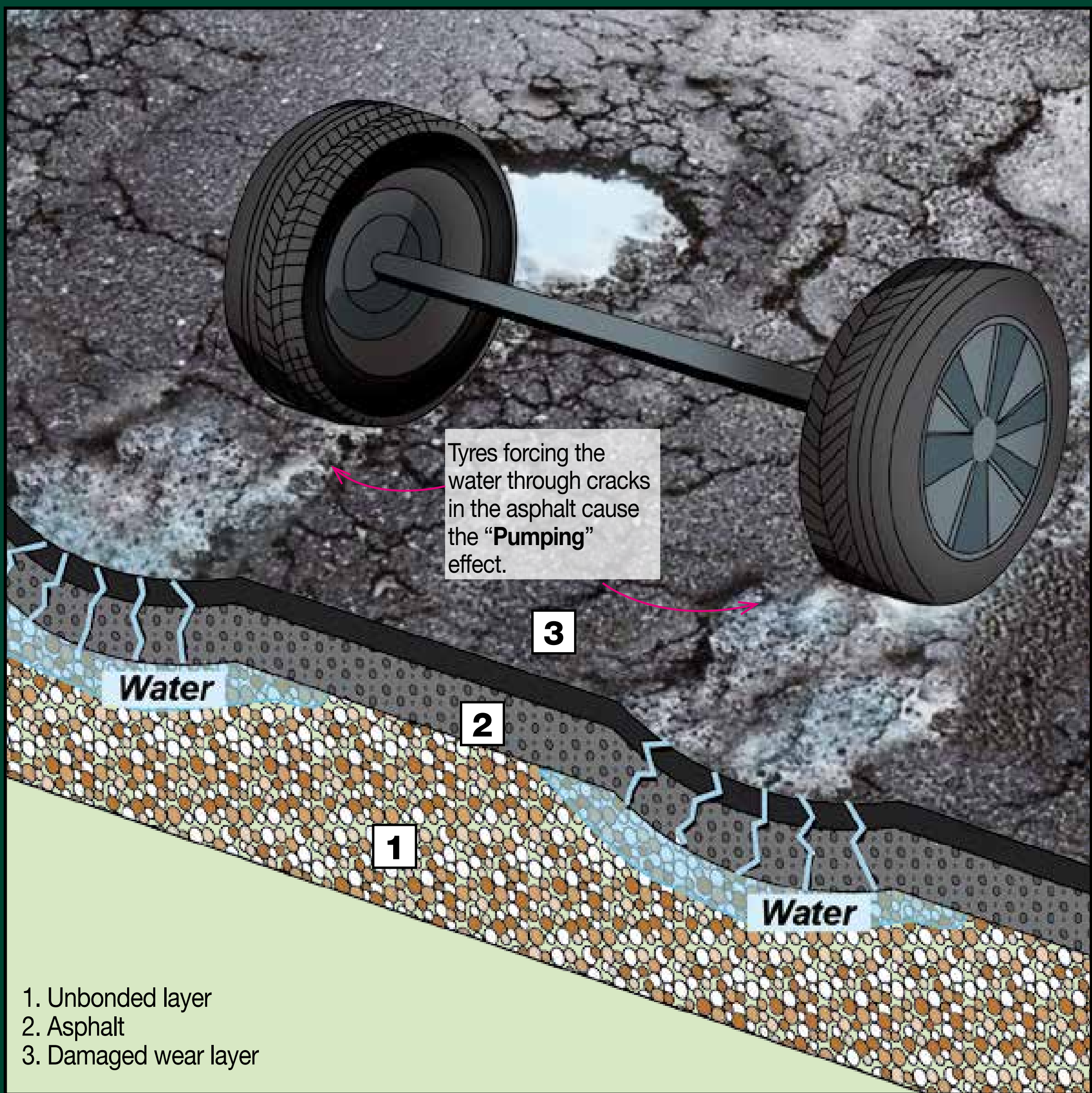
Construction Systems and Products

Guide to road repairs and new paving with
AUTOTENE ASFALTICO ANTIPUMPING



INTRODUCTION

The continual increase in road transport produces an inevitable process of degradation of road pavements. As a result, the considerable maintenance problems arising from this degradation assume the proportions of a real emergency because of their repercussions both in economic terms and with regard to road safety.

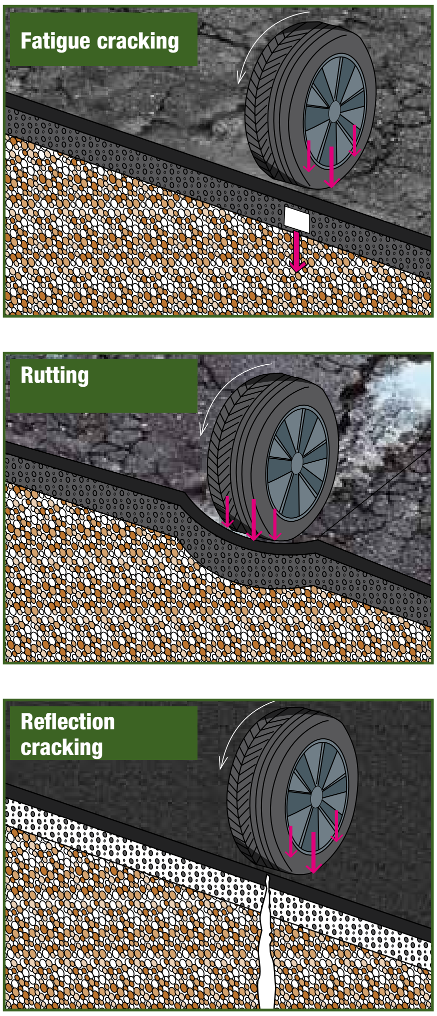
Mechanisms causing degradation of the road pavement

The principal mechanisms causing degradation of the road pavement can be summed up under the following headings:

- **fatigue cracking**
- **rutting**
- **reflection cracking.**

Fatigue cracking is indicated by an extensive web of cracks affecting the road surface, and is manifested when the pavement is subjected to repeated loading cycles.
Rutting consists of longitudinal furrows along the lines most travelled by the wheels, and is due to an accumulation of permanent deformations which can be initiated by plastic deformation of the bonded layers or by subsidence of the unbonded layers.
A typical example of reflection cracking is the cracks which appear in the asphalt pavement of airport runways at the joints between the underlying concrete slabs, caused by differential subsidence of the latter under the heavy load of aircraft wheels.

Principal disruption mechanisms in flexible paving



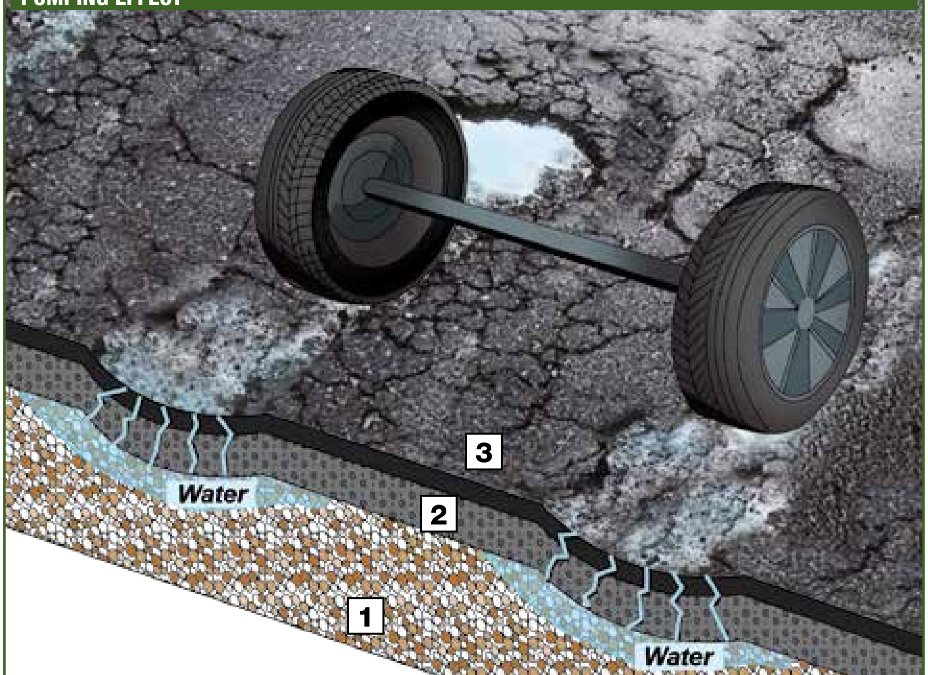
Restoring the carrying capacity

Restoration of the carrying capacity of road superstructures is the commonest reason for intervention at all levels, from autostradas to urban streets managed by local authorities.
Maintenance of a road pavement normally consists of laying one or more layers (generally of asphalt) after removing the damaged existing material by milling.
The need to optimise intervention costs, combined with the difficulties usually encountered in completely removing the superstructure and the necessity of not damaging the existing levels of drivable surface, have given rise over time to a growing interest in, and consensus in favour of the application of, reinforcement systems in the form of various kinds of mesh.
This is confirmed by the numerous international research projects (e.g. RILEM TC SIB-237/TG4) which are currently in progress. These initiatives are all directed at providing responses, from a scientific point of view, on the potential and the benefits deriving from the application of reinforcing elements to combat the principal mechanisms causing degradation of road pavements. There is in fact a unanimous consensus for the belief that, through the correct use of reinforcement systems, it is possible to obtain **a reduction in costs as a result of prolonging the useful life** of road pavements.

The pumping effect

On the basis of past experience and an analysis of the problems encountered, it was decided to design a **high-performance geocomposite**, capable of combining the **reinforcing function** conferred by a glass fibre mesh with the **(anti-pumping) waterproofing** function performed by a geomembrane.
In practice, it has been observed that cracks in the bonded layers produce accelerated deterioration of the pavement because of the infiltration of water into the unbonded layers below. The passage of vehicles, in particular, makes the water and fine-grained material rise (**pumping effect** – Fig. 1), causing the progressive collapse of the loadbearing structure and the consequent subsidence of the road surface.
The use of this new generation of high-performance geocomposites achieves the objective of making it possible to design a new stratigraphy for road pavements, whose purpose is to allow both a saving in the thickness of the bonded layers and the creation of a structure with better performance and greater durability.

Figure 1.
PUMPING EFFECT



1. Unbonded layer
2. Asphalt
3. Damaged wear layer

Research

In order to optimise the characteristics of a high-performance geocomposite, the company INDEX has financed a programme of experimental research conducted under the guidance of Prof. Francesco Canestrari of the Marche Polytechnic University in Ancona, Italy.
This study investigated the composition, among various available alternatives, of the distilled bitumen-polymer mix of the geomembrane, and the type and position of the glass fibre reinforcing mesh. In particular, the laboratory investigation had as its object the characterisation of the performance of various geocomposites through the performance analysis of a double-layer system, with the membrane embedded in traditional closed asphalt concrete characterised by the presence of various types of interface. The variables analysed made it possible to evaluate the influence of different types of interface (varying with the physical, geometrical and dimensional properties of the glass fibre mesh, the geomembrane and the laying method used), by the use of advanced test protocols capable of investigating the behaviour in shear (Fig. 2), under dynamic bending (Fig. 3) and under static bending (Fig. 4) of the double-layer bituminous system.
The experiment, which was conducted using the above-mentioned latest-generation equipment, was designed with the object of evaluating the benefit deriving from the use of a geocomposite in a pavement, through the combined evaluation of the following performances:

- resistance to reflection cracking and to traction stresses induced by bending in the superstructure;
- verification of the maintenance of adequate levels of shear continuity at the interface.

On the basis of the results obtained in the course of the experiments, it was possible to predict the performance level for the products investigated in the case of road applications at real size.

Figure 2. Double-layer slabs prepared with roller compactor and ASTRA device (UNI/TS 11214)

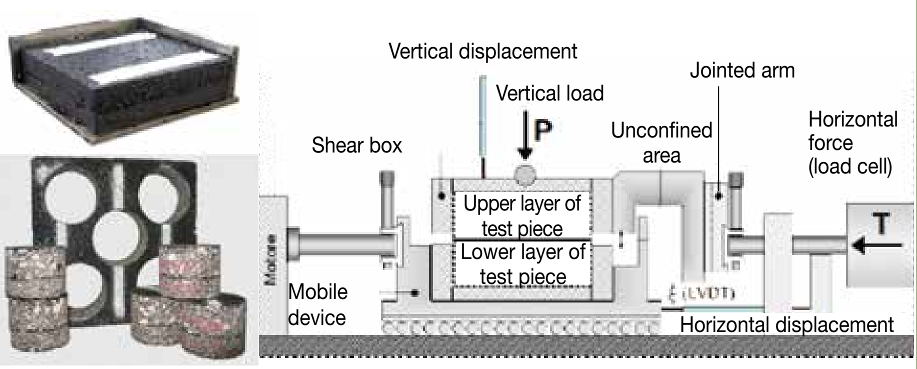


Figure 3. Dynamic flexural system

Figure 4. Static flexural system

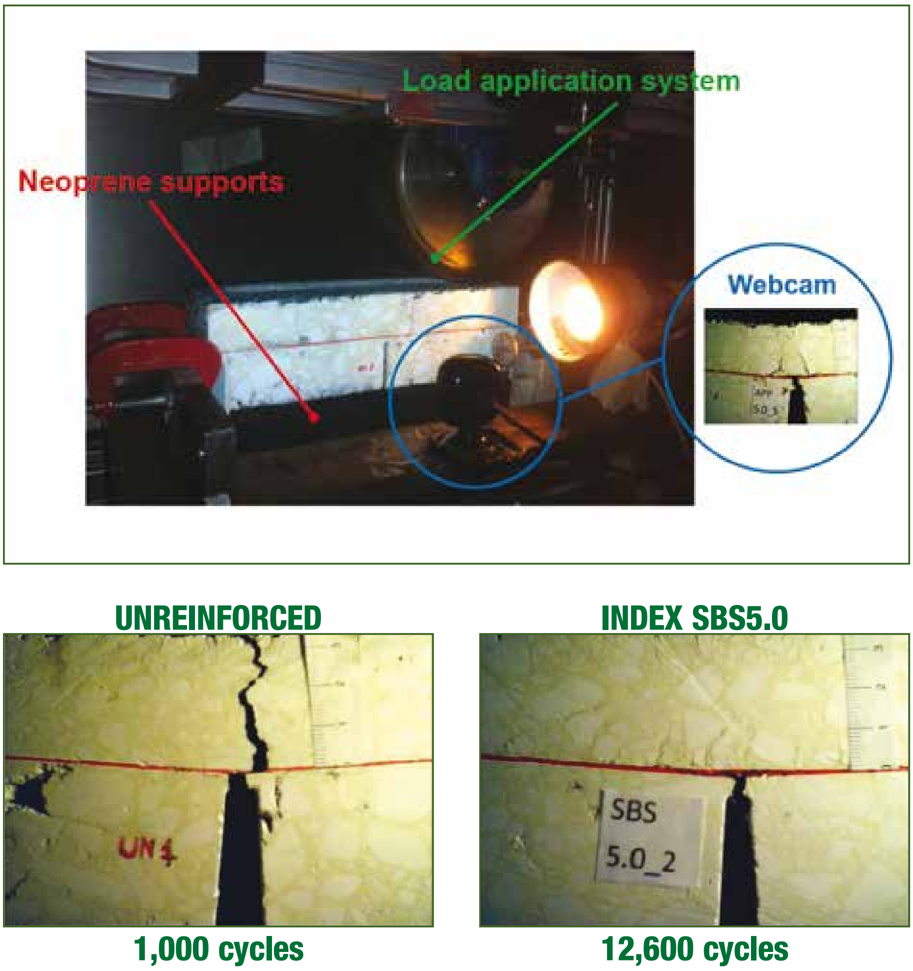
Summary of the main results of the experiment

The geocomposite which emerged from the research, called **AUTOTENE ASFALTICO ANTIPUMPING can be thought of for all practical purposes as the synergistic union between a geogrille and a SAMI (Stress Absorbing Membrane Interlayer) geomembrane.**
The waterproofing geomembrane protects the lower layers from water penetration and the upper layers from the phenomenon of pumping, preventing the water and fine material from being forced upwards as a result of the "pumping" due to vehicular traffic. It also prevents the phenomenon of reflection of cracks and thermal cracking.
As regards the **function of the SAMI**, note that field research conducted by Carl L. Monismith, one of the greatest world experts on roads, led to the conclusion that a 5 cm wear layer laid over a SAMI elastomeric membrane of 2.5 mm thickness (which coincides with the thickness of **AUTOTENE ASFALTICO ANTIPUMPING**, spread over an old cracked pavement, corresponds to a wear layer of 19 cm. It has been established that a 5 cm wear layer, laid without SAMI on an old cracked pavement, reflects the surface cracks after less than two years, whereas the same layer with SAMI has a life expectancy of more than ten years.
The **reinforcing geogrille** contributes to the absorption of the tensions and deformations induced inside the pavement by the vehicular and environmental loads, reducing the tension/deformation state of the individual layers that make up the superstructure and consequently prolonging the useful life of the pavement.

Anti-reflective Cracking Test

The test demonstrates the resistance of **AUTOTENE ASFALTICO ANTIPUMPING** to the propagation of reflection cracks (Figure 5).

Figure 5. Anti-reflective Cracking Test



Unreinforced paving after 1,000 load cycles

Paving reinforced with AUTOTENE ASFALTICO ANTIPUMPING HE/TVP still fully intact after 12,600 load cycles

Experience in the USA

Each year in the United States, more than 80 million square metres² are laid of various types of asphalt interlayer (materials for reinforcing roads), and the American manufacturers' association AIA (Asphalt Interlayer Association) specifies the following types:

• PAVING FABRIC

Non-woven fabrics of various kinds, generally polyester and polypropylene, with a minimum weight of 140 g/m², which are saturated and bonded with bitumen when laid so as to constitute an impermeable layer which is then paved with asphalt.

• PAVING MAT

Hybrid non-woven fabric made up of a glass fibre and polyester non-woven fabric mesh, with a weight of 140 g/m² and high dimensional stability up to approx. 250°C, which is saturated and bonded with bitumen when laid so as to constitute an impermeable layer which is then paved with asphalt.

• PAVING REINFORCING GRIDS

A high-modulus geogrille which is not impermeable, laid by self-bonding (if provided with a coating of adhesive) or by bonding with hot bitumen if coupled with a light fabric, which is then paved with asphalt.

• WATERPROOFING COMPOSITE GRIDS

A high-modulus geogrille coupled with a waterproofed fabric during laying by means of hot bitumen, which is then paved with asphalt.

• STRIP MEMBRANES (Self-bonding)

- Medium Duty

Fabric for pavements pre-impregnated with self-bonding elastomeric bitumen for bonding to the pavement in strips over joints and cracks, or in one piece for waterproofing road decks, which is then paved with asphalt.

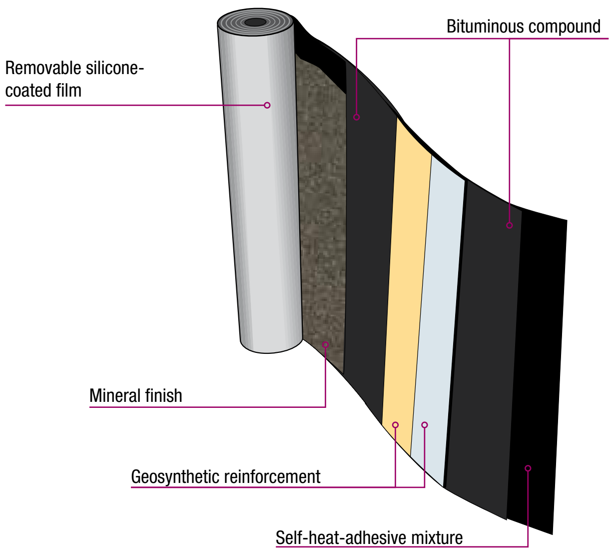
- Heavy Duty

High-strength composite fabric for pavements, pre-impregnated with self-bonding elastomeric bitumen as above.

Special characteristics of the geocomposite AUTOTENE ASFALTICO ANTIPUMPING HE/TVP

AUTOTENE ASFALTICO ANTIPUMPING is self-adhesive and the strength of adhesion increases with the heat of the bituminous pavement which is laid over it. Adhesion strengthens over time, furthermore, under the action of traffic and solar radiation. The membrane is laid dry and, after removal of the silicone-coated sheet protecting the lower face, final bonding to the laying surface takes place due to the subsequent hot-laying and compaction of the asphalt pavement. The heat of the carriageway further activates the adhesive properties of the special mix coating the lower face of the membrane in contact with the laying surface and causes it to bond. The lower face of **AUTOTENE ASFALTICO ANTIPUMPING** is spread with a hot-melt self-heat-adhesive mixture, based on elastomers and tackifying resins, which is elastic even at low temperatures, protected by a peel-off silicone-coated film. The upper face of the membrane is protected with a fine mineral layer which, during laying, allows optimal site traffic but which, when the hot asphalt is laid over it, is incorporated into the membrane, thus ensuring complete adhesion between the layers. On the upper face, across a width of about 70 mm near the edge, there is an overlap strip protected by plastic film.

Schematic section of the geocomposite

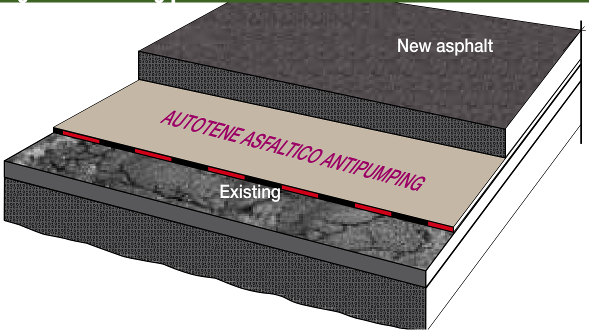


AUTOTENE ASFALTICO ANTIPUMPING can be totally recycled in the asphalt processing cycle and is easy to remove during milling of the wear layer.

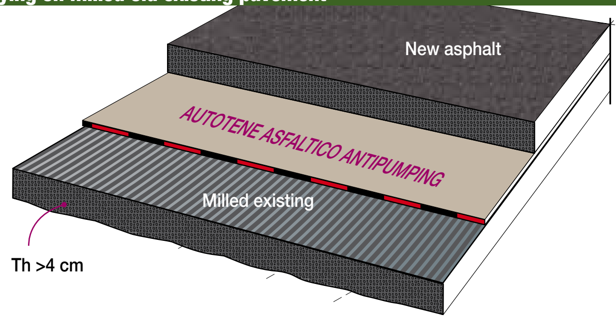
The upper face of the geocomposite membrane is compatible with all types of hot-laid asphalt, while the lower face of this material adheres to:

- old asphalt surfaces
- milled asphalt surfaces
- fresh asphalt surfaces
- cold-laid recycled asphalt surfaces (see page 10).

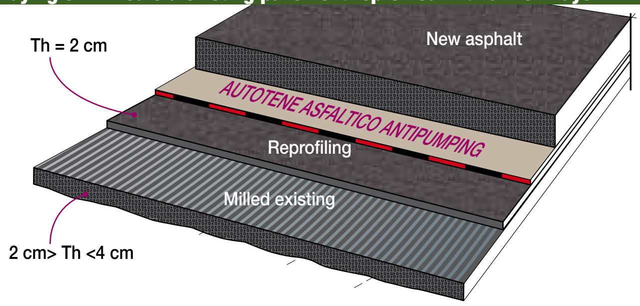
Laying on old existing pavement



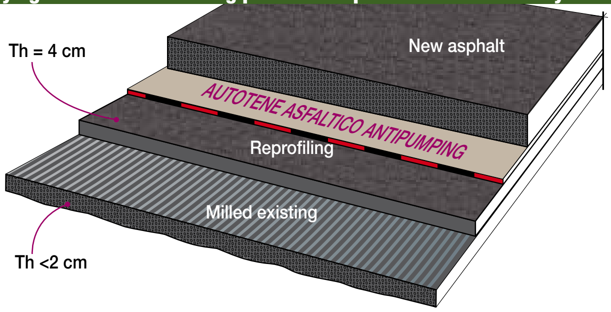
Laying on milled old existing pavement



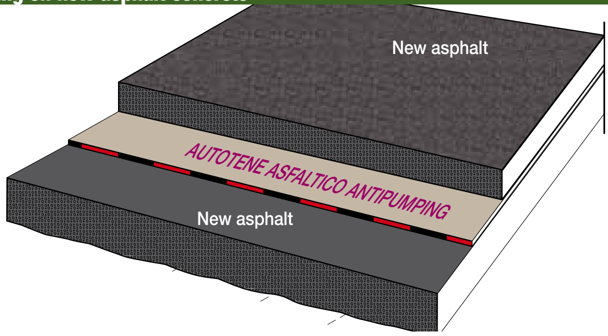
Laying on milled old existing pavement reprofiled with a 2 cm layer



Laying on milled old existing pavement reprofiled with a 4 cm layer



Laying on new asphalt concrete



GUIDE TO EXAMINATION OF THE EXISTING PAVING

The operations involved in laying on newly constructed roads are relatively simple: the geomembrane is laid on layers of smoothed and fresh asphalt where primer is not needed, and the new paving, if correctly designed for the traffic which it is to carry, constitutes a solid base. In the case of road resurfacing, however, a series of assessments must be carried out before proceeding, some of them indicated below, which in certain cases must be supported by tests to establish the composition and condition of the old paving.

The AIA approach

The AIA indicates that:

> ***"Fabric Interlayer Systems will only be successful if placed on stable pavements. Many pavements with alligatored fatigue cracks are structurally adequate. Badly broken pavements that deflect under load are not candidates for an Interlayer System and should be removed and replaced."***
>
> Fabric Interlayer Systems will only be successful if placed on stable pavements. Many pavements with alligatored fatigue cracks are structurally adequate. Badly broken pavements that deflect under load are not candidates for an Interlayer System and should be removed and replaced.

The same applies, as we will see below, in cases where there is crocodile cracking with the scales of the pavement separating, or where there is widespread upward movement of fine parts of the unbonded sub-base, indicating a defect in the loadbearing capacity of the road foundation.

With regard to the preparation of the laying surface, the AIA recommends deep removal of the existing paving in the areas and the cases described below.

Remove and replace areas which:

- **deflect under the action of loads;**
- **display crocodile cracking;**
- **show evidence of widespread pumping: extensive outcrops of fine particles.**

The approach of ANAS (the company which operates the Italian road network)

ANAS's approach is most precise and specific: in the **2011 Special Contract Specifications, Annex C**, it provides design instructions for renovating existing pavements and quotes systems for visual examination of the state of the paving, prior to proceeding with pre-packaged preliminary repair operations, although this does not exempt the designer from a very careful instrument investigation and a properly suitable plan.

In the 2011 ANAS Contract Specifications, Annex C Part IV, design solutions are provided for:

- **Emergency surface repairs "RSS"**
- **Reconstruction and strengthening of the existing pavements classifiable as:**

- Surface repairs "RS"
- Deep repairs "RP"
- Design solutions for new pavements "NC"

In the case of repairs to existing pavements, account must be taken of the type of traffic "TGM" (average daily traffic) which travels on the road, and a careful assessment must be made of the state of disrepair of the pavements in order to establish the most appropriate intervention.

Visual examination of the state of deterioration of the pavement to be repaired

It must be established whether the pavement is fractured and requires a deep repair **"RP"** down to the foundation layers after the complete demolition of the existing pavement, with the removed materials being partially or completely reused, or whether the operation can be limited to the bonded layers of the pavement (surface repair **"RS"**).

Useful support can be provided by the images contained in Annex C of the 2011 Special Contract Specifications "**representing fractures, cracks classified as serious and cracks classified as light, as most frequently found in damaged road pavements**".

Annex C states as follows: ""**In general the decision to carry out deep repairs depends on the spread of fractures in the individual stretches of road; it will also be necessary to perform surveys as indicated in the Technical Regulations. Such fractures should be identified using visual criteria; loadbearing capacity measurements must be performed in cases where they are not clearly defined.**"

Slight crocodile cracking on a stable base, structurally adequate

Deep crocodile cracking becoming detached in scales, structurally inadequate

Fractures, serious cracks and slight cracks

Fractures



Serious cracks



Slight cracks



Source: 2011 ANAS 2011 Contract Specifications, Annex C Part IV

Operating instructions for the project

In the absence of loadbearing capacity measurements with the consequent possibility of identifying similar stretches, the choice of the type of operation is made by identifying the deteriorated stretch and then:

- if fractures are found over more than 30%: **"RPi"**
- if serious cracks are found over more than 30%: **"RS1"**
- if slight cracks are found over more than 40%: **"RS2"**

Fracturing is demonstrated by mud being forced up; serious cracks are accompanied by distortions of the visible surface; slight cracks do not have distortions of the road surface.

Various combinations of the three types of deterioration are assessed on each occasion; if those of the same type are concentrated and continuous, the choice is easy; with different types of deterioration distributed at random, the choice will be dictated by considerations of availability of funds.

However, in operations of "**RS**" type, localised fractures must be treated separately before the current operation, improving the sub-base with unbonded granular material or with milled material.

GUIDE TO THE CHOICE OF INTERVENTION

The data given here are indicative average data relating to current production, and may be changed and updated by INDEX SpA at any time, at its discretion and without prior warning. The suggestions and technical information provided represent INDEX SpA's best information on the properties and uses of the product. Considering the many possible uses and the possible interference of elements not under our control, we take no responsibility for the results. The Purchaser is responsible for establishing the suitability of the product for the use envisaged.

Introduction

The positioning of AUTOTENE ASFALTICO ANTIPUMPING in the stratigraphies indicated below refers to the stratigraphies indicated in the ANAS Annex 3. This does not exclude the possibility of the geocomposite being positioned differently in the case of other technical solutions, bearing in mind, however, that:

- **The residual thickness of the old layers of asphalt (after milling) on which the geocomposite membrane is laid must be at least 4 cm.**
- **If the conditions listed above cannot be met (even quite simply by removing and replacing and/or modifying any non-conforming zones with hot-laid asphalt concrete), the geocomposite membrane can be applied only after addition of a new re-shaping layer (D_{max} = 10 mm) in asphalt concrete of a thickness of at least 2 cm if this is sufficient to restore a minimum thickness of 4 cm, or a 4-cm layer of conglomerate, with greater particle size, if the remaining thickness is insufficient.**
- **Positioning the geocomposite membrane at least below the binder layer is the minimum solution that must always be achieved, both because this best performs the function of resisting bending loads (without the risk of the geocomposite membrane slipping with respect to the laying surface due to high tangential stresses next to the rolling surface) and because it protects the membrane from later milling of the wear layer.**
- **Positioning the geocomposite membrane immediately below the wear layer, especially when it is laid over a milled surface, must be considered carefully and carried out with great care, in favourable atmospheric conditions, and the thickness of the asphalt above (when compaction has been completed) must in any event be at least 4 cm.**
- **The minimum 4 cm thickness requirement clearly refers to situations presenting the fewest possible critical factors. In the case of more problematic operations (in terms of traffic loads, speeds, conditions of pavement etc.), this thickness must be appropriately increased (reinforcement positioned at least below the binder layer).**

ANAS repair stratigraphies "RS" and "RP" ANAS

In Annex C, ANAS delegates responsibility to the Technical Offices of the Departments, taking local conditions into account, for design solutions whether based on visual assessment of the surface state of the pavement to be repaired or using instrument systems, with the recommendation that instrument measurements should be used with increasing frequency.

The characteristics of the types of operation are defined as follows:

- Dimensioning the stratigraphies concerned in the operation with rational calculation methods, using specific stress curves to calculate the useful life of the operation.
- To reduce the environmental impact and cut costs, maximum use is to be made of milled materials and other marginal materials available on site, which must be assessed and checked in the fatigue endurance calculations.
- Definition of the working criteria which take into account the problems of practical application to roads in operation. The thicknesses specified must be correlated with the loadbearing requirements and feasibility with regard to the techniques used.
- Generalised use of modified asphalts to increase working life with certainty of result.
- Definition of the methods of performance checking on individual materials, on mixtures and on complete processes, assigning to the latter performance levels for the surface characteristics and deep characteristics measurable at High Performance.

The part which is the subject of this treatment concerns surface repairs, deep repairs and new pavements.

General criteria for the proposed intervention solutions

It should be taken as an important underlying consideration that the stratigraphies proposed by ANAS and the corresponding alternatives proposed by INDEX SpA are all conditioned by the following points, described in paragraph 5.1 "General criteria for the proposed intervention solutions" of Article 5 of Annex C:

- for **"RP"** (deep repairs) the foundations are made by cold recycling the existing foundation with foamed bitumen (with the addition of cement for initial strength) or, alternatively, by creating a layer in lean concrete mix. In the case of a lean concrete mix foundation, it should be borne in mind that costs, and the time needed for carrying out the work, are increased by removal of the existing layers, given the waiting time required for the minimum level of curing to be reached before the upper layers can be laid, and therefore this solution should be adopted only when the characteristics of the materials on site are not suitable for foaming and must therefore be removed.
- The upper layers of asphalt always require the use of hot bitumens modified with elastomers and partial use of recycled material, or alternatively the use of bituminous emulsions with up to 100% recycled material, cold mixed.
- The use of "straight" bitumen (TQ), without the addition of modifications, would entail a significant reduction (by at least 30%) in the useful life of the pavement, compared with what is stated in the **"RP"** and **"RS" tables.**
- The use of modified bitumen is particularly important in base layers.
- The wear layer can be made as a draining wear level, always over the entire carriageway and always with hard modified bitumen, but only for stratigraphies with an expected life of at least 5 million 12 ton axles, otherwise a 3 cm closed wear layer should be made or other mixtures indicated in the technical regulations.
- **In cases of "RS" surface repairs we are assuming the presence of an overall thickness of existing asphalt of at least 20 cm; for lesser thicknesses, assess the condition of the sub-base or move to a solution of RPC type.**
- At the base of the new pavement for the repaired area, in the milled cavity, the specification requires that a bonding coat with hard modified bitumen should always be applied.
- **In repairs of superficial type, the specification requires that hot-mixed asphalts with modified bitumens should always be used.**
- The wear layer may be made to cover the entire carriageway in the case of a single

carriageway and in the case of two-way traffic in bad conditions. The wear layer must be made in the cavity if it is not considered necessary, or possible, to lay it over the whole carriageway. The necessity or the possibility must be assessed according to the condition of the adjacent lane, damaged or otherwise, and of the levels, the flyovers, the impact on traffic etc.

- The proposed solutions and expected useful life are valid in respect of the assumptions stated here and can only be guaranteed through compliance with the Technical Regulations on performance, which must be attached to supply contracts. The Technical Regulations provide the design requirements and the assessment criteria for the materials to be used, as well as the performance levels required of new pavements, all measurable at High Performance.

We set out below the "**RS**" repair stratigraphies specified by ANAS.
The object of "**RS**" repairs is to strengthen pavements which are not completely degraded; obviously they cannot guarantee a useful life for as long as deep repairs, but they entail a smaller economic commitment to set against this shorter useful life when considering projects.
"**RP**" repairs are performed by milling the most superficial layers of the existing pavement and can also provide for the creation of a covering wear layer, which consequently raises the levels; for this type of operation, too, solutions with different life expectancies are specified, depending on the types of traffic circulating on the road.
Surface repairs are divided into two types:

- **type** "**RS1**", to be specified in the case of a very degraded pavement (surface badly cracked, disfigured, frequent patches, mud forcing its way up);
- **type** "**RS2**", to be specified in the case of a pavement which is simply cracked without surface disfiguration.

For both types there are three proposed solutions with similar materials, differing only in their depth, which is determined by the circulating traffic: see the table below.
Surface repairs reinstate the upper part of the package (to a maximum depth of 15 cm), and are also carried out for reasons other than reinstating the loadbearing capacity, among them the following:

- evidence of purely superficial damage;
- impossibility of closure to traffic for the periods necessary for **"RP"** repairs;
- operations which must be completed within a limited period;
- repairs which affect relatively small areas.

In some of these cases the thicknesses can be reduced below those indicated. In the case of major variations, it will be necessary to recalculate the relevant performance curves to check the loadbearing capacity.

Surface repairs - RS1 and RS2

	A: 0.65 million 12 ton axles TGM = 5,500	B: 0.40 million 12 ton axles TGM = 3,000	C: 0.20 million 12 ton axles TGM = 1,500
RS1 Pavement with serious cracks	Solution RS1 A 3 cm closed wear layer 10 cm soft base-binder asphalt	Solution RS1 B 3 cm closed wear layer 8 cm soft base-binder asphalt	Solution RS1 C 3 cm closed wear layer 6 cm soft base-binder asphalt
RS2 Pavement with slight cracks	Solution RS2 A 3 cm closed wear layer 9 cm soft base-binder asphalt	Solution RS2 B 3 cm closed wear layer 7 cm soft base-binder asphalt	Solution RS2 C 3 cm closed wear layer 4 cm soft base-binder asphalt

"RS" surface repair stratigraphies with AUTOTENE ASFALTICO ANTIPUMPING HE/TVP

• HEAVY TRAFFIC "A"
In the case of heavy traffic on pavement **free of structural failures and with serious cracks**, on the assumption that the thickness of the existing conglomerate layer after milling is **at least 4 cm**, the minimum solution which can be considered is as follows:
- Milling 9 cm deep
- Reprofiling layer (D_{max} = 10 mm) in asphalt with a thickness of at least 2 cm to seal the serious cracks
- Laying **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Applying a binder layer with a thickness of at least 4 cm
- Applying a wear layer of at least 3 cm thickness

• MEDIUM TRAFFIC "B"
In the case of medium traffic on pavement **free of structural failures and with slight cracks**, on the assumption that the thickness of the existing conglomerate layer after milling is **at least 4 cm**, the minimum solution which can be considered is as follows:
- Milling 7 cm deep
- Laying **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Applying a binder layer with a thickness of at least 4 cm
- Applying a wear layer of at least 3 cm thickness

In the case of medium traffic on pavement **free of structural failures and with serious cracks**, on the assumption that the thickness of the existing conglomerate layer after milling is **at least 4 cm**, the minimum solution which can be considered is as follows:
- Milling 7 cm deep
- Laying **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Applying a binder layer with a thickness of at least 4 cm
- Applying a wear layer of at least 3 cm thickness

• LIGHT TRAFFIC "C"
In the case of light traffic on pavements free of structural failures and with slight cracks, on the assumption that the thickness of the existing conglomerate layer after milling is at least 4 cm, the minimum solution which can be considered is as follows:
- Milling 4 cm deep
- Laying **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Applying a wear layer of at least 4 cm thickness

In the case of light traffic on pavements **free from structural failures and with slight cracks**, where the thickness of the underlying asphalt is less than 4 cm but **more than 2 cm**, the minimum solution which can be considered is as follows:
- Milling 6 cm deep
- Reprofiling layer (D_{max} = 10 mm) in asphalt with a thickness of at least 2 cm
- Laying **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Applying a wear layer of at least 4 cm thickness

In the case of light traffic on pavement **free of structural failures and with slight cracks**, where the thickness of the underlying asphalt is **less than 2 cm**, the minimum solution which can be considered is as follows:

- Milling 8 cm deep
- Laying asphalt to a thickness of at least 4 cm
- Laying **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Applying a wear layer of at least 4 cm thickness

In the event of light traffic on a road surface **without structural yielding and with severe cracks**, if the thickness of the layer of concrete present after milling is at least 4 cm, the minimum possible solution, also valid if the thickness of the asphalt concrete **below is less than 4 cm but over 2 cm**, is as follows:

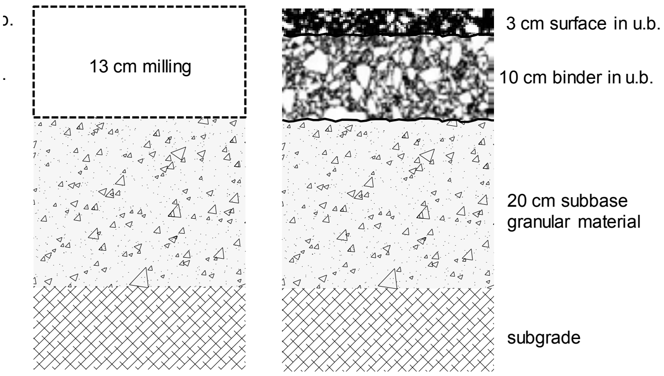
- Milling to a depth of 6 cm
- Resurfacing layer (Dmax = 10 mm) of asphalt concrete at least 2 cm thick
- Application of **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Spreading a wearing layer at least 4 cm thick

In the event of light traffic on a road surface **without structural yielding and with severe cracks** if the thickness of the asphalt concrete below is **less than 2 cm**, the minimum possible solution is as follows:

- Milling to a depth of 8 cm
- Spreading a layer of asphalt concrete at least 4 cm thick
- Application of **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Spreading a wearing layer at least 4 cm thick

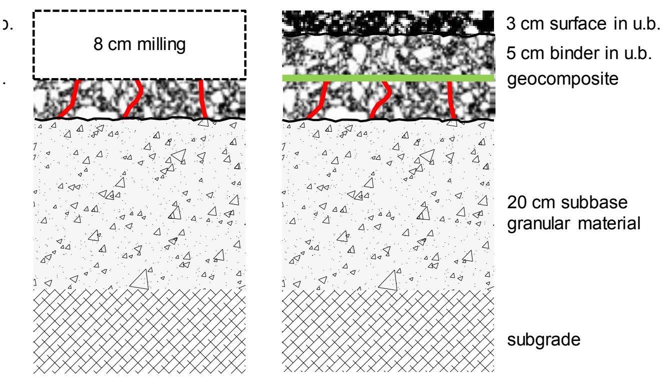
Risanamento superficiale ANAS: tipologia RS1-A

Modified state 5N



Duration of Solution 5N =
3,3 million standard 8,2 t axle loads

Modified state 5R



Duration of Solution 5R =
5,3 million standard 8,2 t axle loads

Summary

5R → 5,3 millions ESAL of 8,2 t = 1,0 millions ESAL of 12 t

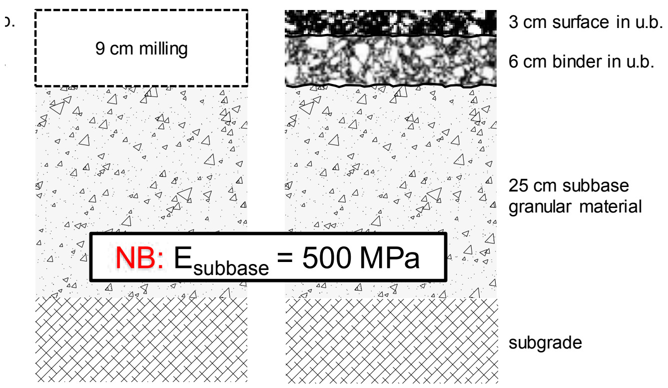
5 cm reduction (out of 13) of milling and unmodified HMA

60% service-life **increase**
+ antipumping effect benefits + environmental benefits

Prof. Ing. Canestrari e PhD Ing. Stimilli
24th february 2017 - Asphaltica 2017

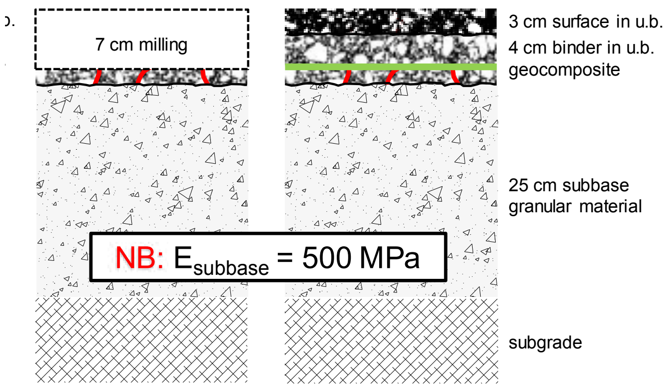
Risanamento superficiale ANAS: tipologia RS1-C

Modified state 8N



Duration of Solution 7N =
0,9 million standard 8,2 t axle loads

Modified state 8R



Duration of Solution 7R =
2,4 million standard 8,2 t axle loads

Summary

8R → 8,5 millions ESAL of 8,2 t = 1,5 millions ESAL of 12 t

2 cm reduction (out of 9) of milling and unmodified HMA

190% service-life **increase**
+ antipumping effect benefits + environmental benefits

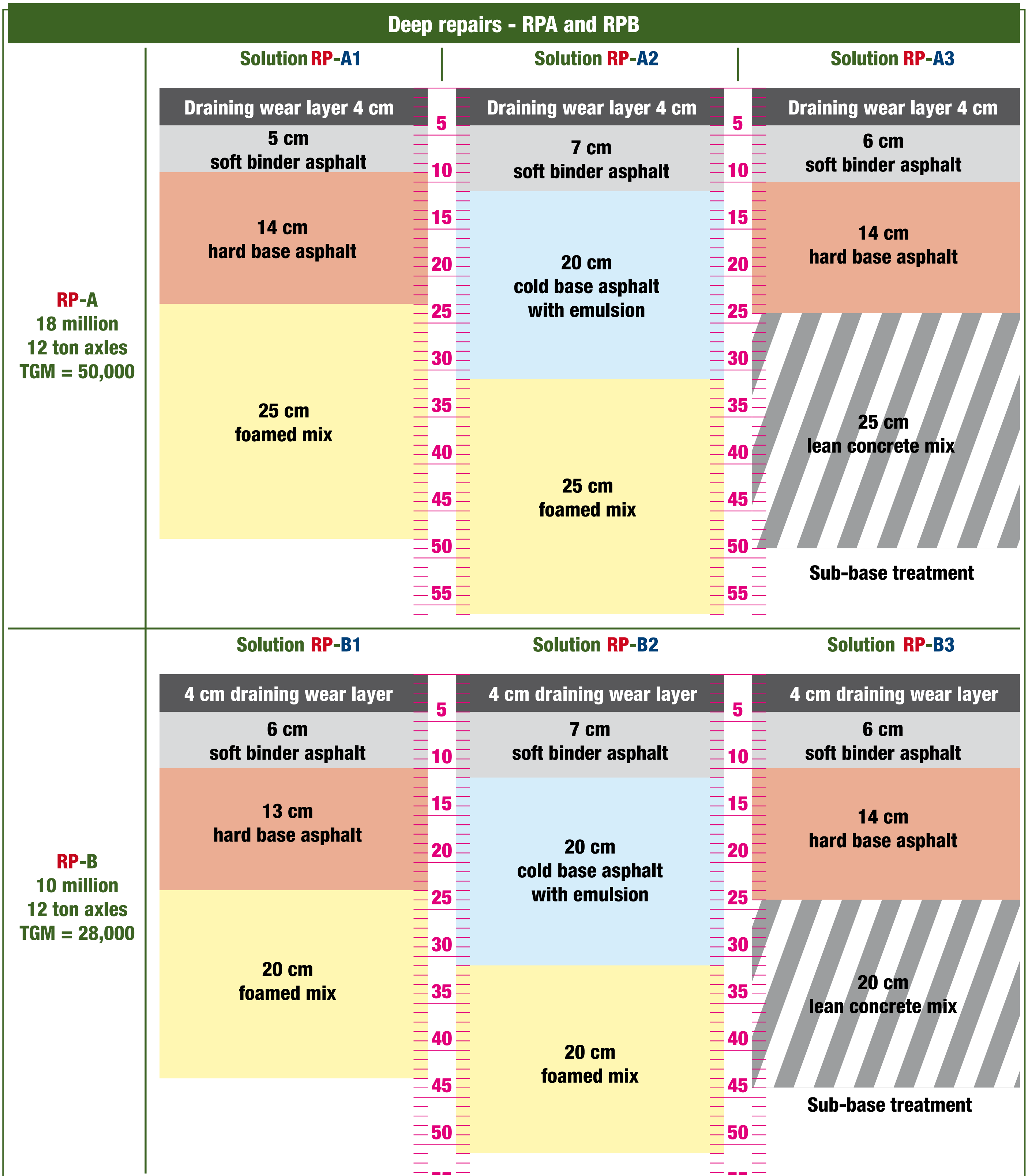
Prof. Ing. Canestrari e PhD Ing. Stimilli
24th february 2017 - Asphaltica 2017

Deep repairs “RP” and new pavements “NC”

In line with ANAS's Annex C, “RP” deep repairs ensure reclassification of existing pavements as high life expectancy; they entail complete demolition of the existing pavement, with partial or complete reuse of the removed materials. These operations are required where the pavement is found to be particularly damaged and where it is desired to ensure high life expectancy on the basis of the traffic actually circulating.

There are three categories of “RP” according to the traffic (“TGM”); each of them is divided in its turn into three types according to the materials used (see tables), all of equivalent life expectancy; the choice of materials and the consequent technique will depend on local conditions (plants, quarries, availability of materials, existing pavement). We should remember, however, that the most reliable techniques for laying foundations are those associated with cold recycling, while the results obtained with lean concrete mix are more variable depending on the conditions on the construction site.

Wear layers, both draining and closed, can vary for reasons to do with local feasibility, it must be said, when using as alternatives only the types specified in the Technical Regulations.



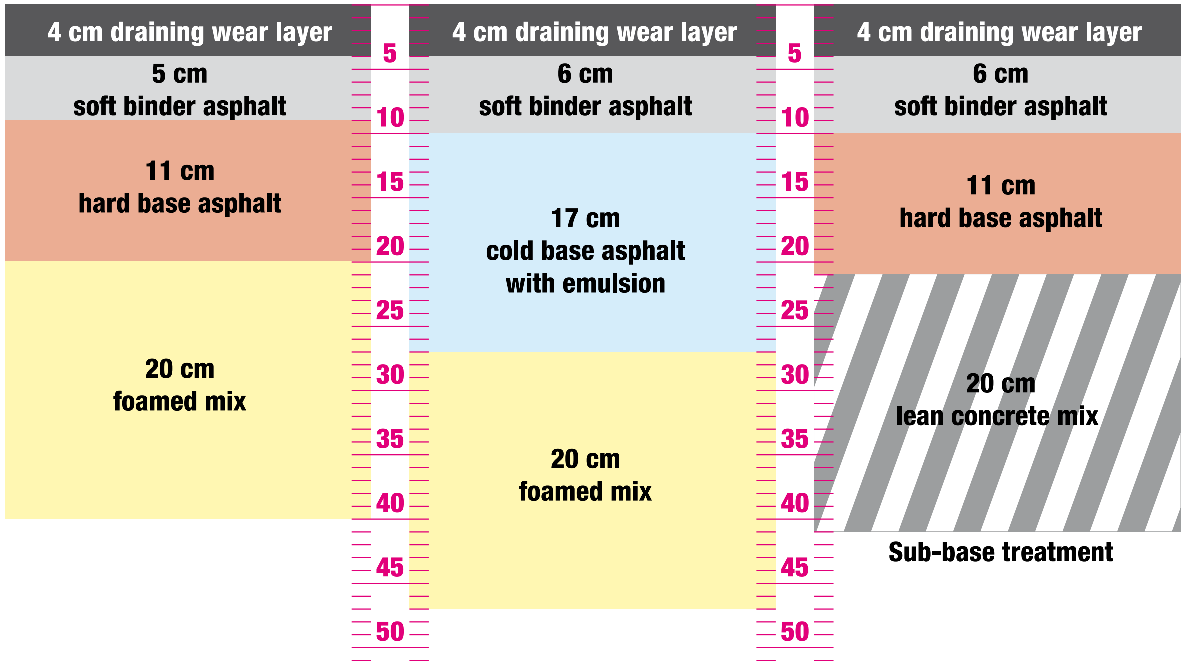
NB: the control curves for loadbearing capacity are shown in the Technical Regulations - Article 10.4.

(See following)

Deep repairs - RPC

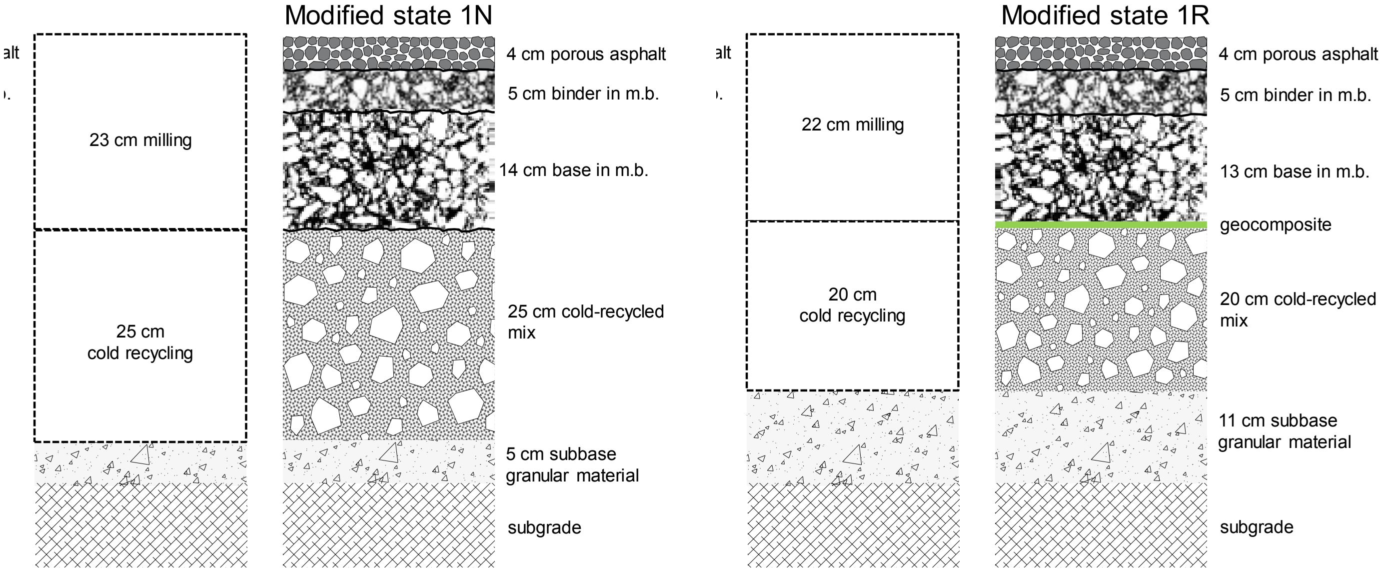
(See previous)

	Solution RP-C1	Solution RP-C2	Solution RP-C3
RP-C 5 million 12 ton axles TGM = 15,000			



NB: the control curves for loadbearing capacity are shown in the Technical Regulations - Article 10.4.

Risanamento superficiale ANAS: tipologia RP-A1



Duration of Solution 1N =
130 million standard 8,2 t axle loads

Duration of Solution 1R =
160 million standard 8,2 t axle loads

Summary

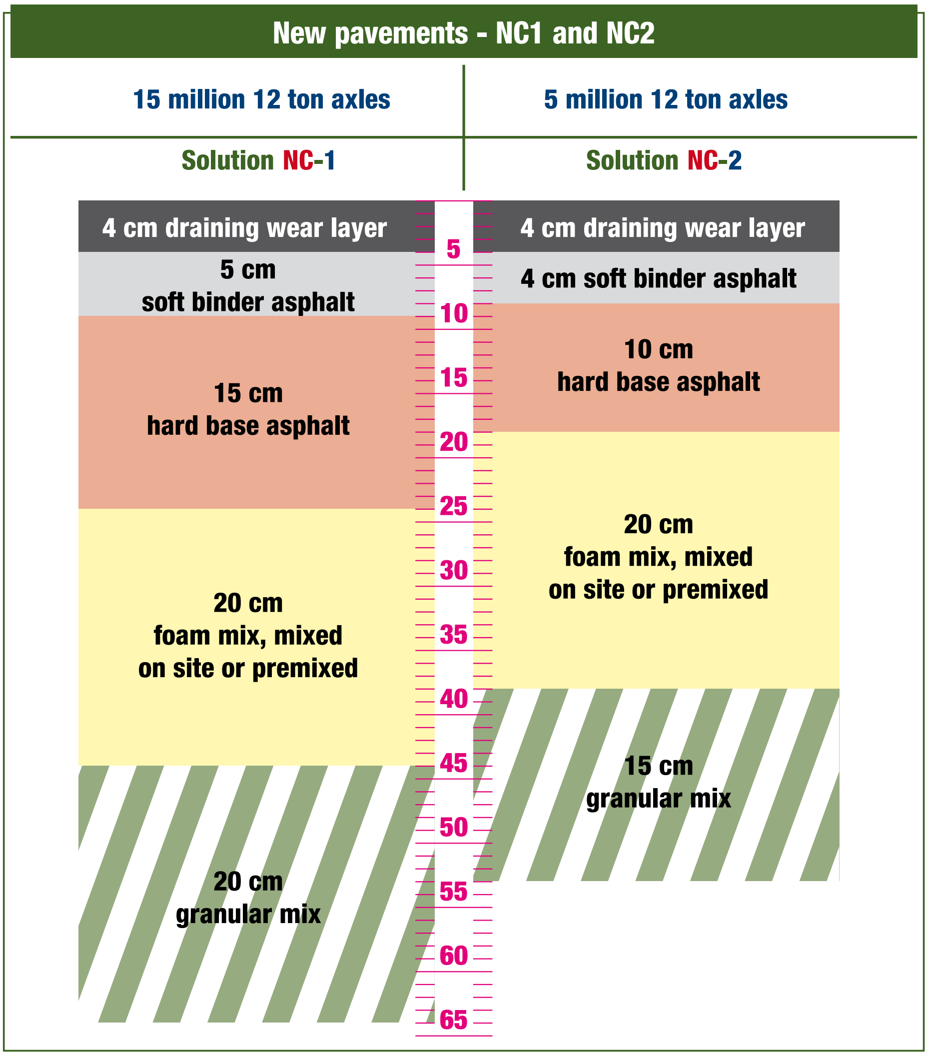
1R → 160 millions ESAL of 8,2 t = 30 millions ESAL of 12 t

6 cm milling **reduction** (out of 48)
1 cm reduction (out of 23) of SBS modified asphalt concrete
5 cm reduction (out of 25) cold recycle bituminous mixture with foamed bitumen

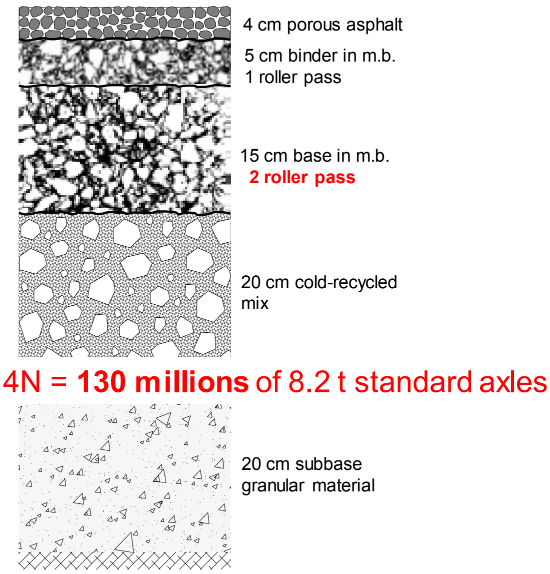
33% service-life **increase**
+ antipumping effect benefits + environmental benefits

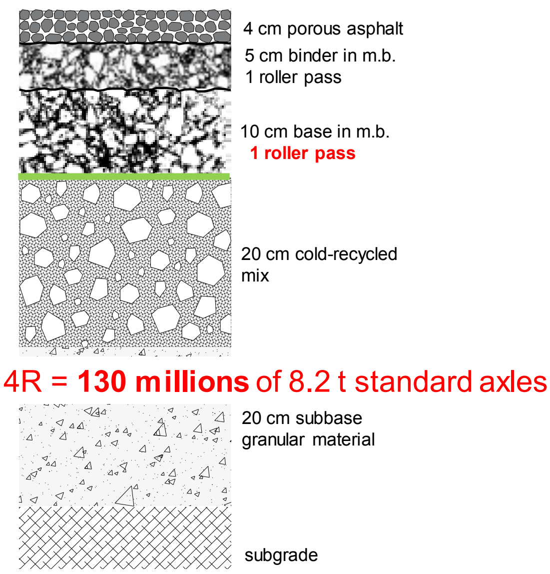
Prof. Ing. Canestrari e PhD Ing. Stimilli
24th february 2017 - Asphaltica 2017

In the case of construction of new pavements ("**NC**"), therefore probably without materials to be recycled, the types of pavement described in the illustrations below must be used, which require a layer of foamed bitumen, mixed on site or premixed in the plant (this alternative being preferable to lean concrete mixes), preceded by a layer of granular mix, besides the layers of hot-laid asphalt, always using modified bitumen. The different composition of the thicknesses of the various layers making up the operation makes the "**NC-1**" solution broadly suitable when there is considerable traffic of motorway type, with a percentage of commercial vehicles of up to 20%, while the "**NC-2**" solution may be suitable in the case of considerable traffic of the type seen on out-of-town roads, with a percentage of commercial vehicles of up to 10%. Given the "TGM" (Average Daily Traffic) and the percentage of commercial vehicles, it is possible to calculate the traffic in terms of 12 ton axle equivalents and consequently to choose the operation which is the most suitable solution. Different intervention solutions may be adopted from those indicated, as regards both thicknesses and types of materials used. However, the materials and types of process adopted must be those listed by the Technical Regulations, and in any event, through the Road Experimental Centre (CSS) in Cesano, the specific control curves must be determined for checking the loadbearing capacity using the IS300 performance indicator. As an alternative to the draining wear layer, depending on the actual local conditions, it is possible to create a closed wear layer in asphalt concrete, again made with hard modified bitumen and conforming to the types listed in the Technical Regulations; in this case, no variations on the control curves are specified. The characteristics of the materials to be used are set out in specific paragraphs of the Technical Regulations (to which please refer); a specific entry is then assigned to each of them in the List of Prices for determining the costs of intervention.



Risanamento superficiale ANAS: tipologia NC-A1





Summary

4R → 130 millions ESAL of 8,2 t = 24.5 millions ESAL of 12 t

5 cm milling **reduction** (out of 24) of rising and SBS modified asphalt concrete
Time operations reduction (reduced compaction times)

At equal service-life di Vita Utile
+ antipumping effect benefits + environmental benefits

Prof. Ing. Canestrari e PhD Ing. Stimilli
24th february 2017 - Asphaltica 2017

AUTOTENE ASFALTICO ANTIPUMPING HE/TVP in the ANAS stratigraphies for deep repair "RS" and new pavements "NC"

With reference to the ANAS stratigraphies quoted above, the correct position for **AUTOTENE ASFALTICO ANTIPUMPING both in the case of deep repair "RP" and in the case of new pavements "NC" is below the binder layer.**

In the case of deep repairs types "**RP-A2**", "**RP-B2**" and "**RP-C2**" where cold base asphalt concrete with emulsion is specified, which constitutes the laying surface for the geocomposite membrane, we emphasise that laboratory tests have been carried out which support the positioning of **AUTOTENE ASFALTICO ANTIPUMPING** above these materials, but there are not yet sufficient field tests available on the subject.

In this connection we reproduce below the article about its potential applications when laid over cold recycled layers.

POTENTIAL APPLICATIONS

Potential applications of the geocomposite membrane AUTOTENE ASFALTICO ANTIPUMPING on cold recycled layers with cement and bituminous emulsion

The geocomposite membrane **AUTOTENE ASFALTICO ANTIPUMPING** is the result of joint research by the company INDEX SpA and the Marche Polytechnic University. This product consists of a synergistic union between a glass fibre reinforcing geogrille and a bituminous geomembrane. The geocomposite is designed to maintain its properties of impermeability even after the operations of spreading and compacting the asphalt concrete above it. Correct adhesion of the geocomposite membrane to the laying surface is achieved by exploiting the heat of the overlying hot-spread asphalt concrete, which enables the activation of the self-heat-adhesive layer with which the geocomposite is provided on its underside.

This report contains a preview of the results obtained in the course of some preliminary studies, conducted at the Marche Polytechnic University, regarding the application of the geocomposite membrane over cold recycled layers.

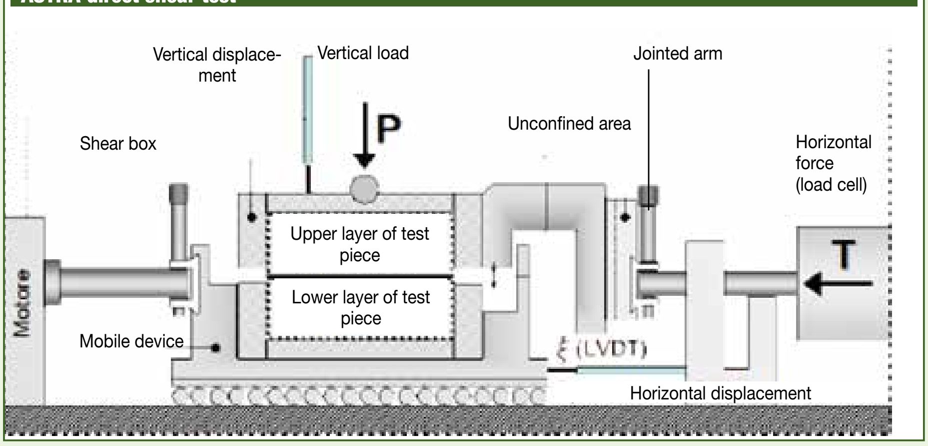
Laboratory experiments

The experiments concerned the shear resistance of two-layer systems with a lower layer composed of virgin and recycled (milled road) aggregates, cold-stabilised with bituminous emulsion (1.8% residual bitumen) and cement (2%), and an upper layer consisting of a hot-laid traditional asphalt concrete.

The geocomposite membrane was positioned at the interface, following the application, above the cold-stabilised layer, of a bonding coat of super-stabilised cationic bituminous emulsion (0.6 kg/m² of residual bitumen) and a monogranular grit (R+G interface). Since the grit could constitute a critical element for the adhesion of the membrane to the layer below, the shear properties were also assessed on similar reinforced interfaces without the application of grit (R interface).

The shear tests were carried out using the ASTRA apparatus (UNI/TS 11214) at a temperature of 20°C and with the application of a normal stress of 0.2 MPa. The cylindrical test pieces (Ø = 100 mm) were obtained, after a curing period of 5 days at a temperature of 60°C, by coring two-layer strips with a thickness of 80 mm (50 mm cold-stabilised + 30 mm hot asphalt concrete) made in the laboratory using a Roller Compactor.

ASTRA direct shear test

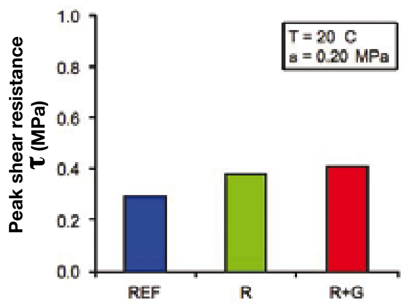


Analysis of the results and conclusions

From the analysis of the results (figure 1) we note that the degree of co-participation between the geocomposite and the layer of cold-stabilised material (R and R+G series) should be considered absolutely satisfactory. In fact, a resistance was encountered τ_{peak}>0.30 MPa, higher than the values obtained in previous studies in the case of interfaces where the reinforcement was positioned between layers of hot asphalt concrete (figure 1 – series REF). In this connection it is as well to remark that, usually, little adhesion is found at the interface between hot-laid bituminous layers and materials packaged with cold recycling techniques. The preliminary results obtained from the shear tests at the interface indicate, therefore, that the adoption of reinforced geomembranes makes it possible to ensure a better "connection" between the layers. Consequently, the degree of solidarity of the entire pavement would be increased, thus ensuring greater resistance to dynamic loads.

By observing the experimental results we can, furthermore state that the presence of the grit has no significant influence on the shear properties of the interface with geocomposite, thus making its use superfluous, contrary to what allegedly would occur if the asphalt concrete were laid directly above the cold-stabilised layer.

Figure 1 - Experimental results – average values (in the photo, a test piece with its lower layer stabilised)



Roller Compactor

Cylindrical test piece

(See following)

AN ALTERNATIVE INTERVENTION

A non-coded intervention that is widely implemented, due to its lower cost and considerable service life, is described below.

Road with slight cracks but with localised fractures

- total milling of 3 cm followed by further localised milling only on fractures measuring at least 4 cm;
- cleaning;
- laying of AUTOTENE ASFALTICO ANTIPUMPING only on fractures;
- 4 cm paving to level the surface and total paving of 3 cm on both the localised fractures and the rest of the road.

(See previous)

Besides the aspects already pointed out, the application of a reinforced geomembrane between hot-laid bituminous layers and cold-recycled materials could ensure further performance advantages.

In fact, it should be emphasised that the cold-recycled materials, because of the presence of the cement, tend to manifest fragile behaviour with cracks starting even though they cannot be directly correlated with the action of vehicles. In this sense, the presence of the geocomposite may perform an important anti-reflective cracking function by preserving the upper bituminous layers from premature degradation.

Furthermore, construction defects (laying joints) or local imperfections could lead to the infiltration of water through the pavement towards the deeper layers. In that case, it must be emphasised that the geomembrane constitutes an impenetrable barrier for the layers below it, which are particularly vulnerable to the action of water.

From the above considerations, it is evident that the use of the geocomposite membrane **AUTOTENE ASFALTICO ANTIPUMPING** over cold-recycled materials can deliver benefits of strategic importance. The opportunity therefore arises of preparing suitable experimental sections, shortly to be constructed, with the intention of verifying the potential discussed above.

The illustrations below relate to an application over cold-recycled asphalt. **AUTOTENE ASFALTICO ANTIPUMPING** was used in rebuilding the "TELEPASS" lanes of a motorway toll booth. These lanes are subject to wear caused by braking, especially by heavy lorries, which degrade them prematurely.

Repairs to "TELEPASS" lanes

After removal of the old asphalt the strip is re-covered with a layer of cold-recycled conglomerate.

The lanes are crossed by a trench housing the services.

The conglomerate is removed in the vicinity of the trench where the prefabricated channel is housed.

The channel is locked in place by poured concrete.

Laying AUTOTENE ASFALTICO ANTIPUMPING HE/TVP

Hot laying of an open conglomerate

Saturating the pores of the conglomerate with a special cement mortar has the object of increasing the loadbearing capacity to support heavy traffic.

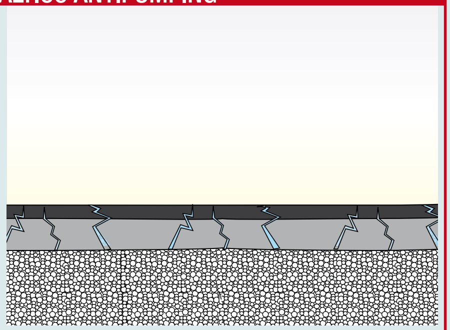
VARIOUS TYPES OF IMPLEMENTED USES

COMPLETE ROADS

2010 - Completion of milling over 4 kilometres

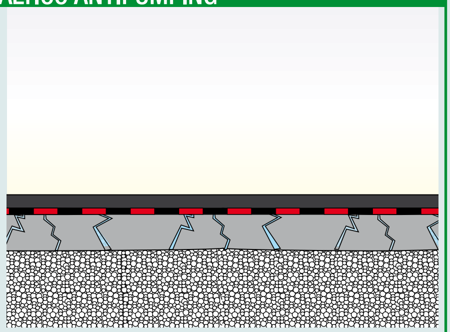
February 2013 - Inspection - the first 2 km - Without AUTOTENE ASFALTICO ANTIPUMPING





February 2017 - Inspection - the second 2 km - With AUTOTENE ASFALTICO ANTIPUMPING

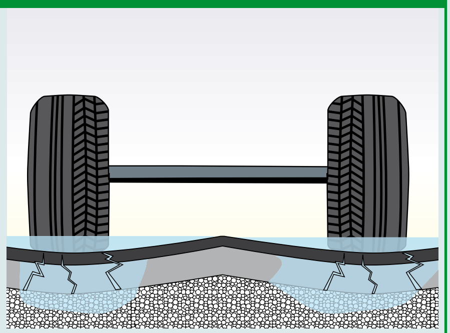




OCCASIONAL PATCH-UPS

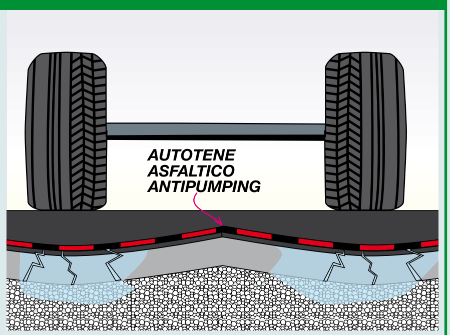
November 2012 - Resurfacing with AUTOTENE ASFALTICO ANTIPUMPING

November 2012

November 2016 - Inspection after 4 years





VARIOUS TYPES OF IMPLEMENTED USES

EXCAVATIONS - UNDERGROUND UTILITIES

February 2013 - Existing situation

February 2014 - Inspection - 7 months after renovation without AUTOTENE ASFALTICO ANTIPUMPING

April 2014 - Renovation with AUTOTENE ASFALTICO ANTIPUMPING

April 2014 - Renovation

February 2017 - Inspection - 34 months after renovation with AUTOTENE ASFALTICO ANTIPUMPING

AIRPORTS

VARIOUS TYPES OF IMPLEMENTED USES

HIGHWAYS - DUAL CARRIAGEWAYS




YARDS - HARBOURS




VARIOUS TYPES OF IMPLEMENTED USES

RUTTING

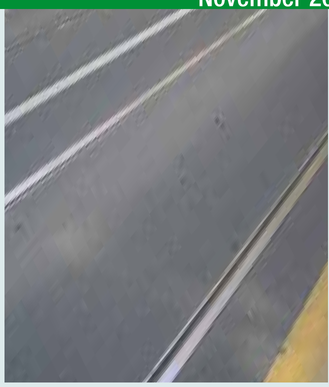



TRAMWAYS - RAILWAYS - LOGISTIC CENTRES

August 2015 - Recurrent problems affecting paved-in tracks


August 2015 - Renovation with AUTOTENE ASFALTICO ANTIPUMPING

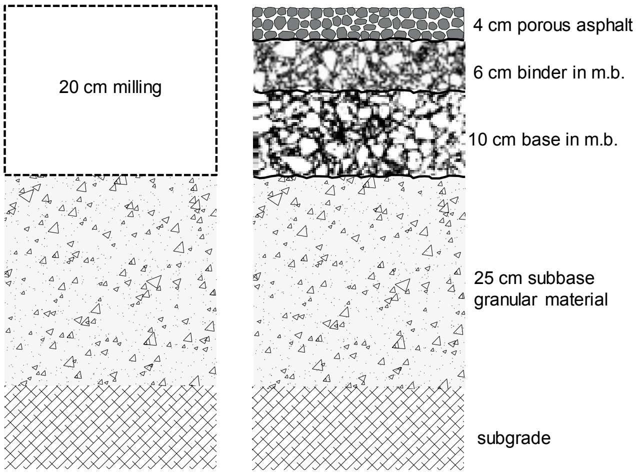

November 2016 - Inspection

POTENTIAL PRACTICAL APPLICATIONS

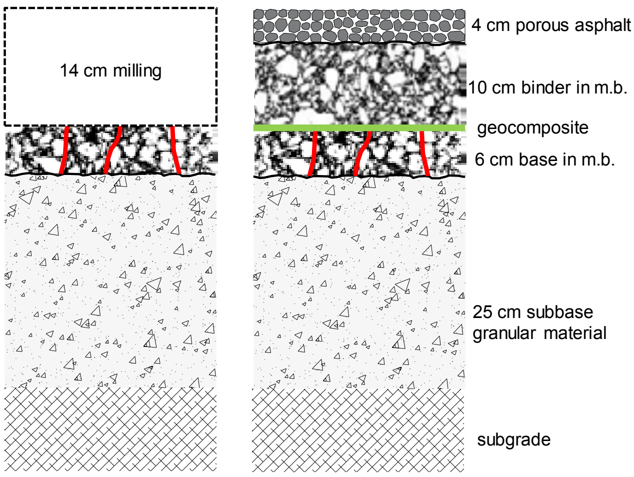
"Serenissima" A31 type branch-off from the A4 highway

Modified state 2N



Duration of Solution 2N =
11 million standard 8.2 t axle loads

Modified state 2R



Duration of Solution 2R =
12 million standard 8.2 t axle loads

Summary

2R → 12 millions ESAL of 8,2 t = 2,3 millions ESAL of 12 t

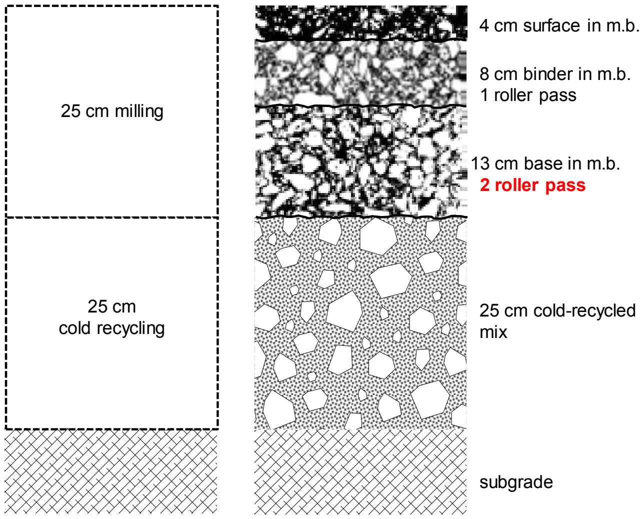
6 cm reduction (out of 20) of milling and modified HMA

9% service-life **increase**
+ antipumping effect benefits + environmental benefits

Prof. Ing. Canestrari e PhD Ing. Stimilli
24th february 2017 - Asphaltica 2017

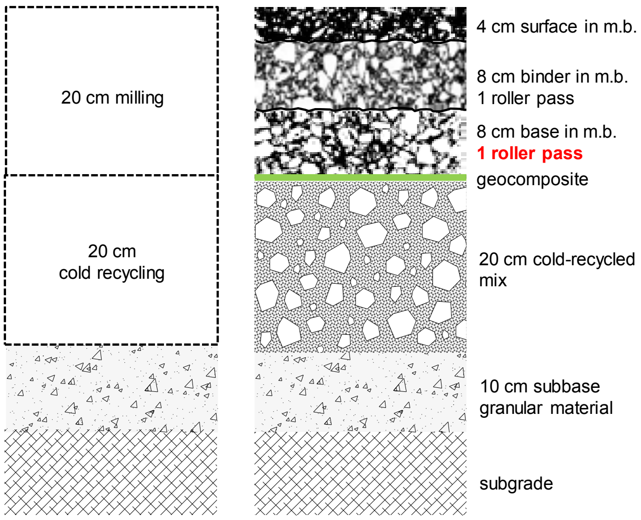
"Transpolesana (SS 434)" type

Modified state 3N



Duration of Solution 3N =
140 million standard 8.2 t axle loads

Modified state 3R



Duration of Solution 3R =
140 million standard 8.2 t axle loads

Summary

3R → 140 millions ESAL of 8,2 t = 27 millions ESAL of 12 t

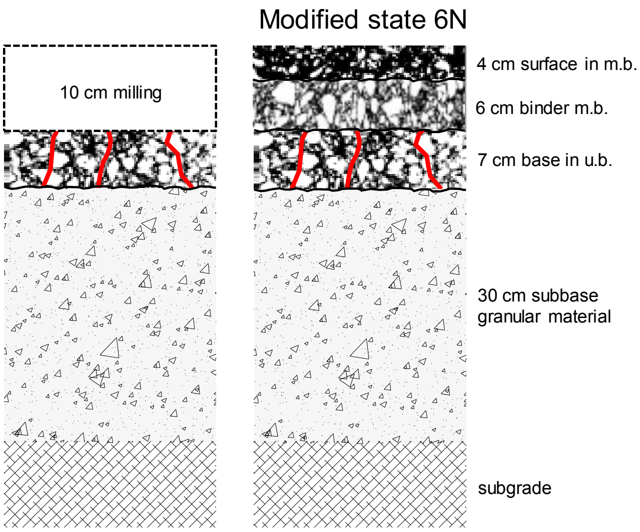
5 cm reduction (out of 25) of milling and modified HMA
5 cm reduction (out of 25) of cold-recycled mixtures
Shorter **working time** (reduced n. of roller passes)

At equal service-life
+ antipumping effect benefits + environmental benefits

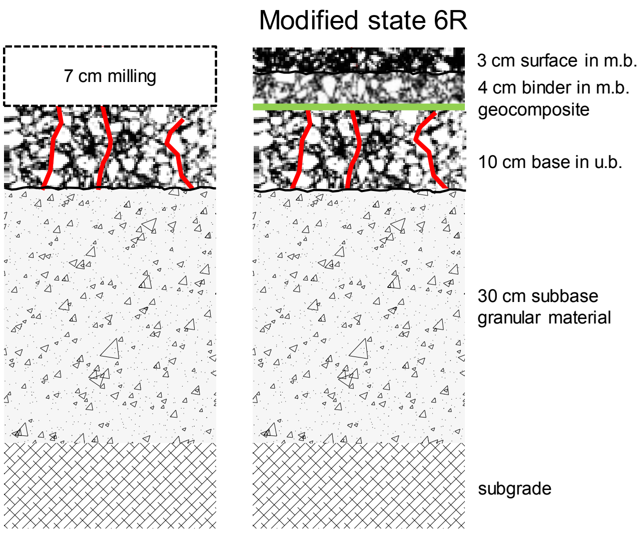
Prof. Ing. Canestrari e PhD Ing. Stimilli
24th february 2017 - Asphaltica 2017

COMPLETED INTERVENTIONS

ANAS type RA11 project



Duration of Solution 6N =
1.4 million standard 8.2 t axle loads



Duration of Solution 6R =
3.3 million standard 8.2 t axle loads

Summary

6R → 3,3 millions ESAL of 8,2 t = 0,6 millions ESAL of 12 t

3 cm reduction (out of 10) of milling and modified HMA

130% service-life **increase**
+ antipumping effect benefits + environmental benefits

Prof. Ing. Canestrari e PhD Ing. Stimilli
24th february 2017 - Asphaltica 2017

RE-COVERING OLD PAVEMENTS

In the case of re-covering existing pavements, **ANAS states as follows.**

When carrying out simple re-covering with a thickness of 5 cm (because of budgetary constraints), it should be borne in mind that the useful lifetimes would be much shorter, as shown in the table (right).

it therefore follows that it is often preferable to opt for solutions with a longer projected life than those dictated by budgetary constraints, because interventions with an excessively short projected life would result in stretches of road which were always in bad condition, and eliminating these would require the minimum interventions which are being discussed having to be repeated several times.
It is preferable therefore to opt for more durable solutions, possibly reducing the sections on which the work is carried out and treating the others with RSS systems.

AUTOTENE ASFALTICO ANTIPUMPING HE/TVP in re-covering existing pavements

The technical solutions specified below, which involve laying **AUTOTENE ASFALTICO ANTIPUMPING**, are intended to increase assumed durability with simple re-covering operations.

Expected lifetime of reinforcements with 5 cm cover

	Serious cracks			Slight cracks		
TGM	5.500	3.000	1.500	5.500	3.000	1.500
years	<1	<1	1	<1	1.5	3

• LIGHT/MEDIUM TRAFFIC
In the case of light/medium traffic on pavements free from structural failures and with **slight cracks**, on the assumption that the thickness of the existing conglomerate layer after milling is **at least 4 cm**, the minimum solution which can be considered is as follows:

- Existing pavement
- Laying **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Applying a wear layer with a thickness of at least 4 cm

In the case of light/medium traffic on pavements free from structural failures and with **serious cracks**, on the assumption that the thickness of the existing conglomerate layer after milling is **at least 4 cm**, the minimum solution which can be considered is as follows:

SMALL-SCALE INTERVENTIONS
- Existing pavement
- Hot sealing of serious cracks with **ROADBOND HE** elastomeric bituminous mastic or cold sealing with **ROADBOND PUR**.
- Laying **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Applying a wear layer of at least 4 cm thickness

LARGE-SCALE INTERVENTIONS
In the case mentioned above, sealing with bituminous mastic becomes too onerous both in terms of costs and in terms of time, and in this case the alternative is as follows.
- Existing pavement
- Reprofiling layer (D_{max} = 10 mm) in asphalt with a thickness of at least 2 cm
- Laying **AUTOTENE ASFALTICO ANTIPUMPING HE/TVP**
- Applying a wear layer of at least 4 cm thickness

PREPARING THE LAYING SURFACE

AUTOTENE ASFALTICO ANTIPUMPING must always be laid over a sufficiently stable layer of conglomerate of at least 4 cm thickness, as indicated in previous chapters. Many pavements, especially on municipal roads, do not have the required thickness after milling. For this reason it is preferable, if the levels allow it, to avoid milling and opt for re-covering the existing pavement after repairing the deep holes and troughs. The minimum solutions are those specified in the chapter on re-covering existing pavements.

Preparing the laying surface

- Primer (if necessary)
- Sealing the cracks
- Milled surfaces
- Holes and differences in level
- Rolling the geocomposite membrane
- Laying and compacting the asphalt concrete

The function of the primer

The primers used in preparation for laying the geocomposite membrane are ECOVER ANTIPUMPING and INDEVER PRIMER E. The former consists of a bituminous emulsion modified with elastomers, while the latter consists of a bituminous emulsion in solvent, modified with elastomers. In favourable environmental conditions, strong sunshine and temperatures higher than 25°C, the minimum drying time for INDEVER PRIMER E is 30 minutes, while the drying time for ECOVER ANTIPUMPING is 3 hours. Coverage for both is about 250 g/m². On fresh asphalt concrete surfaces, and on cold-recycled conglomerates, primer should not be used, while on existing pavements, if they are too old, after careful cleaning the primer can be avoided. Otherwise, if in doubt it is preferable to use it.
Cement or lean concrete surfaces must always be treated with primer.
Cement surfaces must be free from anti-evaporating agents (curing agents) and must be cured for at least three weeks.
In the case of milled surfaces where adhesion is more problematic and depends both on the profile of the milling and on the thoroughness of the cleaning operations, greater attention must be paid to the environmental conditions in which the operations are taking place.
The laboratory trials conducted on **AUTOTENE ASFALTICO ANTIPUMPING**, both on test specimens taken in the field and on those constructed in the laboratory, have demonstrated that the Shear Rates for two layers of conglomerate separated by AUTOTENE with and without emulsion primer, after a drying time of 3 hours, are similar, and the same applies if the conglomerate below is milled. Indeed, if other primers are used, as opposed to the specific primers prescribed by INDEX SpA, there is a risk that the specified Shear Rate values will not be obtained. As indicated in the AIA's laying recommendations, primer is useful for increasing the adhesion of the “strip membrane” in “marginal conditions” (i.e. when environmental conditions are not favourable and tend to reduce the adhesive properties of the geocomposite membrane).
Typical cases are when laying takes place in cold or damp conditions, and attention must be paid to the fact that in cold conditions, the primer used cannot be ECOVER ANTIPUMPING, which, since it is a water-based emulsion, does not dry within the laying times required on site, and it will be necessary to change to the solvent type INDEVER PRIMER E.
An alternative could be to carry out a 2 cm reprofiling, over which primer is not required, and which furthermore has the function of sealing the largest cracks in the old pavement.

Sealing the cracks

The surfaces of old pavements are often crossed by cracks of various widths and depths.
In line with the AIA's instructions:

"Cracks between 1/4" and 1/2" (0.6-1.27 cm) shall be filled with hot pour rubberized crack filler or other approved crack filler as specified by the Engineer. Wider cracks are to be repaired with a fine hot mix asphalt."

Cracks between 0.6 and 1.3 cm must be sealed with hot pour sealant, bitumen elastomeric sealants or other sealants approved by the Site Manager. Wider cracks must be repaired with a fine hot asphalt (this is probably intended to mean "carry out a fine 2 cm reprofiling").

Cracks wider than 5 mm must be sealed with the **AUTOTENE ASFALTICO ANTIPUMPING** membrane.

Hot sealing operations on US roads before laying an "Interlayer"

The illustrations that follow show crack sealing operations on a mountain road in Switzerland prior to laying the geocomposite **AUTOTENE ASFALTICO ANTIPUMPING**.

Crack-sealing operations on a mountain road in Switzerland

Cracks in the pavement after milling are sealed and then the geocomposite membrane is laid, followed as part of the same operation by the wear layer.

Sealing operations are justifiable for small-scale patching jobs, but on large-scale jobs, if the cracks are wider than 5 mm and so widespread over the entire surface as to make sealing unworkable, it is more advantageous to carry out a reprofiling of 2 cm thickness with fine asphalt.

Milled surfaces

Laying over milled surfaces is often problematic because planers are often used which leave an excessively rough surface, and the membrane adheres only on the high points and not in the recesses, resulting in a resistance to shear forces lower than the theoretical resistances found in the laboratory.

Laboratory tests and sampling on site have shown that the use of primer on milled surfaces is not strictly necessary, but work is often carried out on surfaces that have not been properly swept or in unfavourable environmental conditions.
Sweeping the milled areas must be performed without water.
As may be seen from the photographs below, excessive quantities of water are often used, which prevent the geocomposite from adhering.

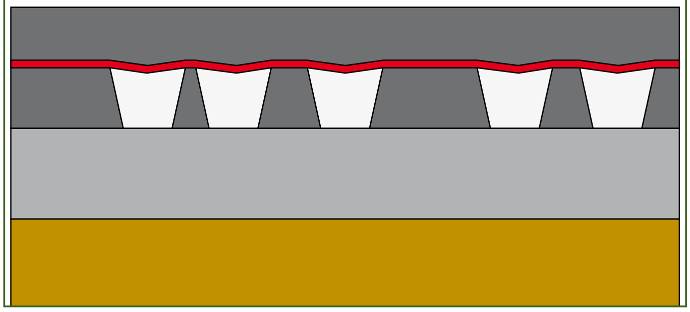
As regards the profile of the milling, the AIA recommends as follows:

"Where grooves in milled pavements result in vertical surfaces, a levelling course will be required. When paving over a shoulder or other sharp edge, the surface should be ground down or a levelling course of asphalt mix used to smooth it out."

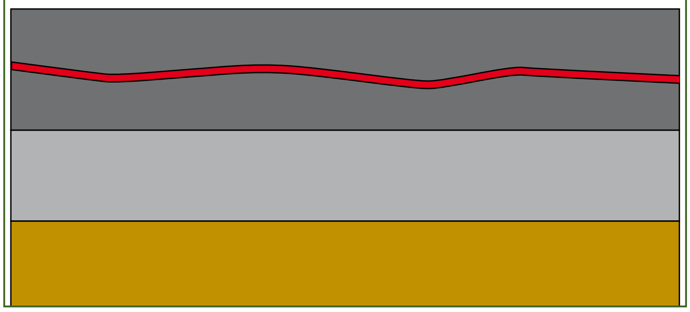
A smoothing/levelling course will be necessary where there are grooves or furrows in vertical surfaces in milled pavements. When paving on the edge of the road or other sharp edge (sharp corner), the surface should be smoothed or a levelling course of asphalt should be used to adjust it.

If the geometry of the milling is too deep, with a sharp, not rounded, profile, it must be rounded or else a fine 2 cm reprofiling course must be laid.

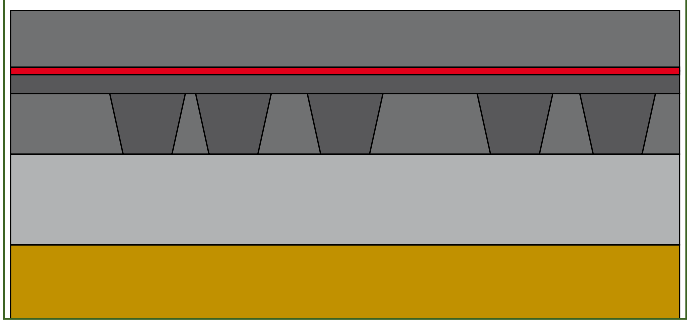
Excessively deep milling with sharp corners. The geomembrane does not adapt to the recesses and the water is able to leak under the membrane.



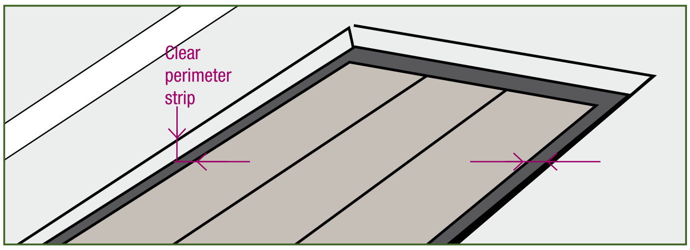
Rounded milling to which the geomembrane adapts better



Reprofiling eliminates the voids and the membrane adheres completely to the laying surface.



The area to be milled must correspond to the area which will be covered by the membrane, taking account of overlaps and of a 5 cm clear strip at the perimeter which will not be covered by the membrane but treated with bituminous primer. The geomembrane must be kept clear of the milled area for about 5 cm at the perimeter, particularly at points where the thickness of the conglomerate is less than 4 cm.



Holes and differences in level

Holes and depressions in the pavement must be filled with hot-spread conglomerate, proceeding as illustrated below.
Areas with large differences in level must not be covered immediately.

When the hot conglomerate arrives on site, holes must be filled to re-establish the correct level, compacting them well to avoid the subsequent pavement breaking up. Finally, coverage of the areas which had been left behind must be completed.

Rolling the geocomposite membrane

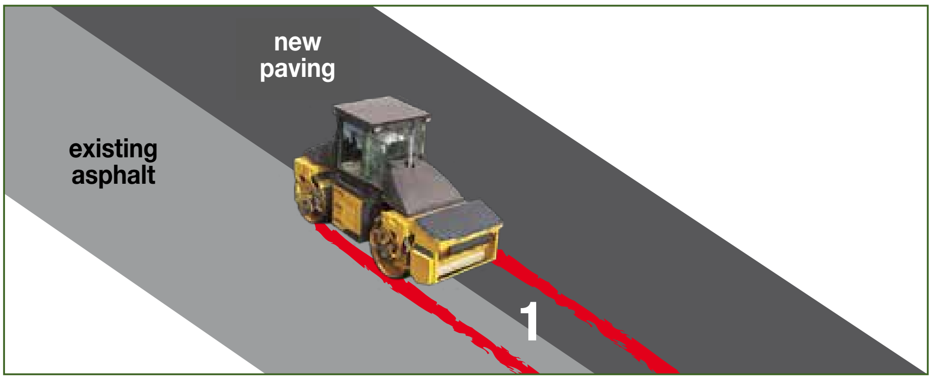
Products with their own adhesive (self-adhesive, self-stick adhesive) are more correctly described by the term "Pressure Sensitive Adhesive" often abbreviated to PSA. They are so-called because they adhere when they are **pressed** onto the surface to which they must adhere, and the **degree of adhesion depends on the pressure exerted in applying the adhesive to the surface.**
Other important factors which affect adhesion are: the smoothness of the surface, the cleanliness of the surface, the nature of the surface (surface energy) etc.
For the above reasons, and all the more so when laying in unfavourable environmental conditions or on irregular surfaces such as milled surfaces, the laid sheets must be stabilised by rolling to prevent them from moving or forming folds under the wheels of the finisher or site vehicles.

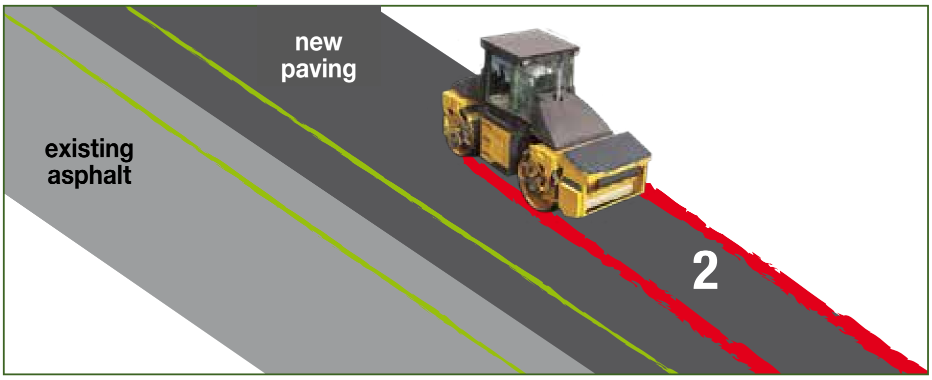
Rolling should preferably be carried out by a tyred vehicle, which is better at stretching the membrane over the laying surface, with care being taken at the overlaps between the sheets.

Laying and compacting the asphalt concrete

Laying the asphalt concrete must take place at a temperature not lower than 140°C, preferably above 150°C. Compaction must be carried out to the highest standard in order for the conglomerate to reach the correct density and further strengthen the adhesion of the membrane.
Compacting incorrectly performed to save on conglomerate leads not only to early deterioration of the conglomerate but also to insufficient adhesion of the geocomposite membrane.

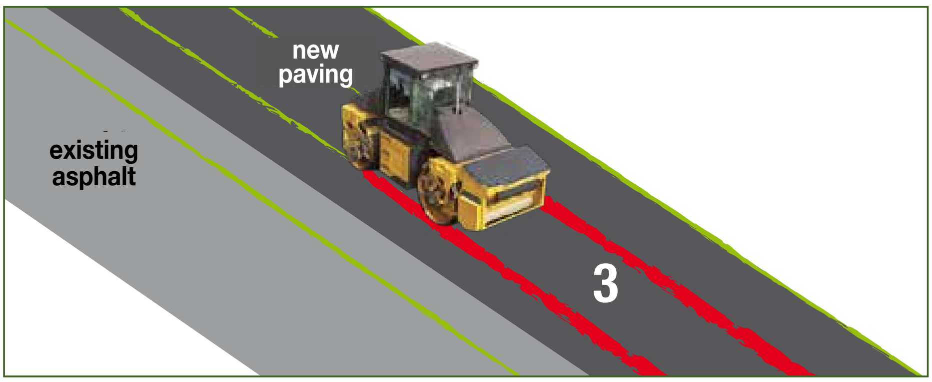
1st stage.
Compact the border between the lane with new paving and the existing lane.





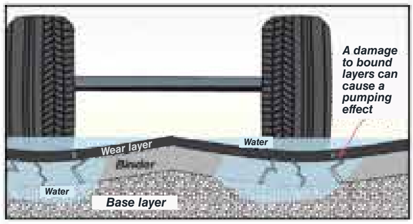
2nd stage.
Compact the area near the outer edge.

3rd stage.
Compact the central surface.



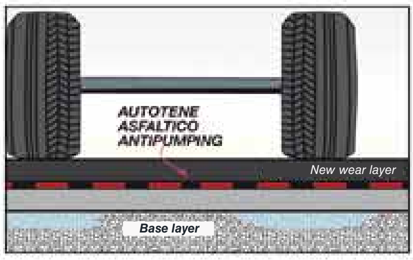
Is your asphalt a sea of holes?

Protect it with Autotene Antipumping HE/TVP



PROBLEM: PUMPING

Over time, cracks and ruts form in road pavements. Vehicle traffic pumps rainwater into the surface through the cracks, which transports the fine particles away from the base layer, causing the progressive failure of the pavement.



SOLUTION: AUTOTENE ASFALTICO ANTIPUMPING HE/TVP

The Index armoured self-heat-adhesive elastomeric membrane inserted between the the binder and the wear layer reinforces and waterproofs the pavement and prolongs its expected life, because:

- it blocks the transmission of cracks
- it increases fatigue resistance
- it reduces rutting
- it prevents the formation of holes and cracks
- it eliminates “pumping”.

• FOR FURTHER INFORMATION OR SPECIAL USES, CONSULT OUR TECHNICAL OFFICE

index
Construction Systems and Products
Via G. Rossini, 22 - 37060 Castel D’Azzano (VR) - Italy - C.P.67
Tel. +39 045 8546201 - Fax. +39 045 512444

Internet: www.index-spa.com
Technical & Sales Information
tecom@indexspa.it
Management and Administration
index@indexspa.it
Index Export Dept.
index.export@indexspa.it

TOTAL QUALITY index UNI EN ISO 9001 | Environmental Management Systems index UNI EN ISO 14001 | index socio del GBC Italia

5/2017ing-3/2017
K.S./dig. - 500