Foreword

This second edition of the Code of Practice has been produced by the Road Surface Treatments Association (RSTA) Geosynthetics & Steel Meshes Committee to provide highway authorities, designers and principal contractors with a thorough understanding of Asphalt Interlayers, their use, laying techniques and applications.

Reference has been made to BS EN 15381 Geotextiles and Geotextile Related Products – characteristics required for use in pavements and asphalt overlays. This EN sets the standard for manufacturers to produce Asphalt Interlayers with CE marking. This document also cross references the work of ISO committee TC221 WG6/PG10 who are producing design guidance for using geosynthetics in asphalt overlays (anticipated publication date 2019).

This edition has been written and may be used with reference to the ADEPT document “Guidance on the use of paving fabrics and grids as asphalt reinforcement.

This edition anticipates the publication of CD227 Chapter in the DMRB and new specification clause 936 (see appendix K) which includes a requirement for Product Assessment, although this particular requirement will not come into force before June 2020.

This document has been peer reviewed by ADEPT Soils, Materials, Design and Specifications Committee and Highways England Pavement Materials Team.

The information contained herein is intended to represent industry best practice. No liability is accepted by RSTA for any damages caused to property or personal injury resulting from using the guidance contained within this document.
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1.1 The RSTA shall not be liable in respect of any event of default for loss of profits, goodwill or any type of special, indirect or consequential loss, including loss or damage suffered by you as a result of any action brought by a third party even if such loss was reasonably foreseeable, or that the RSTA had been advised of the possibility of you incurring the same. Notwithstanding that all warranties are hereby excluded to the fullest extent permitted by law, in the event that the RSTA is found to be liable in damages for breach of contract (however caused) then the RSTA’s total liability shall not in any circumstance exceed [£5M].

1.2 Subject in all respects to the other provisions of this clause 1 the RSTA’s entire liability in respect of any single event of default shall be limited to damages of an amount equal to [£5M] in respect of your tangible property resulting from the negligence of the RSTA or any of their employees, agents or subcontractors.

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   - inappropriate use of the 2008 Code/2017 Guidance;
   - failure to exercise reasonable levels of due care and attention when using the 2008 Code/2017 Guidance; or
   - failure to exercise reasonable levels of professional skill and competence when using the 2008 Code/2017 Guidance.

1.5 Nothing in these Terms and Conditions excludes or limits the RSTA’s liability for:
   - death or personal injury caused by our negligence;
   - fraud or fraudulent misrepresentation;
   - defective products under the Consumer Protection Act 1987; or any other matter for which it would be illegal for us to exclude or attempt to exclude our liability”.

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Appendix A: Glossary of terms
Appendix B: Reference Documents
Appendix C: Quality Control Testing for Bond Condition (Adhesion)
Appendix D: Case Study Template
Appendix E: Installation Photographs
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### DOCUMENT CONTROL

**Issue Statement**

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### REVISION LIST – AMENDMENTS MADE IN THIS ISSUE

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<td>The document has been significantly re-organized with content in Issue 1 containing significant technical detail now included in Appendices.</td>
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<td>The Foreword has been updated to recognize the new Specification Clause 936, the new Chapter in CD227 and to recognize the new requirement in Clause 936 for a Product Assessment/Certification scheme.</td>
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<td>The Contents page has been updated to reflect changes in the document</td>
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<td>Some editorial changes made to the Introduction. The part that deals with Crack Development in Issue 1 has been updated and now forms Appendix F.</td>
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<td>Section 2 now includes new information on ‘Functions’ and guidance on ‘System Selection’.</td>
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<td>Section 3 (Site Conditions and Assessment) has been significantly re-written and the Flow Chart in Issue 1 advising on product selection now forms Appendix G and the Design Input Sheet now forms Appendix H.</td>
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<td>Section 5 (Installation) has been significantly updated with new images showing surface condition after planning and new information on Bond Coats.</td>
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<td>The Austrian Splitting test has been deleted from Appendix C pending publication of an improved test procedure.</td>
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<td>Appendix D now includes a Case Study template to be used for capturing project information. Reference projects in the previous Appendix D in Issue 1 have been deleted.</td>
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<td>Appendix F now includes information on Crack Development which was previously located in the main body of the text and the list of Committee members in Issue 1 has been deleted.</td>
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<td>Appendix G is new and contains a Product Selection Chart previously located in the main text under System Selection.</td>
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<td>Appendix H is new and contains a Design Input Sheet previously located in the main text under System Selection and new Design Consideration.</td>
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<td>Appendix I is new and contains information on maintenance</td>
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<td>The old Section 5 (Conclusions) has been deleted with some information retained but now incorporated into relevant sections.</td>
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1. INTRODUCTION

Cracking in asphalt pavements is recognised as one of the biggest problems faced by highway maintenance engineers. Asphalt Interlayers are a proven approach for extending the life of pavements. When placed between bituminous bound layers or between concrete and an asphalt overlay, these products retard the initiation and propagation of reflective cracking which leads to premature pavement failure.

These systems have a long track record of successful use with over 2.7 million m² used annually in the UK based on 2017 data and more than 100 million m² installed throughout Europe since the 1980's. Over this period the industry has continuously improved its products, systems and installation techniques and captured evidence of performance. It is worth noting that the majority of UK local authorities have now used these systems as they have grown in acceptance.

For clarity this document is mainly concerned with addressing pavement defects caused by reflective cracking. Failures and degradation resulting from the following circumstances are not addressed:

- Asphalt deterioration
- Sub-grade failure and associated rutting
- Asphalt rutting associated with permanent asphalt strain

The maintenance of roads in the UK has always been a challenge due to heavy trafficking and variable weather conditions. Many types of treatments have been used to extend the service life of asphalt roads with a view to minimising maintenance costs. Breakdown of the road surface is caused by weathering, movement and fatigue, accelerated by the asphalt's susceptibility to reflective cracking leading to ingress of water, then to potholes and a finally, total breakdown of the surface.

One of the treatments which has been used extensively over the past 30 years in the UK and globally is the use of an asphalt interlayer which is installed within the pavement to intercept the path of a crack propagating through the pavement. These are usually supplied as a rolled product in different forms consisting of different raw materials.

A useful way of comparing the effectiveness of these systems is to express performance in terms of a ‘cost life index’. This is the cost per square metre of the work divided by the service life in years. It provides a measure of ‘value for money’ which the highway authority is achieving. A low ‘cost life index’ and high ‘value for money’ result from specifying high-quality
Benefits include:

- Delayed re-occurrence of reflective cracking
- Longer pavement service life
- Reduced maintenance interventions
- Reduced environmental impact associated with longer maintenance intervals
- Reduced hidden costs to businesses and the public through fewer road closures and traffic restrictions
- Reduced embodied Carbon (PRoTECT tools [www.rsta-uk.org](http://www.rsta-uk.org))

A range of possible solutions increasing the life of a pavement might include: mill and fill (and overlay), application of thick asphalt overlays, the use of modified asphalt mixtures containing high polymer modified bitumen content and the application of an interlayer for stress-absorption (SAMI) or reinforcement systems. Combinations of these solutions are of course also possible. During the design phase of a project, each potential solution needs to be assessed in terms of the whole life cost benefit before deciding on the most appropriate maintenance option.

The environmental savings associated with the reduced pavement structure are linked with the environmental costs associated with the manufacturing, transport and placement of the aggregated and geosynthetics. Potential environmental savings and enhanced whole life cycle of the reinforced pavement structure have been studied and evaluated. TRL and RSTA have embraced a research on carbon footprint (please contact RSTA for more information). Specific information could be also requested to geosynthetics and woven steel mesh manufactures.

### 2. MATERIALS and CATEGORISATION

Geosynthetics and steel mesh products are available in a variety of forms (grids, textiles, or composites), and are manufactured from different base materials (typically glass, polymers, and steel). Whatever type of asphalt interlayer is used the product must comply with EN15381 as designed for use in pavements and asphalt overlays.

Asphalt interlayers can have very different characteristics depending on the method of manufacture and raw material(s) used. Therefore, asphalt interlayers are not interchangeable by function e.g. a product designed to provide a barrier function may be unsuitable as a reinforcement in a pavement.

In detail, asphalt interlayers 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 and structural improvement through a reinforcing function and/or stress relief function
- Mitigation of water ingress into the bound and unbound layers through their interlayer barrier function
- Can increase the stiffness of bound layers above the interlayer through their reinforcing function
- Can enhance adhesion between asphalt layers
Increased stiffness, structural improvement and mitigation of water ingress, can reduce the fatigue behaviour of the bound layers above the asphalt interlayer which again leads to a mitigation of reflective but also of top-down cracking.

2.1 TYPES

a) **Paving Fabrics**
A paving fabric is a non-woven geotextile used in an asphalt pavement construction to provide, in conjunction with an adequate amount of bitumen, a moisture barrier and stress relief function. It can be used as a single element or as part of a paving composite grid (paving fabric attached to a grid). In order to provide an adequate level of performance and lifetime regarding its functions, the nominal weight is defined as ≥130 g/m² (according ISO 9864) and the bitumen retention (according EN 15381 Annex C) is defined as ≥ 1,1 kg/m².

*Provided Functions: Interlayer barrier, stress relief*

b) **Paving Grids**
A paving grid is used in an asphalt pavement construction to provide a reinforcing function. It can be used as single grid element or as a grid attached to an installation aid. The grid can be composed of crossing flexible fibre strands, made of mineral or polymeric materials (e.g. glass, PES, PVA, carbon) or it can consist of rigid apertures, high profile ribs and load transferring junctions, made of metallic or polymeric materials (e.g. steel or punched and stretched PP-grids).

*Provided Function: Reinforcement*
**Installation Aid**
An installation aid is attached to a paving grid in order to support the installation process in different ways. It could consist of a nonwoven fabric (<130 g/m²), additional fibres in the apertures of a grid or a thin foil. An installation aid can increase the contact area of the product to the underlayment to achieve a better adhesion to secure the paving process. In case of a thin foil attached to a grid it can help to decrease roll adhesion for an easy unrolling of the product.

c) **Paving Composite Grids**
A composite grid is used in an asphalt pavement construction to provide, together with an adequate amount of bitumen, an interlayer barrier, stress relief and reinforcing function. It is composed of a grid attached to a paving fabric.
*Provided Functions: Interlayer barrier, Stress Relief, Reinforcement*

![Composite Grids](image)

**d) Woven Wire Meshes**
Steel reinforcing overlay for cracked or deformed roads. The woven wire netting, manufactured out of heavy galvanised steel wire, is reinforced at regular intervals by transverse twisted steel wire stands, interwoven into the mesh.
*Provided Function: Reinforcement*

![Woven Wire Meshes](image)
2.2 FUNCTIONS

   a) Reinforcing Function
A function provided by a paving grid or paving composite grid or woven wire steel mesh on a flexible, rigid or semi-rigid pavement. By the absorption of tensile forces, the reinforcement can mitigate reflective cracking, increasing the stiffness of the structure and lead to structural improvement of the asphalt layers above the product. Improved fatigue resistance is achieved compared to an unreinforced structure. Grids or mesh can provide reinforcement by adhesion (friction) in between layers and by interlock through apertures in the grid or mesh.

   b) Interlayer Barrier Function
It is a function provided by bitumen impregnated paving fabrics, which act – in conjunction with a bitumen layer – as a barrier to the ingress of water and thus prevent or delay the deterioration of the pavement.

   c) Stress Relief Function (STR)
Function provided by an adequately bitumen-saturated layer such us a paving fabric, SAMI non-woven or purpose-built composite) which – when properly installed between a road surface and a new asphalt overlay – allows for slight differential movements between the two layers and thus provides stress relief.

2.3 QUALITY ASSURANCE

All the products listed in section 2 a) should be manufactured under a quality management system that meets the requirements of ISO 9001, be CE marked in accordance with BS EN 15381 (specific product details may be obtained directly from the relevant manufacturers). Quality assurance of any product used is required to ensure a high standard of installation to maintain its required performance, under the influence of foreseeable actions (normal loading and climatic conditions), for a reasonable economic working life.

Installers and their sub-contractors must be registered to National Highway Sector Scheme 13.

2.4 CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH (COSHH)

All materials utilised must comply with COSHH Regulations. Installers must be provided with COSHH datasheets from the product manufacturer describing potential hazards to health during installation.

2.5 SYSTEM SELECTION

As indicated in the section 2.1 and 2.2, there are different types of Asphalt Interlayers in use and there are also many ways in which to categorise these materials but in terms of design philosophy related to reflective cracking they tend to be split as:

   • Products which permit intimate contact between the overlay and the underlying asphalt or concrete and rely on reinforcing the upper layer to inhibit crack propagation.
   • Products which provide a change in horizontal stiffness between pavement layers thus reducing stress transfer between upper and lower layers. This is often known as the SAMI effect (Stress Absorbing Membrane Interlayer) / stress relief function.
• Products which, via the use of paving composite-grids, provide the beneficial effects of combining a paving grid with a SAMI.

Following a System Selection Matrix:

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Provided Function</th>
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<tr>
<td></td>
<td>Interlayer Barrier</td>
<td>Stress relief</td>
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<tr>
<td>Paving Fabric</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Paving Grid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paving Composite Grid</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Steel Woven Mesh</td>
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Success has been achieved with all three of the above methods and associated materials and given the complex nature and importance of site specific information, it is therefore strongly recommended that the advice of individual manufacturers and installers is sought regarding the suitability of their products and systems to particular project conditions.

Further information is available in Appendix G.

3. SITE CONDITIONS AND ASSESSMENT

The following issues should also be considered when selecting one of the products presented above and an assessment of the existing site should be carried out.

Asset Managers and Designers should collaborate with the Geosynthetic and Steel Mesh supplier/installer with an early contractor involvement. A collaborative environment could facilitate an answer to the following questions:

• What is the mode of failure and cracking mechanism prevalent at the site and how will the proposed solution address this?
• What are the required mechanical and durability characteristics of the Asphalt Interlayer and how are these to be specified? Any product related specifications should generally conform to accepted (European) format, where the minimum level of product description is according to international standards (e.g. BS, CEN, ISO).
• How does the Asphalt Interlayer interact with surrounding asphalt mixtures for the system to function, including details of any mechanism of stress relief required (SAMI)?
• How has the performance of the specific Asphalt Interlayer system been validated? (e.g. long-term usage, monitoring field data, laboratory research)
• What is the whole life cost benefit of the utilisation of the system for the project in question?
• What are the installation requirements associated with the proposed system? (e.g. regulating layer, minimum overlay thickness, particular type and quantity of bond coat etc).

Site selection is a key aspect when a geosynthetic and/or steel mesh is used to achieve the required end performance. The existing pavement must show no signs of pumping, excessive movement, or structural instability. To maximise the benefit of an interlayer, pavements must be structurally sound. If the pavement is structurally unstable, the designer must first address
the structural problem and then the asphalt pavement problem.

3.1 PAVEMENT ASSESSMENT

Before an Asphalt Interlayer solution can be proposed every project should be carefully assessed and information should be collected on a range of site specific conditions. It may be the case that issues exist that require other forms of treatment prior, or in preference, to Asphalt Interlayers.

Assessment should include a visual distress survey, existing pavement construction obtained from core logs and if necessary deflection testing such as FWD (falling weight deflectometer). This data should be used to determine the effective modulus of the existing pavement. Slab replacement, grouting, full depth asphalt replacement, pot hole repairs shall be made prior to the installation of the interlayer and subsequent asphalt overlay.

All existing cracks should be sealed by conventional methods and cracks greater than 5mm should be filled with a suitable crack repair system. Guidance is available in the RSTA ADEPT Code of Practice for Crack Sealing Systems.

In many cases the road network has informally evolved over decades rather than designed to withstand the increased traffic loading so there are many differing pavement construction types and failure mechanisms. It is therefore important to make careful observations and measure existing site conditions to help assess the potential failure mechanism so the most appropriate solution can be recommended.

In order to make a fully informed evaluation of a reflective cracking problem there are number of key pieces of information which must be collected or recorded.

**Surface Existing Condition**

Information on surface cracking must be recorded as follows:

- Number and length of cracks greater than 5 mm with spalling and bifurcation
- Number and length of cracks less than 5mm wide (e.g. cracks spacing)
- Location and direction of cracks (e.g. only in wheel tracks or over the entire road surface)
- Photographs are useful as a point of reference (e.g. 1m from road surface)
- Road scanning equipment can be used to identify reflective cracking

Other information required on the existing condition and history includes:

- Type of the road and road construction
- Traffic loads (number, type of vehicles, speed) and
- Load bearing capacity of the traffic area
- Location of service trenches
- Variations in temperature high and low recorded from Summer to Winter (climate)
- Pavement type (flexible, rigid or semi-rigid)
- Pavement properties (e.g. pavement stiffness MPa, subgrade information)
- Drainage and groundwater information

During the site survey care should be taken to observe the entire site for other site issues.
The flow charts in Appendix G are intended to help the designer with system selection.

As a general consideration associated with all pavement construction, water plays a significant role in carriageway deterioration. Water table and drainage issues must be identified and dealt with prior to pavement remedial works to prevent premature failures.

Roads built through cuttings in rural areas are particularly susceptible to drainage problems. Any site should be examined for signs of upward pumping of groundwater or excessive movement and structural instability. If the pavement is structurally unstable or hydraulically compromised, the designer should first address the structural and groundwater issues before the solution to any remaining reflective cracking problem can be considered.

*(Guidance in the Design Manual for Roads and Bridges, Volume 7, Section 3, Part 3, HD 30 Pavement Maintenance Procedure may also be helpful).*

### 3.2 TYPES OF PAVEMENTS

**a) Flexible Pavements**

Flexible pavements can fail for a number of reasons, it is critical that the correct mode of failure is identified so that appropriate remedial action can be taken. Flexible pavements with weak foundations often display alligator cracking in patches. Ruts can be present in conjunction with areas of alligator cracking where carriageways have sub-standard bearing capacity for imposed traffic loadings. Many rural carriageways also display edge deterioration mainly caused by over-run.

**b) Flexible Composite Pavements**

Flexible composite pavements often display reflective cracking from construction joints. Such pavements are constructed in differing forms, with some internally reinforced with steel mesh, some incorporating connecting dowel bars and others with no reinforcement at all. Most flexible composite road bases will have been installed with expansion joints which commonly initiate cracking in flexible overlay materials. Another common problem associated with these pavements is settlement of the underlying slabs resulting in the formation of voids, which can lead to rocking movement and/or some slabs fracturing under the stress. Significant vertical shear movement must be alleviated prior to installation of any Asphalt Interlayer or early failures will occur.

**c) Pavement Quality Concrete/Cement Bound Materials/Lean Mix Road Base**

Roads constructed using a lean mix road base display reflective cracking in a similar manner to composite roads, although the material is not jointed, reinforced or dowelled. Lean mix roads may suffer with some slabs fracturing into irregular slabs and acting independently from the rest of the carriageway.

**d) Sett Paved Carriageways**

In many areas of the UK older roads were originally constructed using setts (cobbles) which have been subsequently overlaid with bituminous materials. The presence of setts can lead to de-lamination and cracking of overlay materials. Care must be taken to ensure that setts are stable.

The following images are showing some example of pavement deterioration and damaging. Further information on crack development and its categories are shown on Appendix F.
Reflective cracking from concrete bays

Reflective cracking from thermal movement

Reflective cracking from expansion joints

Cracking from utility trench

Surfacin
g failure caused by underlying setts

Alligator cracking due to structural failure

**3.3 DETERMINE REQUIRED PERFORMANCE AND LIMITATIONS**

Clearly in addition to the existing conditions the choice of solution will be influenced by practical and future limitations, performance requirements and expectations. The following points should be considered:

- The required life of the solution e.g. as specified in MCHW Clause 936.
- Minimum required asphalt thickness in the first layer above the product (ask the manufacture for specific advice and specific product)
- The presumed life of any alternative solution e.g. plane & overlay with no asphalt interlayer
- Any practical limitations on overlay thickness (e.g. ironwork, kerb lines, drainage etc)
- If installation is to take place on a planed surface, the proposed coarseness of the milled or planed surface will be required as this may influence choice of solution (check the accepted surface roughness).
• Details of any other planned works which will impinge on or compromise the chosen solution.
• Details of any likely changes in traffic characteristics with time.
• Any limitations on carriageway possessions in terms of time or space.
• Installation in an environment with high pH-value
• How will the Interlayer be removed at the end of its working life and what are the recycling characteristics of the system?

4. DESIGN

There are a range of different design procedures outlined in the work of the European research group (COST ACTION 348) on Reinforcement of Pavements with Asphalt Interlayers. www.cost.eu/COST_Actions/tud/348.


Designers and clients are encouraged to collect long-term field data in a uniform way and in sufficient detail such that it can be utilised for the validation of future (analytical) design tools and system performance, including control sections (without interlayers) to permit direct comparison with the performance on treated sections is also recommended.

Further information is included on Appendix H.

5. INSTALLATION

Asphalt Interlayer installers shall be registered to National Highway Sector Scheme 13 (NHSS13) and should be members of the RSTA Geosynthetics and Steel Meshes Sector. Where bond coats are required the binder distributor driver shall have a Level 2 NVQ in Geosynthetics & Steel Mesh application with an endorsement for Bond Coat application.

The specialist sub-contractor shall use good quality, well maintained, purpose-made installation equipment (refer to Appendix E). The client should ensure that the chosen contractor is suitably experienced to install the specified Asphalt Interlayer.

5.1 PLANNING THE EXECUTION OF THE WORK

To ensure a successful outcome it is advisable the installation contractor shall have early contractor involvement in the planning stage. Installation of the Asphalt Interlayer will usually be scheduled to take place immediately prior to the asphalt surfacing.

The Interlayer shall not be left exposed for extended periods for the following reasons;
• avoid damage by construction traffic
• avoid exposure to inclement weather

The time allowed for installation will depend on the programme and site constraints.
5.2 SITE PREPARATION

The preparation required will vary according to the type of Asphalt Interlayer to be installed. Paving fabrics and paving composite grids, are installed onto a bond coat sprayed onto an existing clean bituminous or concrete surface. Where a bituminous surfacing has been laid it must have cooled to ambient temperature before installation of the interlayer. Refer to the installer for advice on acceptable surface temperature prior to installation.

Where Installation of the interlayer is on a milled surface it is recommended it is finely milled with +/-5mm striations. This can be achieved by slowing down the speed of the planing machine i.e. 10 metres per minute. Some products should be laid directly onto existing roads or on a newly laid bituminous surface.

The receiving surface must be clean, dust free, relatively dry and must be free from standing water and exhibit sufficient bearing capacity. All potholes must be repaired and any cracks greater than 5mm wide must be sealed. Self-adhesive paving grids should only be laid on smooth, even surfaces and generally should be installed onto a regulating layer, existing
surface or new asphalt layer. Self-adhesive paving grids will also require the application of bond coat either prior or post installation and the receiving surface must be thoroughly dry.

Woven steel meshes can be fixed by nailing/screw, slurry surfacing or blinding with asphalt. It is recommended that the individual manufacturer is contacted for project specific advice.

5.3 INSTALLATION OF GEOSYNTHETICS

**Bond Coat**

Where required the application of the bond coat is an integral part of the installation process and needs to be properly controlled to ensure a successful outcome.

- The bond coat holds the Asphalt Interlayer in position during the asphalt paving process.
- The bond coat forms a seal between the underlying surface and the overlying asphalt. Where a backing fabric is present, the heat and compaction of the overlying asphalt will soften the bond coat causing it to thoroughly impregnate the fabric.
- It is essential that the correct type of bond coat and the correct rate of spread are specified and that the installer strictly adheres to these specifications.
- The use of hot straight run bitumen (typically 160/220 pen) is recommended by a number of manufacturers because an immediate and effective fixing is achieved and therefore paving over the Asphalt Interlayer may take place immediately reducing time on site. Minimum installation air temperature should be 0°C and rising.
- Bitumen emulsions (typically minimum 65% binder content) are also employed, although consideration needs to be given to the break (curing) time required. Paving over the geosynthetic must not occur until the emulsion has fully broken (cured). Breaking agents to accelerate the breaking process can be considered. If an emulsion is used the rate of spread must be calculated so that the quantity of residual bitumen (after evaporation of the water) meets the specification. Minimum installation air temperature should be 4°C and rising with humidity ≤70% and road surface temperature ≤ 40°C.

The bond coat may be polymer modified and consideration should be given to the change in properties that may result.

The bond coat must be sprayed by a calibrated binder distributor, tested within the past twelve months for conformity to BS1707. The evenness and overall rate of bond coat distribution should be regularly checked on site by carpet tile testing in accordance BS EN 12272 Part 1. The binder distributor should be of appropriate size that the bond coat can be mechanically sprayed to all except the most inaccessible of areas. Ironwork and other street furniture must be masked for protection from bitumen spray.

The Asphalt Interlayer should be applied by a purpose made applicator capable of laying the fabric under tension without wrinkles or creases and brushing it firmly into the bond coat. Rolling out the interlayer by hand should be avoided except in the smallest or most inaccessible areas. Considerable care should be exercised to avoid creases in the laid fabric but in the event of a crease occurring this should be removed in accordance with the manufacturer's installation instructions. Dependent on the type of Asphalt Interlayer and project limitations either butt jointing or overlapping will be recommended to ensure continuous coverage without gaps and avoid issues that may occur from reduced overlay
thickness. Where overlaps are recommended, longitudinal overlaps should be a minimum of 50mm and transverse overlaps should be a minimum of 100mm. It is essential that the requisite rate of spread of bond coat has been fully applied under the overlapping material.

At the end of a run the interlayer is cut with a suitable implement (e.g. sharp knife or shears) and can similarly be cut around ironwork and removed.

The bond condition between the bond coat and interlayer shall be tested and recorded to ensure adequate bond is achieved. A suitable test procedure is illustrated in Appendix C.

 Trafficking of the Asphalt Interlayer should normally be restricted to the paving machine and delivery vehicles only. Drivers of delivery vehicles should take care to avoid braking sharply and turning on the geosynthetic. Steel drum rollers should not run over the Asphalt Interlayer.

**Chipping application on SAMI**

1. The application of 10mm chippings keeps the paving traffic away from the highly adhesive binder layer and provides an excellent key into the overlay.

2. As soon as possible after spraying the Polymer Modified Binder use a mechanical spreader to apply 7kg/m² of 10mm aggregate so that 50% of the binder should be visible. It is not necessary to roll the applied aggregate into the binder.

3. Do not turn the steering wheel when the spreader stands still.

4. It may be necessary to spray anti-adhesive agent to the spreader tyres to avoid sticking.

**5.4 STEEL WOVEN MESH INSTALLATION**

The steel mesh shall be unrolled with the outside of the roll facing upwards to keep the concave curvature downwards. Various devices may be used to facilitate the deployment operation, such as a truck or a loader. The steel mesh should be unrolled in close proximity to the final position then if necessary be moved into the correct position by hand. Laps should be 150mm transversely and 300mm longitudinally and tied with wire. A staggered installation should be adopted to prevent overlaps of 3-4 meshes in one point.

Once the rolls are in their final position, the mesh is rolled a minimum of two passes using a pneumatic tyred roller. The roller must cover the entire width of the roll ensuring that the steel mesh conforms to the prepared road surface. Cutting the edge wire may facilitate the flattening of the steel mesh.

The steel mesh should be stretched to remove any curvature before being fixed: the mesh is initially secured at one end with anchors or heavy equipment e.g. roller compactor which can be used to maintain the mesh in position. The mesh is stretched with a hooked bar attached to a small truck or a loader. After being stretched, the mesh shall be anchored: the first 4m of each mesh roll should be securely fastened. Except for the installation with a slurry seal, the paver must not be allowed to ‘push’ the asphalt delivery truck on the mesh. The delivery truck must either unload into the paving machine and then move away, or, must drive under its own power, just ahead of the paving machine. Care must be taken by drivers of all vehicles on the mesh not to make aggressive turns, stops or starts that could disturb the steel mesh.
The minimum thickness of the compacted asphalt mixture on top of the installed mesh is 50mm. Care should be taken to ensure that the mesh does not lift-up under the paver.

The mesh is then secured with nails, slurry seal or asphalt blinding or as appropriate:

a) **Nailing**
Nail the entire panel with a nailing density of 1 nail per square meter including overlap, nailing the single wire strands, rather than the twisted sections. Nails with PVC sleeve should be used on new asphalt.

b) **Screw fixing**
Anchor the entire panel with a fixing density of 1 screw every 2 m\(^2\) including overlaps. Additional fixing may be required at locations where construction traffic moves onto and off the woven steel mesh and/or to flatten any isolated sections of mesh which still have curvature or undulations in them.

c) **Slurry Seal**
The Steel Mesh is fixed to the pavement by a slurry seal at a rate of at least 17 kg/m\(^2\). An amount of 20-22 kg/m\(^2\) is recommended for rough surfaces. Slurry seal must be a modified bitumen emulsion; when a minimum 17 kg/m\(^2\) is applied the pattern of the mesh is visible through the slurry seal. After hardening of the slurry, traffic is allowed over the mesh at a reduced speed. The slurry seal should not be applied when the ambient temperature is < 5°C or > 30°C or on wet roads and during rain.

d) **Blinding**
Lay 10-20mm hot asphalt mix (same asphalt mixture as that used in the pavement) onto the steel mesh in both wheel paths in front of the paver. This is made easier if the truck is equipped with trapdoors in the tailgate. Care should be taken to ensure that the blinding is continuous; breaks in the blinding strips will cause the mesh to lift up under the paver. Compact the blinding layer in the wheel tracks with a roller or rubber tyred vehicle.

**5.5 MAINTENANCE**

The performance of geosynthetic and woven steel mesh reinforcement interlayers can be compromised by the undertaking of repair and maintenance to utility services located within the carriageway if suitable reinstatement of the geosynthetic or woven steel mesh reinforcement interlayer is not undertaken following the works. A suitable method for undertaking repair and maintenance to utility services and effective reinstatement of the geosynthetic or steel mesh reinforcement interlayer is given in Appendix I.

**6. OVERLAY APPLICATION**

Asphalt is laid over the Asphalt Interlayer in the normal way subject to the points referred to above.

It is essential that the designed minimum compacted overlay thickness is achieved as insufficient thickness is the principle cause of post installation issues and premature cracking. Each Asphalt Interlayers will have a required minimum compacted thickness of overlay; manufacturer’s recommendations should be sought and strictly adhered to in this respect.
The minimum thickness of overlay must be achieved in a single lift rather than relying on the cumulative thickness of two or more lifts of asphalt. When laying asphalt over steel meshes a tracked paver may be less likely to cause rucking than a wheeled paver.

7. **SAMI (SURFACE DRESSING INSTALLATION)**

Surface dressing is the most widely used surface treatment and for the past 20+ years has been used in combination with a nonwoven interlayer on roads suffering from cracking that would otherwise have had to be resurfaced. Refer to *Guidance on the use of non-woven fabrics in surface dressing* [www.rsta-uk.org/publications.htm](http://www.rsta-uk.org/publications.htm)

8. **TRAINING**

The installer must demonstrate their personnel are technically competent and provide certificates of training. All site operatives and visitors to site must hold an appropriate CSCS card to demonstrate an understanding of Health and Safety. Machine operators must hold CPCS or equivalent certificates to demonstrate a level of competence.

Training requirements are embodied within National Highway Sector Scheme 13 (NHSS13) which stipulates the minimum training and qualification requirements for operatives and supervisors on site. Operatives and supervisors will be required to hold an NVQ for the installation of geosynthetics and steel meshes used in bound pavement layers.

- Operatives must hold NVQ level 2 and RSTA endorsed CSCS cards.
- Supervisors must hold NVQ level 3 cards.

It is a requirement of NHSS13 registration that supervisors attend the RSTA training course on geosynthetics and steel meshes every 5 years and obtain an RSTA Silver certificate as evidence of maintaining competence. It is also recommended that operatives also attend the RSTA training course every 5 years to remain up to date with industry best practice.

The RSTA can assist installers in obtaining NVQ’s and RSTA endorsed CSCS cards for operatives and supervisors in accordance with the requirements of National Highway Sector Scheme 13. It is the Association’s view that a competent qualified workforce makes a fundamental contribution to achieving a high-quality service.

Details of all training courses can be obtained from the RSTA website; [www.rsta-uk.org/our-training](http://www.rsta-uk.org/our-training)

9. **TRAFFIC MANAGEMENT**

Traffic Management will be the responsibility of the Principal Contractor.

10. **HEALTH & SAFETY**

RSTA members involved in manufacturing and installing interlayers take the health and safety of all their operatives and associated personnel extremely seriously. This concern is extended to all personnel in close proximity during the installation operation up to when the interlayer is overlaid.
The product must be installed in accordance with the manufacturers recommendations and the advice given in this Code of Practice.

Under the CDM regulations it will be the duty of the Principal Contractor to prepare a detailed health and safety plan for the installation of the works based on the pre-construction information supplied by the installer, client, designers and CDM-coordinator. This must itemise the methods to be employed to overcome identified hazards and risk reduction measures that will be in force on the contract works. The Principal Contractor must also ensure adequate welfare is provided from the start of the contract. Once the works commence all team members must take responsibility for the control of health, safety and environment matters.

The Principal Contractor has additional duties under other legislation to look after the health and safety not only of his own employees but of other persons who work alongside them and also of the passing public. Written specific risk assessments must be prepared which can be used to identify control measures for both physical and chemical hazards. The control measures must be incorporated in the Contractor’s safe system of work which should enhance the safe behaviour of the workforce as well as protect the general public during the various stages of the works. These measures must be communicated to all involved in the project.

Account must also be taken of environmental factors including pollution from fumes, noise and dust etc. Disposal of waste and protection from spillage and contamination should also be considered.
RSTA Code of Practice for Geosynthetics and Steel Mesh
for Asphalt Reinforcement (Interlayers) 2018

APPENDIX A

GLOSSARY OF TERMS

Adhesion
The property by which a geosynthetic adheres to the surface of the road and or binder.

Binder
A liquid comprised of bitumen, either in its natural condition or modified in some way (see Modified Binder).

Binder Distributor
A tanker fitted with a spray bar through which the binder is applied to the road surface.

Bitumen Emulsion
Liquid product in which a substantial amount of bitumen is suspended in a finely divided condition in an aqueous medium by means of one or more suitable emulsifying agents.

Bitumen/Emulsion – Polymer Modified
A binder in which the original properties of the base binder have been altered by the addition of “modifiers”. The most common of these are polymers. The resulting binders are often referred to as being “polymer modified”.

Bitumen – Penetration Grade
A bitumen which complies with the requirements set out in BS EN 12591. Also often called straight run bitumen or paving grade.

Bitumen – Road
A viscous liquid, or a solid, consisting of hydrocarbons and their derivatives which are soluble in trichloroethylene, is substantially non-volatile and softens gradually when heated. It is black or brown in colour and possesses waterproofing and adhesive properties. It is obtained by refinery processes from crude petroleum.

Bond Coat
An application of bitumen emulsion usually polymer modified onto the planed asphalt surface prior to applying a geosynthetic. It is used to ensure good bond condition between the substrate and the geosynthetic to enhance durability.

BSI
British Standards Institution

Butt Joint
A type of joint where the geosynthetic does not overlap significantly.

CDM
Construction Design and Management Regulations.

C. E. N.
European Standards Organisation.
COSHH
Control of Substances Hazardous to Health.

COSHH Assessment
An assessment relating to the hazards to health arising from use of materials or equipment.

Cost Life Index
The cost expressed as the cost per square metre per annum of satisfactory life.

CSCS
Construction Skills Certification Scheme. CSCS cards are issued to contractors workers who have obtained an NVQ at some level and are often specified as a requirement by highway authorities.

Fatigue
Fatigue cracking in flexible pavements caused by repeated traffic loading and deflections over time.

Flexible Pavement
There are two types of pavements based on design considerations i.e. flexible pavement and rigid pavement. The difference between flexible and rigid pavements is based on the manner in which the loads are distributed to the subgrade. A flexible pavement can be defined as consisting of a mixture of asphaltic or bituminous material and aggregates placed on a bed of compacted granular material of appropriate quality in layers over the subgrade.

FWD
Falling Weight Deflectograph – a technique/equipment used to measure the elastic stiffness/condition of a pavement

Interlayer
A term used to describe a geosynthetic or steel mesh product/system installed at a specified depth in a pavement structure to mitigate against reflective cracking.

Joint
The line or area at which separate panels of installed geosynthetic or steel mesh meet.

Mask
An adhesive tape or other similar material used to cover cat’s eyes, road ironwork, etc, in such a way that, after removal, they are free from binder.

Modulus
A term used to describe the elastic stiffness of a geosynthetic or steel mesh.

NVQ
National Vocational Qualifications

Pre-Patching
The remedial measures carried out to make good defective areas of surfacing in advance of installing the geosynthetic
PMB
Polymer Modified Bitumen

PTR
An abbreviation for pneumatic-tyred roller

PVA
Polymer Vinyl Acetate a type of polymer used to make geosynthetics.

Quality Assurance or QA
Registration to a standard e.g. ISO9001 awarded to a manufacturer or installer by a certification body accredited by UKAS or similar.

Reflective Cracking
Vertical cracking through a pavement structure caused by stresses generated in the pavement foundations resulting from movement that propagate upwards or downwards through the pavement structure.

Sector Scheme
A Quality Assurance Scheme for the installer based on ISO9001 used in highways construction and maintenance.

SAMI
A Stress Absorbing Membrane Interlayer installed at a specific depth in the pavement structure to mitigate vertically induced stresses and reduce the rate of propagation of reflective cracking.

Set
A description of the state of a binder which has cooled to road temperature or, in the case of an emulsion, has ‘broken’.
APPENDIX B

REFERENCE DOCUMENTS

- CD224 (previously HD 24) Traffic assessment
- CD227 (previously HD37 and HD38) Design for Pavement Maintenance

- Volume 1: Specification for Highway Works (MCHW 1)
  www.dft.gov.uk/ha/standards/mchw/vol1/ Clause 936
- Volume 2: Notes for Guidance on the Specification for Highway Works (MCHW 2)
  www.dft.gov.uk/ha/standards/mchw/vol2/


DEPARTMENT OF TRANSPORT. Safety at street works and road works – A Code of Practice. Her Majesty's Stationery Office, Norwich.


Dr JOHN READ & DAVID WHITEOAK Shell Bitumen Handbook, Shell Bitumen UK, Chertsey.

COST ACTION 348 reinforcement of pavements with steel meshes and geosynthetics, symposium, Egham, Surrey, 16th March 2006, www.cost.eu

RSTA Code of Practice for Geosynthetics and Steel Mesh for Asphalt Reinforcement (Interlayers) 2018


BS 434 Part 2, Bitumen Road Emulsions, Part 2 Code of Practice for the use of cationic bitumen emulsions on roads and other paved areas. British Standards Institution, London.

BS 594987, Asphalt for roads and other paved areas. Specification for transport, laying, compaction and type testing protocols. British Standards Institution, London.

EN 15381 Geotextiles & geotextile-related products – Characteristics required for use in pavements & asphalt overlays

EN ISO 10318-1 Geosynthetics – Part 1: Terms & definitions

EN ISO 10319 Geotextiles – Wide-width tensile test

EN ISO 10320 Geotextiles & geotextile-related products – Identification on site

EN ISO 12236 Geosynthetics – Static puncture test (CBR)

EN ISO 13433 Geosynthetics – Dynamic perforation test (cone drop test)

EN 12224 Geotextiles & geotextile-related products – Determination to the resistance of weathering

EN 14030 Geotextiles & geotextile-related products – Screening test method for determining the resistance to acid and alkaline liquids (ISO/TR 12960:1998, modified


ISO 9864:2005 Geosynthetics – Test method for the determination of mass per unit area of geotextiles and geotextile-related products

The latest version of each standard and guidance document should be used.
APPENDIX C

QUALITY CONTROL TESTING FOR BOND CONDITION (ADHESION)

ADHESION TEST PROCEDURE*

The contractor shall test to the satisfaction of the Engineer that adequate adhesion exists between the Asphalt Interlayer and the underlying road surface.

1. This test may be carried out on the Asphalt Interlayer after it is placed or it may be carried out on a minimum one square metre sample cut in a square shape.
2. Place the Asphalt Interlayer on the surface to be overlaid.
3. Apply adequate vertical pressure to fully activate the bond, e.g. by use of an installation machine, roller or other means approved by the manufacturer/Installer.
4. Insert a hook of a spring balance (fish scale) under the centre of the Asphalt Interlayer sample. Pull the spring balance up until the sample just starts to pull loose and record the gauge reading. In the event that adequate force as recommended by the manufacturer is required to pull the sample up from the road surface, sufficient adhesion has taken place and the paving operation may begin.
5. In the event that the sample does not achieve adequate adhesion, stop installation, identify if the bond to activate the adhesion needs to be improved or if there is a cleanliness, or moisture issue present. Resolve these issues prior to installing the remainder of the Asphalt Interlayer and prior to placing asphalt on top of the Asphalt Interlayer.
6. Verify adequate adhesion with this test once every 1,000 m² or as directed by the Engineer.

*not applicable for Woven wire steel mesh

*Leutner Test

The Leutner test method is a laboratory measurement of shear interface properties between asphalt layers. Results are presented and compared for both laboratory prepared specimens and field cores. The standard Leutner test was modified by the introduction of a 5 mm gap into the shear plane to reduce edge damage caused by misalignment of the specimen and specimens that incorporate a thin surfacing material were extended using a 30 mm thick grooved metal cylinder to eliminate dependence of the shear strength on surfacing thickness. The laboratory produced surfacing/binder course combinations incorporating the 20 mm Dense Bitumen Macadam (20 DBM) binder course showed the highest average shear strengths when nothing was applied at the interface and the lowest average shear strengths when the tack coat was applied at the interface. The average shear strength from field cores
was found to increase as the class of the road increases for both surfacing/binder course interfaces and binder course/base interfaces.

**APPENDIX D – CASE STUDY TEMPLATE**

Case study data requirements for inclusion in the RSTA Geosynthetics and Steel Mesh data base.

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Location data (Use HE referencing system on the HE network)</td>
</tr>
<tr>
<td></td>
<td>Road name/number:</td>
</tr>
<tr>
<td></td>
<td>Road class (non-HE network):</td>
</tr>
<tr>
<td></td>
<td>Section reference:</td>
</tr>
<tr>
<td></td>
<td>Direction:</td>
</tr>
<tr>
<td></td>
<td>Lane:</td>
</tr>
<tr>
<td></td>
<td>Chainage: Start Finish</td>
</tr>
<tr>
<td></td>
<td>Marker post: Start Finish</td>
</tr>
<tr>
<td>Pavement structure</td>
<td>• Layer thicknesses from core logs/trial pit</td>
</tr>
<tr>
<td></td>
<td>• Bituminous material types and age</td>
</tr>
<tr>
<td>Traffic conditions</td>
<td>Design value for the geosynthetic/steel mesh solution.</td>
</tr>
<tr>
<td>Visual survey record</td>
<td>• Crack pattern especially whether transverse or longitudinal</td>
</tr>
<tr>
<td></td>
<td>• Crack spacing</td>
</tr>
<tr>
<td></td>
<td>• Any other relevant defects (such as asphalt quality/condition)</td>
</tr>
<tr>
<td>Core logs/trial pit records</td>
<td>• Crack depth</td>
</tr>
<tr>
<td></td>
<td>• Bound layer condition</td>
</tr>
</tbody>
</table>

**Product and application**

Details of the product used and its application. This will include
- interlayer depth,
- bond/tack coat rates/nailing details/slurry application
- any other relevant information relating to installation

**Performance**

Evidence to illustrate performance, such as a comparison of
- crack development vs ‘control’ sections,
- reduced incidence of unplanned/planned maintenance vs adjacent sections NOT treated with geosynthetics and steel meshes.
- comparison of design predictions vs actual performance (e.g. no more than 10% recurrent cracking within 5 years)
APPENDIX E

INSTALLATION PHOTOGRAPHS

Filling excessive voids after planing the surface

Purpose built Applicator for installing an Asphalt Interlayer
Installing a Paving Composite Grid onto Bond Coat

Installing a Paving Grid
Protective layer of chippings applied onto a Polymer Modified Binder (PMB) sprayed onto an Asphalt Interlayer

Installation of a Paving Composite Grid
Steel Mesh Installation on a rigid pavement

Steel Mesh Installation on a flexible pavement with nail or screw fixing
APPENDIX F

CRACK DEVELOPMENT

Bituminous bound layers crack in-situ because of their inability to withstand strain, shear and tensile stresses created by several factors resulting in one or more of the following outcomes:

- Reflective cracking
- Fatigue cracking
- Differential settlement (often prevalent in road widening schemes or soft subgrade)
- Thermal cracking

The asphalt pavement is subjected to different types of loads and stresses:

- Vertical forces from the wheel loads of vehicles
- Horizontal forces mainly from braking and acceleration
- Expansion and contraction of materials due to temperature changes
- Expansion due to the water freezing
- Differential settlement of the foundation
- Swelling and shrinkage of the foundation as a result of changes in the moisture content

These forces and stresses, deformations and displacements lead to different mechanisms of cracking and rutting.

The effectiveness and performance of Asphalt Interlayer systems is highly dependent on site specific circumstances. The majority of UK pavements have evolved over time and were not originally designed to withstand the weight and increasing traffic volume of commercial vehicles. It has taken many years of careful monitoring to establish the performance of these systems after accounting for the many variables that can influence pavement deterioration and this work continues.

To obtain the best performance it is necessary to consider a range of variables and based on these carefully select the correct interlayer system. Research over the years has addressed and isolated these variables, either through laboratory or site trials and this work has been supplemented via extensive practical experience gained from many thousands of successful
installations.

Reflective cracking generally results mainly from one of three types of pavement movement, bending, shear or thermal.

**Bending:** this mode of failure is relatively common and is well understood. It has been simply recreated via several laboratory models to test a range of materials.

**Shear:** this is generally accepted to be the most difficult mode of failure to accommodate and if significant vertical shear movements (> several mm) are present then Asphalt Interlayers are unlikely to prevent reflective cracking for any length of time. It is generally recommended that other remedial works are undertaken in order to remove/reduce the shear movements prior to treatment with Asphalt Interlayers. This is also a very difficult mode of failure to model successfully in the laboratory although some modelling has been undertaken.

**Thermal:** this is a failure mechanism that can be treated successfully with a range of solutions although as movements can be cyclic, consideration should be given to the type asphalt interlayer employed. Thermal, in-line, movement is relatively simple to model in the laboratory as indicated below.
APPENDIX G

PRODUCT SELECTION FLOW CHART

The charts and table below are included to assist with selecting the most appropriate product. May be of assistance with design input parameters or generally could be used in the process of system selection.

The chart below, could be a useful inspection sheet to use for assessing existing pavement condition and a possible maintenance strategy.
The chart and table below, could further support on the selection of the product/application. Please for further advice do not hesitate to contact the relevant manufacturer.

<table>
<thead>
<tr>
<th>REFLECTIVE CRACKING</th>
<th>FROST DAMAGE DUE TO WATER INGRESS</th>
<th>INCREASE OF SYSTEM STIFFNESS AND STRUCTURAL IMPROVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smaller cracks 0-3mm</td>
<td>+ +</td>
<td>+</td>
</tr>
<tr>
<td>Medium cracks 3-5mm</td>
<td>+</td>
<td>+**</td>
</tr>
<tr>
<td>Wide cracks &gt;5mm</td>
<td>++</td>
<td>+**</td>
</tr>
<tr>
<td>Loss of bearing capacity due to water ingress</td>
<td><em>+</em></td>
<td>+**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reinforcement</th>
<th>Stress Relief Interlayer Barrier</th>
<th>Reinforcement Stress Relief Interlayer Barrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>++</td>
<td>+</td>
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<td>+**</td>
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<td>+**</td>
</tr>
</tbody>
</table>

* Only increase of structural improvement due to mitigation of reflective cracking through stress relief
* Stress relief function allows horizontal displacement of underlying layer
** Intact drainage required
*** Interlayer needs to be applied in tension zone of the bound structure
APPENDIX H

DESIGN INPUT SHEET

As described in section 4 of this document, due to the large number of Asphalt Interlayers available in the market, with their individual properties, there is not a universally agreed design method available to the industry at this moment in time.

However, a small number of manufacturers and associated designers have developed bespoke design packages which are available on request. For assistance in this regard please consult with RSTA member organisations.

European research group for asphalt reinforcement (COST 348) has identified several calculation methods for asphalt reinforcement in 2006:

• ARCDES. Method developed by Ooms-Strukton. This method is only valid for Glass-grids and only for horizontal thermal movements.
• BITUFORE Method developed by Bekart; This method can be used to calculate several mechanisms.
• REFLEX. Method developed by VTI Sweden. This method is only valid for grids in steel. It is unknown which mechanisms are considered.
• THERMCR. Method developed by the University of Nottingham. This method is valid for several products and only horizontal temperature movements;
• OLCRACK. Method developed by the University of Nottingham. The method is appropriate for several products. The input consists of mechanical parameters of asphalt reinforcement products, which can be determined in fact for all products.

All of the above methods have the disadvantage that they do not cover all the relevant damage mechanisms, and partially, that they are product specific and cannot be used in general. The programs THERMCR and OLCRACK seem to have the widest range. The OLCRACK theory has been validated by researches and universities. OLCRACK has been used to design roads in the last 15-20 years within UK and worldwide. The performance of the road nowadays is another practice proof for the validity of the software and its design approach.

The application of Finite Element Method (FEM) programs, such as Abaqus, Plaxis or CAPA, is another opportunity to design reinforced asphalt interlayer systems. With these programs, the project specific situation (geometry, loads and material properties) are modelled. In particular, the characterization and numerical modelling of the interaction between the reinforcement and the surrounding asphalt is taking a big challenge. In addition, calculating with these types of programs has the disadvantage that it is time-consuming (one to a few weeks for person), and therefore is costly to build up the element mesh.

In an interlayer system, the properties of each element must be adapted to the specific objective of the measure to archive 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 should take these variations into account. Currently ISO committee TC221 WG6/PG10 are producing design guidance for using geosynthetics in asphalt overlays.
APPENDIX I

MAINTENANCE

Repair or maintenance of underground services below a road reinforced with geosynthetic or steel mesh interlayers can be undertaken as follows:

a. Establish the required width (A-A) for the excavation needed to gain access to the services.
   - Make 2 saw cuts, with abrasive wheel or saw, at points A through both the pavement materials and the reinforcing interlayer.
   - Make two further saw cuts at points B which should be at least 300mm either side of points A. These saw cuts should stop just above the reinforcing interlayer, the depth of which will have been recorded on As Built drawings following its' initial installation.

b. The asphalt layer should be removed over the area B-B. Access to the services can then be made in area A-A.

c. Once repair or maintenance to the services is completed, the working area should be refilled and adequately compacted up to the level of the existing geosynthetic or steel mesh reinforcing interlayer.

d. A replacement section of matching geosynthetic or steel mesh reinforcing interlayer should then be applied in area B-B ensuring that a minimum 300 mm overlap on top of the existing reinforcing interlayer is achieved in all directions, on all sides of the utility cut.

e. Re-surfacing above the reinforcing interlayer can then be carried out.
APPENDIX J

FEEDBACK ON THIS DOCUMENT

Any observations, feedback or complaints relating to the content of this document or the process described herein should be addressed (using the form below) to:

Chief Executive
The Road Surface Treatments Association Ltd
Technology Centre, Science Park
Glaisher Drive, Wolverhampton WV10 9RU

Email: enquiries@rsta-uk.org
Tel: 01902 824325

Issue Identified:

Suggested Action:

Name:

Organization:

Address:

Contact details:

Date:

Issue 2 October 2018

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APPENDIX K – Clause 936

936 Geosynthetics and Steel Meshe: installation and end product performance
1 Systems that are intended to suppress reflection cracking in asphalt surfacing by use of a proprietary interlayer shall have Product Acceptance Scheme certification in compliance with clause 104.16 to demonstrate their performance. Systems without Product Acceptance Scheme certification in compliance with clause 104.16 shall not be used without prior approval by the Overseeing Organisation.

2 The contractor shall be responsible for the installation of geosynthetic or steel mesh systems, observing any site or process constraints presented by the site and traffic data specified in Appendix 7/1.

3 The contractor shall:

- Work in accordance with the design provided to achieve the performance requirements in terms of control of reflection cracking as set out in this Clause and in Appendix 7/1.
- Be registered to National Highway Sector Scheme 13 (NHSS13) for The Supply and Application of Surface Treatments to Road Surfaces and certified to ISO 9001. In particular contractors must be fully compliant with the Training and Qualification requirements in Appendix C of NHSS13.
- Ensure that the geosynthetic or steel mesh has initial bond such that it is capable of withstanding construction traffic, and remains fully adhered to the substrate and the asphalt overlay with no separation.

Materials and Equipment
Geosynthetic and steel mesh
4 The geosynthetic or steel mesh shall be manufactured to the requirements of BS EN 15381 and the contractor shall only use products with a CE mark and Declaration of Performance.

5 The installation of the geosynthetic or steel mesh must be carried out by a purpose built mechanical applicator where it is possible to do so. Hand-laying may be required in locations such as tight radius bends and on small restricted sites.

Bond coats
6 Systems requiring hot bitumen bond coats for installation shall use paving grade bitumen produced in accordance with BS EN 12591 or use hot modified bitumen in accordance with BS EN 14023.

7 Bitumen emulsion bond coats produced in accordance with BS EN 13808 may be used as an alternative to using hot bitumen.

8 Bond coats shall be installed in accordance with the following criteria:

- A bond coat shall be applied directly beneath the geosynthetic in accordance with the minimum application rates given in BS 594987. Higher application rates may be specified on a product specific basis.
Note: in some cases this bond coat may be part of a composite system including a geosynthetic.

- The bond coat must be sprayed through a calibrated spray bar at the agreed rate appropriate to the specific project. The calibrated spray bar must be in good working order and shall be certified showing that it has been tested within the last twelve months to conform to BS 1707:1989 Hot Binder Distributors for Road Surface Dressing.
- The rate and accuracy of the distribution of the bond coat shall be checked at the commencement of the work by means of a carpet tile test carried out in accordance with BS EN12272-1:2002 and shall meet the requirements for Class 2. This test shall be repeated for each binder distributor used during the course of the work.
- Where bitumen emulsions are used, evidence must be provided by the contractor that the emulsion will “break” within the time limits likely to be encountered during normal maintenance working windows.
- Systems requiring slurry surfacing bond coats for installation shall use a slurry surfacing system complying with the requirements in BS EN12273.

9 Systems requiring a levelling or regulating course shall be laid in accordance with the requirements of Clause 907.

10 As a minimum, the contractor must implement the quality plan given in NHSS13 on site.

Surface Preparation

11 The surface to receive the geosynthetic or steel mesh must be free of surface defects in accordance with the contractor’s quality plan.

12 Before binder is applied, ironwork shall be masked. Any planings or asphalt deposits on the surface shall be removed and the receiving surface shall be swept free of all loose material.

Application

13 Installation shall be carried out by a company that is accredited to ISO9001 and approved for this work by the manufacturer of the geosynthetic, using appropriate mechanical equipment that is designed specifically to lay the material under tension. Installation must be planned and carried out such that there is continuity of works and other surfacing operations are not impeded.

14 The contractor’s quality plan will determine the weather conditions under which the geosynthetic or steel mesh can be installed. Transverse and longitudinal overlaps will be in accordance with the contractor’s quality plan. The installer shall measure and record the bond condition as stipulated in the quality plan and refer to the RSTA ADEPT Code of Practice for Geosynthetics and Steel Meshes.

15 A geosynthetic or steel mesh interlayer should be placed sufficiently deep within the bound layers so that it is not removed when the TSCS is replaced. If a TSCS is to be placed directly on a geosynthetic, approval by the Overseeing Authority (a Departure from Standard) will be needed.

Aftercare
16 Masking shall be removed after the geosynthetic or steel mesh has been installed and before the surfacing operation commences. The geosynthetic or steel mesh must be overlaid in the same shift, or as soon as is practically possible.

17 The geosynthetic or steel mesh installer shall undertake remedial action where necessary, which may include nailing, patching, cutting or dusting if there are signs of distress, such as separation, turning damage, bleeding or pickup of the geosynthetic or steel mesh in order to prevent further damage to the System.

As built manual
18 Not more than 30 days after completion of the work the Contractor shall provide a record of the progress of the work in the form of an ‘as built’ manual incorporating all relevant information, including:

- The product name
- All test results
- Variations to the design proposal and those necessitated by local conditions (which need to be agreed prior to installation)
- A record of installation control carried out
- Weather information
- Unforeseen problems encountered
- A list of complaints, if any, from the general public or road users
- Any other information that the Overseeing Organisation may reasonably require to be included, as previously agreed.

Records are to be sent to HE using the PavementInnovationsDevelopment@highwaysengland.co.uk email address.

Defects
19 The surface course shall not have more than 10% of the reflection cracking that was present before the installation of the geosynthetic or steel mesh, for a minimum period of 5 years. The amount of cracking shall be expressed as a length per 100m for each 100m length. The length of cracking before treatment shall be taken from the visual survey produced as part of the pavement investigation used for scheme identification.

20 Replacement of the surfacing or other remedial measures agreed with the Overseeing Organisation shall be carried out if reflection cracking appears within the first 5 years.

21 For the period of the guarantee, the geosynthetic or steel mesh shall meet the performance requirements stated in this Clause and contract specific Appendix 7/1.

22 The guarantee shall exclude defects arising from accidental damage or damage caused by settlement or subsidence on which the surfacing material has been laid.

23 The reappearance of reflection cracking shall be confirmed by comparing locations of cracking with visual survey records carried out as part of the investigation prior to maintenance treatment design and coring through the cracks. This will identify whether cracking in the ‘new’ surface appears over existing cracks lower in the pavement structure. Note that reflection cracking may be ‘top-down’ or ‘bottom-up’.