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TII Publications

GE PE DN CC OP AM RE

Design of Bituminous Mixtures, Surface Treatments, and Miscellaneous Products and Processes

DN-PAV-03074
June 2017

DN Design

Standards

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TII Publications

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Contents

Updates to TII Publications resulting in changes to

Design of Bituminous Mixtures, Surface Treatments, and Miscellaneous Products and Processes DN-PAV-03074

Date: June 2017

Amendment Details:

A new Chapter 4 has been added to the document for determining the design of recipe surface dressing, and the requirements and performance of surface dressing product (end performance). This document is re-issued as Interim Technical Advice for an initial period to allow for feedback following its use for the design of surface dressing on the initial sites.

Date: September 2017

Amendment Details:

The following minor amendments have been incorporated into the June 2017 version of this Standard:

a) The abbreviation for Traffic Speed and High Road temperature in Table 4.4 on page 41 have been corrected.

b) Incorrect document reference in Section 2.3.6 corrected.

Contents Table

1. Introduction

This Standard sets out requirements and advice for the design of road pavements using products detailed in the Construction and Commissioning (CC) Activity of TII Publications (Standards).

1.1 Implementation

This Standard shall be used forthwith on all schemes on national roads, except where the scheme has received, prior to publication of this Standard, its statutory approvals to allow it to proceed.

1.2 Documentation

The preparation of Contact documents for the products contained within the Specification for Road Works Series 900 - Road Pavements - Bituminous Materials (CC-SPW-00900) requires the use of a series of linked documents contained within TII Publications (Standards).

The Designer should utilise the documentation to complete the following stages:

i. Select suitable product type(s) to be installed in the Works;

a) Refer to GE-PAV-01006 - Use of Volume 7 for general information on pavement design and maintenance.

b) Refer to DN-PAV-03024 for general information regarding bituminous mixtures, surface treatments, and miscellaneous products and processes.

ii. Design the product to be installed in the Works;

a) Refer to this document DN-PAV-03074 for design requirements of bituminous mixtures, surface treatments, and miscellaneous products and processes.

iii. Refer to the Specification for Works and Notes for Guidance on the Specification for Works Series 000 - Introduction (CC-SPW-00010 and CC-GSW-00010) for general requirements pertaining to construction products, Declaration of Performance and CE marking of products.

iv. Detail the approval process if product not covered by a harmonised European Standard;

a) Refer to DN-PAV-03075 for requirements for approval of specific products.

v. Prepare Contract Specification and Specification Appendix/Appendices relevant to the Contract;

a) Refer to CC-SPW-00900 - Specification for Works Series 900 for requirements pertaining to the products and installation of the Works.

b) Refer to CC-SPW-00700 - Specification for Works Series 700 for general requirements for pavements.

c) Refer to CC-GSW-00700 - Notes for Guidance on the Specification for Works Series 700 for sample Specification Appendices.

d) Refer to CC-GSW-00900 - Notes for Guidance on the Specification for Works Series 900 for guidance on the specification of products.

Table 1.1 provides a summary of the documentation to be used for the design and specification for each of the product types within CC-SPW-00900.

Table 1.1 –TII Publications (Standards) documentation to be used for design and specification (by product type)

	Product								
TII Publication Number	**Bituminous Mixtures**	**Microsurfacing**	**Surface Dressing**	**HFS**	**LEBM**	**Retexturing**	**Geotextiles and Geotextile-related products**	**PRMS / LSRS**	**ERMS**
GE-PAV-01006	Yes - General								
DN-PAV-03024	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DN-PAV-03074	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DN-PAV-03075	No	No	No	Yes	Yes	Yes	No	Yes	No
CC-SPW-00010	Yes - General								
CC-SPW-00700	Yes - General								
CC-SPW-00900	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CC-GSW-00010	Yes - General								
CC-GSW-00700	Yes - General								
CC-GSW-00900	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Notes:									
HFS: High Friction Surfacing LEBM: Low Energy Bound Mixtures PRMS: Permanent Repair Material Systems LSRS: Localised Surface Repair Systems ERMS: Emergency Repair Material Systems									

2. Bituminous Mixtures

2.1 Introduction

The design of road pavements, incorporating bituminous mixtures, shall use this Chapter of DN-PAV-03074 for reference during the design process.

While certain products covered by harmonised European Standards (hEN's) are included, this Standard shall not supersede the requirements of those hEN's.

2.2 Process Flowcharts

Figures 2.1 and 2.2 contain flowcharts for specifying bituminous mixtures. The flowcharts provide a sample process for pavement design, using bituminous mixtures, where:

i. New pavements are to be constructed or existing pavements are to be fully reconstructed; and

ii. Existing pavements are to be overlaid, partially overlaid/inlaid, or inlaid.

The flowchart makes reference to various documents contained within TII Publications (Standards) that should be used to assist in determining the requirements of the bituminous mixtures.

The information that is required in the flowchart is the minimum that shall be included; other items may be included by the Purchaser depending on site-specific requirements. The information is normative; the layout is informative.

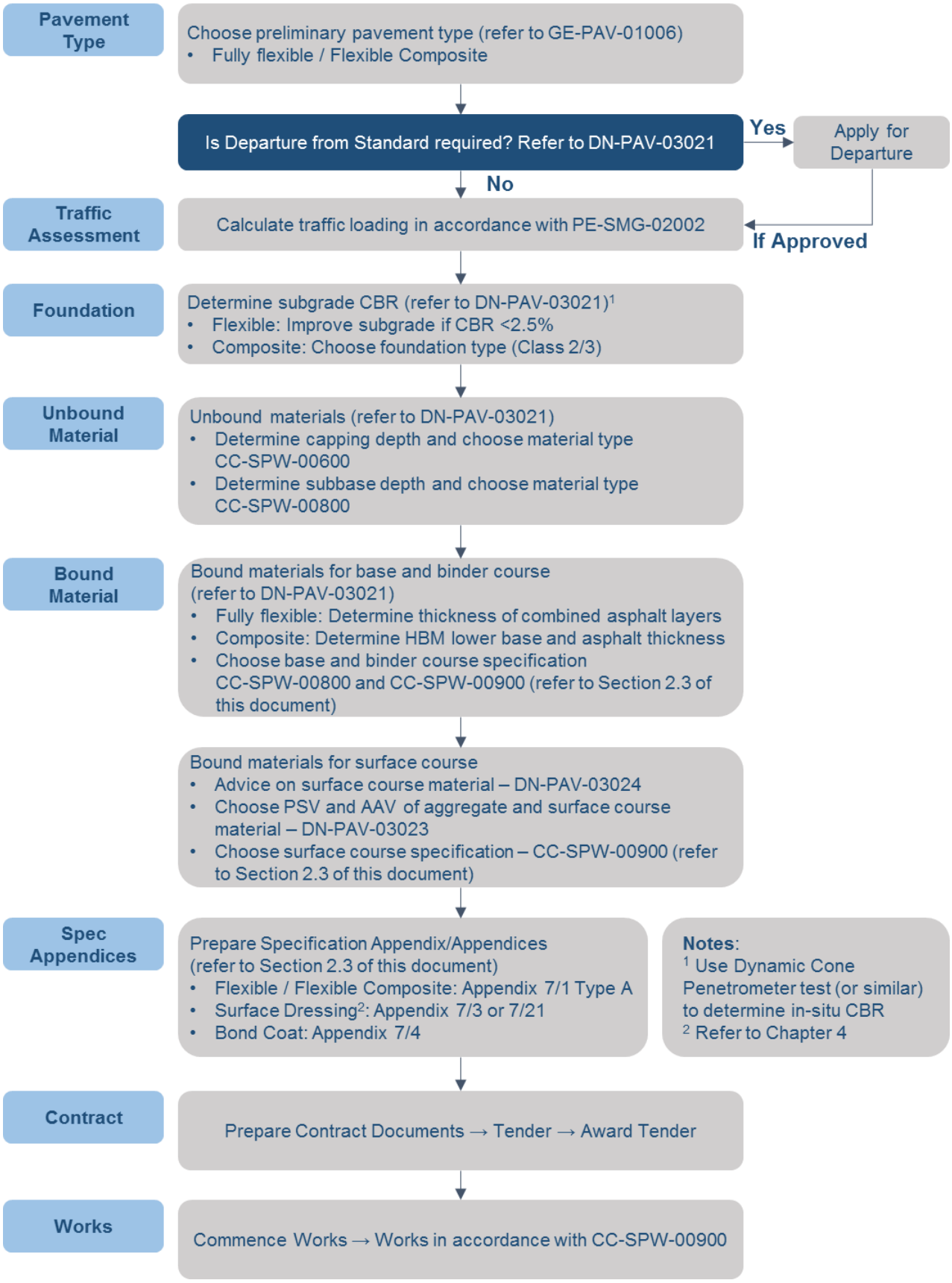


Figure 2.1 – Process Flowchart for Fully Flexible Pavement – New pavement/full reconstruction of existing pavement

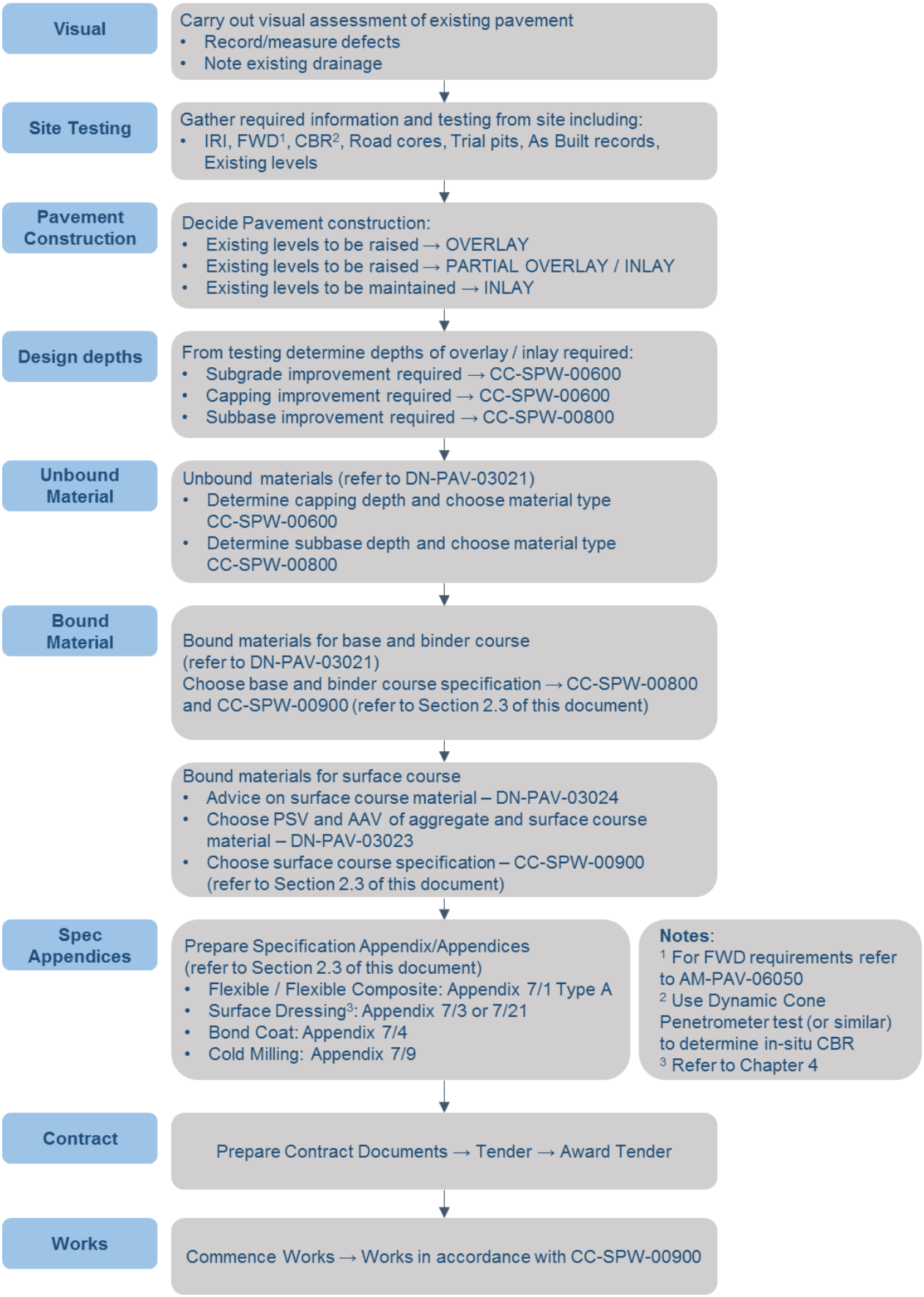


Figure 2.2 – Process Flowchart for Fully Flexible Pavement – Existing Pavement to be overlaid, partial overlaid/inlaid, or inlaid

2.3 Choice of Material Specification Requirements

The requirements for bituminous mixtures shall be in accordance with CC-SPW-00900. The choices available to the Designer in compiling Appendix 7/1 are explained below. A sample Specification Appendix 7/1 is provided in CC-GSW-00700.

Pavement design methods developed by the Designer may give the Contractor a choice of construction materials. The extent of this choice should be stated in Appendix 7/1. The materials shall be identified by reference to CC-SPW-00900 Clause numbers and mixture designations. Bituminous mixture specifications and mixture designations are given in CC-SPW-00900 and the relevant parts of IS EN 13108. For further advice on choice of bituminous surface courses, refer to DN-PAV-03024.

2.3.1 Combined Thickness

The thickness of combined asphalt layers shall be determined in accordance with DN-PAV-03021 Figure 4.2 (for fully flexible pavement) and Figure 5.3 (for flexible composite pavement).

The design thickness of the combined asphalt layers is dependent on the binder grade. Refer to Sub-section 2.3.2 below.

2.3.2 Binder

The binder grade to be used is chosen as a function of the thickness of combined asphalt layers. Greater combined thicknesses are required for binder and base layers if a softer binder is proposed. DN-PAV-03021 provides options for Asphalt Concrete using grade 70/100 bitumen (less stiff material requiring thicker construction) and Asphalt Concrete utilising grade 40/60 bitumen (stiffer material requiring a reduced pavement thickness to provide the same structural equivalence).

The numerically higher grades are softer; hence a 160/220 paving grade is considered more workable than 40/60 paving grade and is therefore more suitable for hand lay work. The use of 160/220 paving grade binder shall only be permitted for accommodation works.

Once the thickness of the combined asphalt layers has been determined, the Designer may choose to use ‘polymer modified bitumen’ in place of ‘paving grade bitumen’ in accordance with the options available in CC-SPW-00900 Tables 2, 5, 8 and 11. This shall not affect the thickness of the combined asphalt layers.

A Polymer Modified Binder (PMB) may provide a number of benefits compared with a paving grade binder depending on the course in which the PMB is used. In a surface course, the increased viscosity of a PMB allows a thicker binder film to be obtained in more open mixtures which can aid the durability, longevity, and prevent binder drainage of the mixture due to reduced hardening or ageing in service.

2.3.3 Mixtures

Bituminous mixtures shall be chosen from the following list:

i) Asphalt Concrete (AC)
ii) Hot Rolled Asphalt (HRA)
iii) Stone Mastic Asphalt (SMA)
iv) Porous Asphalt (PA)

CC-SPW-00900 Tables 2, 5, 8 and 11 define what bituminous mixtures are appropriate for base, binder and surface courses.

2.3.4 Layer Thickness

The Designer shall choose layer thicknesses for each pavement course required. The layer thicknesses shall comply with the nominal thickness requirements of CC-SPW-00900 Tables 3, 6, 9 and 12.

Base and binder course should be laid in thicker lifts to minimise the number of layers and, hence, interfaces.

Sample pavement build-ups, based on a range of combined asphalt thicknesses, are provided in Table 2.1 below.

Table 2.1 – Sample pavement build-ups for fully flexible pavements

Combined Asphalt Layer Thickness required (mm)	Layer	Sample Pavement Build-up		
		Option 1	Option 2	Option 3
250	Surface	45mm HRA 35/14	40mm SMA 14	30mm SMA 10
	Binder	85mm AC 20	80mm AC 20	60mm AC 20
	Upper Base	-	-	60mm AC 20
	Base / Lower Base	120mm AC 32	130mm AC 32	100mm AC 32
180	Surface	45mm HRA 35/14	35mm SMA 14	25mm SMA 10
	Binder	55mm AC 20	65mm AC 20	55mm AC 20
	Base	80mm AC 32	80mm AC 32	100mm AC 32
100	Surface	40mm HRA 30/14	40mm SMA 14	25mm SMA 10
	Binder	60mm AC 20	60mm SMA 14	75mm AC 20

2.3.5 Mixture Designation

The mixture designation should be chosen to suit the thickness of the layer as indicated in Tables 3, 6, 9 and 12 of CC-SPW-00900.

For use of asphalt concrete in base and binder course, the choice of mixture designation shall be between AC Dense Bitumen Macadam (dense) and AC High Density Macadam (HDM). As per Table 3 of CC-SPW-00900, only some binder grades are suitable for either designation. HDM has a range higher filler content than dense.

Examples of mixture designations from CC-SPW-00900 include:

i) Clause 3.1.5: AC 20 dense bin 70/100 des

ii) Clause 3.1.6: AC 20 HDM bin 40/60 des

2.3.6 Aggregate

In accordance with CC-SPW-00900 Tables 1, 4, 7 and 10, the Designer shall detail the PSV and AAV requirements for the surface course.

The minimum PSV of aggregate is required to ensure adequate microtexture to provide suitable friction properties to the road surface and the values in DN-PAV-03023 - Surfacing Materials for New and Maintenance Construction, for Use in Ireland should be used.

The maximum AAV of aggregate is required to ensure adequate resistance to abrasion by traffic and the values in DN-PAV-03023 should be used.

The frequency of testing and the method of assessment for testing Polished Stone Value shall be in accordance with DN-PAV-03023.

The requirement for the friction after polishing test shall be included in Appendix 7/1.

2.3.7 Reclaimed Asphalt

Where the Designer proposes to allow the use of reclaimed asphalt as a constituent of the bituminous mixtures, the requirements of CC-SPW-00900 Clause 9 shall be adhered to and the performance of the material shall be demonstrated.

2.4 Product Approval

2.4.1 General

The conformity of bituminous mixtures shall be demonstrated as described in CC-SPW-00900 and:

i) IS EN 13108 – 20 Type Testing; and

ii) IS EN 13108 – 21 Factory Production Control

For each product to be incorporated into the Works the DoP, CE Mark, and Type Test reports shall be supplied to the Employer's Representative for review prior to commencement of the Works.

During production of bituminous mixtures for incorporation into the Works, the operating compliance reports required under Factory Production Control shall be submitted at weekly intervals to the Employer's Representative. The minimum Operating Compliance Level (OCL) shall comply with the requirement of CC-SPW-00900.

2.4.2 Site Works Approval

When monitoring the transport, delivery and installation of bituminous mixtures, the Employer's Representative should be aware that:

i) The Contractor shall submit Type Test reports for the constituent materials with the DoP for the product.

ii) The minimum delivery temperature of the product shall be declared by the manufacturer of the bituminous product.

iii) Coated chippings used in hot rolled asphalt are considered a product under IS EN 13108-4 and therefore require an associated DoP and CE Marking for the properties specified in CC-SPW-00900 Clause 4.2.4, Table 4 and Table 5.

3. Microsurfacing

3.1 Introduction

The design and performance requirements of microsurfacing shall be determined in accordance with this Chapter of this Standard.

Microsurfacing does not provide increased strength to the structure of a pavement and any underlying structural defects may appear through the microsurfacing in time. Microsurfacing has been successfully used to rectify minor localised defects on National Roads and can generally be classified as a preventative maintenance treatment. In the short to medium term microsurfacing can offer improved skid resistance and waterproofing of the pavement structure, and can rectify surface defects such as ravelling.

Microsurfacing is a mixture of aggregates, filler and polymer modified bitumen emulsion, fibres and other additives. The mixing takes place in a mobile unit at the place of installation and is a continuous flow of a very fluid product. The rear of the mobile unit has a strike-off type screed and compaction only takes place after the material has set, which may take up to an hour. The final thickness can range from approximately 10mm to 20mm. The addition of fibres within the microsurfacing process can help to reduce reflective cracking and enables the use of coarser aggregates, which improves texture depth.

Until the material has cured or reached a sufficient cohesive strength, it is vulnerable to traffic, and proprietary systems have been developed to speed up this curing time.

Microsurfacing is targeted at all roads, including high speed roads carrying significant traffic volumes, and as a consequence requires appropriate levels of microtexture and macrotexture retention.

All sites with surface defects may be considered suitable for treatment with microsurfacing. However, microsurfacing should not be seen as a long-term alternative to rectifying defects as it is more appropriate for use in routine maintenance and emergency works. As described in Section 3.4, should microsurfacing be deemed the most cost effective option the Purchaser shall seek approval from the TII Network Management section for its use.

Microsurfacing is aesthetically pleasing as it restores a black and uniform appearance to a pavement surface. Microsurfacing requires no adjustment of kerb lines, manholes, guide rails, or bridge clearances due to its thin lift height.

Microsurfacing permits only limited surface regulation when laid in one pass. If greater surface regulation is necessary, an initial pass may be made to fill in surface irregularities, such as minor rutting, followed by a second pass to provide the complete overlay.

Microsurfacing should not be applied if either the pavement or air temperature is below 10°C or if there is a possibility of freezing or significant reduction in temperatures within 24 hours of placement.

For microsurfacing to be suitable there should be a high probability that the treatment will produce the level of performance required over a reasonable lifetime. The factors affecting the decision are: traffic levels and speed, difficulty of the site and the existing road surface.

As would be expected, the heavier the traffic the more critical is the condition of the current surface. On very lightly trafficked roads a successful outcome is possible in virtually all cases subject only to proper design and installation.

For general details on microsurfacing, refer to DN-PAV-03024.

3.2 Process Flowchart

Figure 3.1 contains a flowchart for specifying microsurfacing. The flowchart makes reference to various documents contained within TII Publications (Standards) that should be used to assist in determining the requirements and performance of the microsurfacing.

The information that is required in the flowchart is the minimum that shall be included; other items may be included by the Purchaser depending on site-specific requirements. The information is normative; the layout is informative.

The various stages shown in Figure 3.1 below are discussed in detail in the following Sections of this Standard.

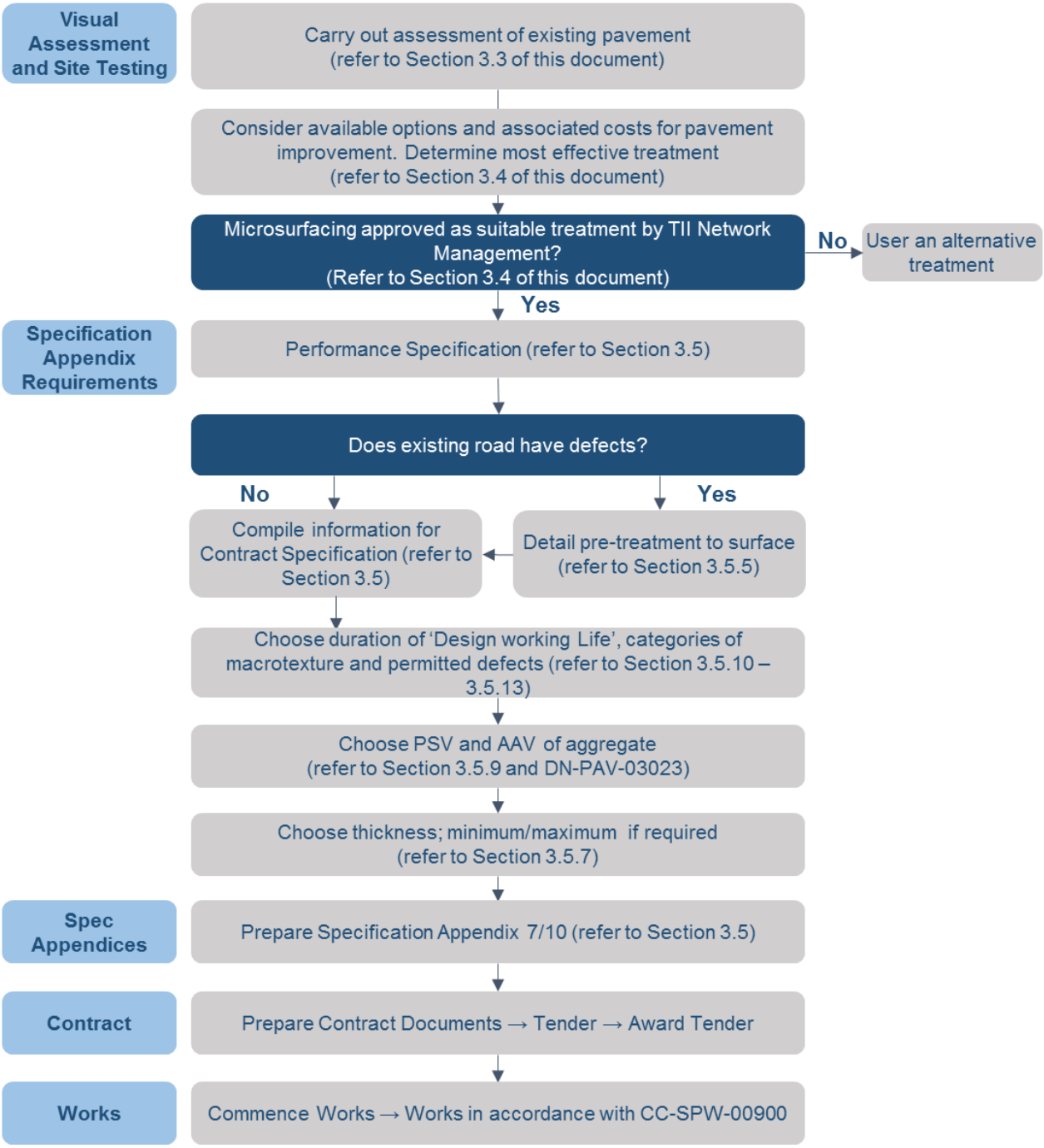


Figure 3.1 – Process Flowchart for Microsurfacing

3.3 Assessment

3.3.1 Introduction

The party responsible for maintenance of the pavement should carry out routine inspections to assess the existing road surface. If works are deemed to be required, a representative of the Purchaser (Local Authority engineer, Consultant designer, etc.) should carry out a detailed inspection of the site prior to compiling the Contract Documents. This inspection should include a detailed visual assessment of the existing surface, testing the macrotexture of the road surface, and noting the existing drainage system.

3.3.2 Visual Assessment

Each site should be inspected on foot to commence the process of detailed design of the road works. Such inspections should be carried out to enable any defects to be recorded and rectified prior to the commencement of pavement works.

The visual assessment should be carried out to determine the consistency of the existing road surface. When microsurfacing design is being carried out on National Roads, the structural condition of the road should be determined using the TII Pavement Management System. Requisite methodologies to confirm if the pavement is structurally sound are outlined in AM-STR-06049 and AM-STR-06050.

When inspecting the road surface the extent of any of the following structural defects should be assessed:

i) Cracking (may include alligator cracking, edge cracking and breakup).

ii) Rutting/wheel tracking.

iii) Heterogeneity/variability (may include pavement deformation, surface distortion).

When inspecting the road surface extent of any of the following surface defects should be assessed:

i) Bleeding.

ii) Fatting up.

iii) Ravelling/fretting.

iv) Patching (may include potholes).

The Purchaser will need to assess the level of any defects and decide if, and to what extent, pre-treatment is required. The responsibility of which party designs the pre-treatment is explained in Sub-section 3.5.5 below.

The visual assessment should also note the condition of the existing road drainage. Refer to AM-STR-06049 and AM-STR-06050 for assistance on this issue.

3.3.3 Macrotexture

Macrotexture measurements should be carried out in accordance with IS EN 13036-1 and recorded as mm of texture.

Note that macrotexture readings should be taken in the same location on the road surface which best represents the predominant condition of the existing road surface as adjudged by the assessor.

Although the standard method of measuring macrotexture is the patch test in IS EN 13036-1, alternative methods may be used (to speed up testing) provided that they have been calibrated against the patch test. Reference should be made to the records available from the annual surveys on the National Road network.

3.3.4 Traffic Volume

Traffic volumes may be obtained from the TII traffic data website or site specific traffic counts. The traffic flow shall be the maximum volume of traffic measured as commercial vehicles per lane per day (cv/lane/day) based on the Average Annual Daily Flow (AADF). Refer to =PE-SMG-02002 for further details.

3.3.5 Traffic Speed & Site Category

The site shall be designated as a 'high-speed' or 'low-speed' road. For the purpose of this Standard, high-speed roads are defined as those with a posted speed limit above 60 km/h.

The site category based on Table 4.1 of DN-PAV-03023 shall also be determined.

3.4 Suitability of Road for Microsurfacing

Following the completion of the assessment of the existing road in accordance with Section 3.3, the Purchaser should carefully consider if microsurfacing is an appropriate treatment for the surface or if rectification works need to be carried out to enable a high confidence level in its long term life expectancy.

Depending on the level of defects, budget available and time frame for any proposed works, treatment options may include pavement reconstruction, pavement overlay (for both refer to Chapter 2) and microsurfacing. The Purchaser should determine the cost of each option and carry out an economic assessment to determine the most cost effective option. If the road surface is found not to be suitable for microsurfacing, an alternative treatment must be found.

Should microsurfacing be deemed the most cost effective option, the Purchaser shall seek approval from the TII Network Management section for its use.

Table 3.1 below provides guidance on where microsurfacing works are not suitable, based on existing characteristics found during visual inspection and testing. Table 3.2 below provides guidance on where microsurfacing works may be suitable as an alternative to surface dressing, based on site category and traffic volumes (expressed in terms of cv/lane/day).

Table 3.1 – Suitability of Existing Road Surface for Microsurfacing

Existing surface characteristic	**Traffic Category (cv/lane/day)**								
	0-25	26-50	51-125	126-250	251-500	501-1000	1001-2000	2001-3000	Over 3000
Homogeneous									
Fatting up in wheel tracks									
High macrotexture or fretted									
Porous									
Very variable along lane width									
Extensive patching									
Severe bleeding & extensive blackening									

Key to Table 3.1

	Existing surface may be suitable for microsurfacing subject to the requirements of DN-PAV-03074
	Microsurfacing is not an appropriate treatment

Table 3.2 – Suitability of Microsurfacing as an alternative to Surface Dressing

Site Category	**Site Description**	**IL**	**Traffic (Commercial Vehicles per Lane per Day)**		
			0-25	**26-50**	**51-125**
Q	Approaches to and across major and minor junctions	0.40			
		0.45			
S1	Bends radius <250m – dual carriageway	0.45			
		0.50			
S2	Bends radius <250m - single carriageway	0.45			

Key to Table 3.2

	Microsurfacing with polymer modified binder and a bond coat should be considered as an alternative treatment to surface dressing if substrate suitable.
	Microsurfacing is not an appropriate treatment

3.5 Specification Appendix Requirements

Should microsurfacing be deemed the most cost effective option and the TII Network Management Inspector has granted approval for its use, the criteria outlined below need to be established for the compilation of Appendix 7/10. A sample Specification Appendix 7/10 is provided in CC-GSW-00700.

CC-GSW-00900 Clause 7.1.2 provides requirements pertaining to microsurfacing systems. Microsurfacing shall be designed and installed by the Producer and shall be CE marked in accordance with IS EN 12273. Unless otherwise specified in Appendix 7/10, the permitted types of microsurfacing shall be two layer systems or one layer with machine integrated bond coat application.

The Producer is also responsible for the supply of all labour, plant, materials along with supervision of the Works. The Producer shall take into account the performance requirements relating to macrotexture and defects and ensure that the values are achieved and retained for the 'Design Working Life'. The proposed microsurfacing shall have been subject to a Type Approval Installation Trial (TAIT) for the intended use in accordance with IS EN 12273.

The Purchaser is responsible for providing information relating to the site, specifying the PSV and AAV of the aggregate and specifying performance requirements; all of which shall be detailed in Appendix 7/10. The following sub-sections detail the items to be included in Appendix 7/10.

3.5.1 Location

Details of the road name, number, ITM grid reference of start and finish, lanes to be treated including drawings where appropriate.

3.5.2 Traffic Volume

As determined under Sub-section 3.3.4.

3.5.3 Traffic Speed & Site Category

As determined under Sub-section 3.3.5.

3.5.4 Description of existing surface

To include the pertinent items found under Sub-sections 3.3.2 and 3.3.3.

3.5.5 Pre-Treatment

If the assessment under Sub-sections 3.3.2 and 3.3.3 highlighted the need for pre-treatment, then the requirements shall be clearly defined by the Purchaser. The responsibility for the installation of any pre-treatment works shall be clearly defined as that of the Producer or the Purchaser.

Cleanliness of the existing surface is extremely important. The microsurfacing will only adhere to the top layer of the material on which it is placed and if this is deleterious then the surfacing may fail due to delamination. It may be necessary to use high pressure washing to remove strongly adherent material or the substrate may be prepared using a milling machine with a fine mill drum (8mm tool spacing as compared with a standard 15mm tool spacing).

Any requirement for 'fine milling' i.e., a tool spacing of maximum 8mm, should be specified in Appendix 7/9.

3.5.6 Type of Microsurfacing

The permitted types of microsurfacing shall be two layer systems or one layer systems with machine integrated bond coat application. Any alternatives shall be detailed by the Purchaser in Appendix 7/10.

3.5.7 Thickness

The minimum and/or maximum thickness at which the microsurfacing is to be laid should only be specified where there are specific reasons for so doing. If the product is being laid purely to restore surface characteristics such as microtexture and macrotexture, the choice of thickness should not be restricted. One reason for specifying a minimum thickness is to improve the profile. For rut filling this is often accomplished by the application of two layers, sometimes using different materials.

3.5.8 Binder

The Producer shall propose a polymer modified cationic bituminous emulsion type to meet the performance requirements of the Contract.

3.5.9 Aggregate

The Producer shall propose an aggregate type, based on the PSV and AAV requirements detailed by the Purchaser, to meet the performance requirements of the Contract.

The minimum PSV of aggregate is required to ensure adequate microtexture to provide suitable frictional properties to the road surface and the values in DN-PAV-03023 should be used.

The maximum AAV of aggregate is required to ensure adequate resistance to abrasion by traffic and the values in DN-PAV-03023 should be used.

3.5.10 Design Working Life

The Purchaser shall detail the ‘Design Working Life’ period over which the microsurfacing, as designed by the Producer, shall perform. The ‘Design Working Life’ shall be the period for which the microsurfacing is to be used for its intended purpose without repair being necessary. This will normally be of 5 years in duration, with the period to commence once the surface is opened to unrestricted traffic. Each site where microsurfacing is installed shall be subject to assessment over the ‘Design Working Life’.

The Purchaser shall be aware that the ‘Design Working Life’ is different to the ‘Defects Period’, as defined in the Public Works Contract - Conditions of the Contract. Identification and rectification for defects within the ‘Defects Period’ shall be treated in accordance with the Conditions of Contract.

3.5.11 Macrotexture

Requirements for higher speed roads are generally higher than those for lower speed roads. Similarly, high traffic levels require a higher texture at one year than lightly trafficked roads as more embedment occurs under heavier traffic after the one-year measurement point.

The category of macrotexture to be achieved shall be demonstrated by means of a previously successful TAIT on the microsurfacing system and maintained throughout the ‘Design Working Life’. The minimum required macrotexture, measured in accordance with IS EN 13036-1, shall be chosen from the categories in Table 3.3. These have been derived from IS EN 12273 Table 1. The category appropriate to the site should be specified in Appendix 7/10.

The Purchaser should be aware that the Producer shall ensure that the microsurfacing has sufficient initial macrotexture depth to enable the performance levels to be achieved.

Posted Speed Limit	Macrotexture Required
Above 60 km/h	≥ 1,0 (Category 5)
60 km/h or below	≥ 0,8 (Category 4)

Table 3.3 – Macrotexture Performance Requirements

3.5.12 Visual Assessment of Area Defects

The categories of area defect to be achieved by visual assessment shall be demonstrated by means previously successful TAIT on the microsurfacing system and maintained throughout the 'Design Working Life'. The categories of area defects shall be chosen from Table 3.4 appropriate to the site. These categories have been derived from IS EN 12273 Table 1. The category appropriate to the site should be specified in Appendix 7/10.

Table 3.4 – Defect Performance Requirements: Area

		Defect Classification			
Site Category	Site Definition	P1, Bleeding Fatting up and Tracking	P2, Delamination, Loss of Aggregate, Wearing, Lane Joint Gaps Rutting and Slippage	P3, Corrugation, Bumps and Ridges	P4, Groups of Small Defects or Repetitive Defects in not more than rectangles (n)
		Maximum % of Area Affected			
B	Dual carriageway	≤ 0.2 (Category 4)	≤ 0.2 (Category 4)	≤ 0.2 (Category 4)	≤ 0.2 in not more than 1 rectangle (Category 4)
K	Approaches to traffic signals, pedestrian crossings	≤ 0.5 (Category 3)	≤ 0.5 (Category 3)	≤ 0.5 (Category 3)	≤ 1.0 in not more than 2 rectangles (Category 3)
Q	Approaches to and across major and minor junctions				
S1	Bend radius < 250m on dual carriageway				
S2	Bend radius < 250m on single carriageway				
C	Single Carriageway (cv/lane/day > 50)	≤ 2.0 (Category 2)	≤ 2.0 (Category 2)	≤ 2.0 (Category 2)	≤ 5 in not more than 6 rectangles (Category 2)
	Single Carriageway (cv/lane/day ≤ 50)	≤ 8.0 (Category 1)	≤ 8.0 (Category 1)	≤ 8.0 (Category 1)	≤ 20 in not more than 20 rectangles (Category 1)
Notes					
Suitability of the microsurfacing an appropriate treatment for the surface shall be confirmed in accordance with Section 3.4 prior to assigning categories of defects					

3.5.13 Visual Assessment of Linear Defects

The category of linear defects to be achieved by visual assessment shall be demonstrated by means previously successful TAIT on the microsurfacing system and maintained throughout the 'Design Working Life'. The category of area defects shall be chosen from Table 3.5 appropriate to the site. This category has been derived from IS EN 12273 Table 1. The category appropriate to the site should be specified in Appendix 7/10.

Table 3.5 – Defect Performance Requirements: Linear

Site Category	Site Definition	Total Length of Defects in metres per 100 m
B	Dual Carriageway	< 1 (Category 4)
K	Approaches to traffic signals, pedestrian crossings	< 1 (Category 4)
Q	Approaches to and across major and minor junctions	
S1	Bend radius < 250m - dual carriageway	
S2	Bend radius < 250m - single carriageway	
C	Single Carriageway (cv/lane/day > 50)	< 5 (Category 3)
	Single Carriageway (cv/lane/day ≤ 50)	< 10 (Category 2)
Notes		
Suitability of the microsurfacing an appropriate treatment for the surface shall be confirmed in accordance with Section 3.4 prior to assigning categories of defects		

3.5.14 Other Requirements

An appropriate special requirement shall be included in the Conditions of Contract drawing particular attention if a 'Design Working Life' duration of longer than five years is required.

Appendix 7/10 shall specify the requirement for the surface shear strength test and the timing of the when the test shall be carried out. The test shall be carried out at two locations within the Works area, with at least one of these to be in the wheel track zone.

The Purchaser should set out any limitations on the availability of a site in Appendix 1/7.

3.5.15 Producer Supplied Information

The Producer shall provide additional information as required in CC-GSW-00700 Sample Appendix 7/10.

3.6 Product Approval

3.6.1 TAIT – General

For each microsurfacing product to be incorporated into the Works the TAIT report, DoP and CE Mark shall be supplied to the Employer's Representative for review prior to commencement of the Works.

Demonstration of the conformity of the microsurfacing shall be as described in the appropriate Annex of IS EN 12273. Annex A and B of the hEN detail the FPC requirements including minimum inspection/test frequencies.

Annex C of the hEN details the Type Approval Installation Trial (TAIT) requirements including performance characteristics measured over a defined period. A TAIT shall be carried out on one section of work that shall be representative of a microsurfacing type. This is generally one year.

One year after the installation, visual assessment to IS EN 12274-8 and macrotexture to IS EN 13036-1 (or to IS EN ISO 13473-1) shall be recorded. These test results shall meet the requirements of IS EN 12273.

Any proposed microsurfacing shall have an approved TAIT. The TAIT shall have been installed in accordance with the Producer's certified Factory Production Control system.

3.6.2 TAIT – Performance

It is important for the Purchaser to ensure that the correct performance levels of the microsurfacing are specified and obtained, in particular any parameters specified must be measured to demonstrate compliance.

The Producer shall continue to monitor the TAIT site and declare the period for which the performance characteristics have been retained in his TAIT certificate. This will aid the Purchaser in satisfying themselves that there is minimum risk of failure during the designed life, which may be much longer than the 'Design Working Life'.

3.6.3 Design Working Life

While the microsurfacing TAIT is carried out on a defined section and classified in a TAIT family, each site where microsurfacing is installed shall be subject to assessment over the 'Design Working Life'. The same performance tests as detailed in the TAIT shall be used to assess the microsurfacing over the duration of the 'Design Working Life'.

The Producer shall be responsible for these performance tests after one year of completion of the installation and at one year intervals thereafter for the five year 'Design Working Life' period, or period specified in Appendix 7/10. Permitted categories of defects shall be in accordance with the requirements of Appendix 7/10. The Purchaser shall monitor the performance levels of the microsurfacing during 'Design Working Life', and bring any defects to the attention of the Producer.

4. Surface Dressing

4.1 Introduction

Surface dressing is the application of a bituminous binder and nominal single size aggregate chippings to the surface of a road, in one or more layers. The procedure is an established method of routine maintenance of road surfaces in Ireland.

Surface Dressing shall be specified in accordance with CC-SPW-00900.

The choice of the surface dressing to be designed and constructed shall be chosen from either Clause 7.2.2 or Clause 7.2.3 of CC-SPW-00900 according to the division of responsibility between the Purchaser (Client, Local Authority, etc.) and the Producer (Contractor).

The design of recipe surface dressing, and the requirements and performance of surface dressing product (end performance) shall be determined in accordance with this Chapter of DN-PAV-03074.

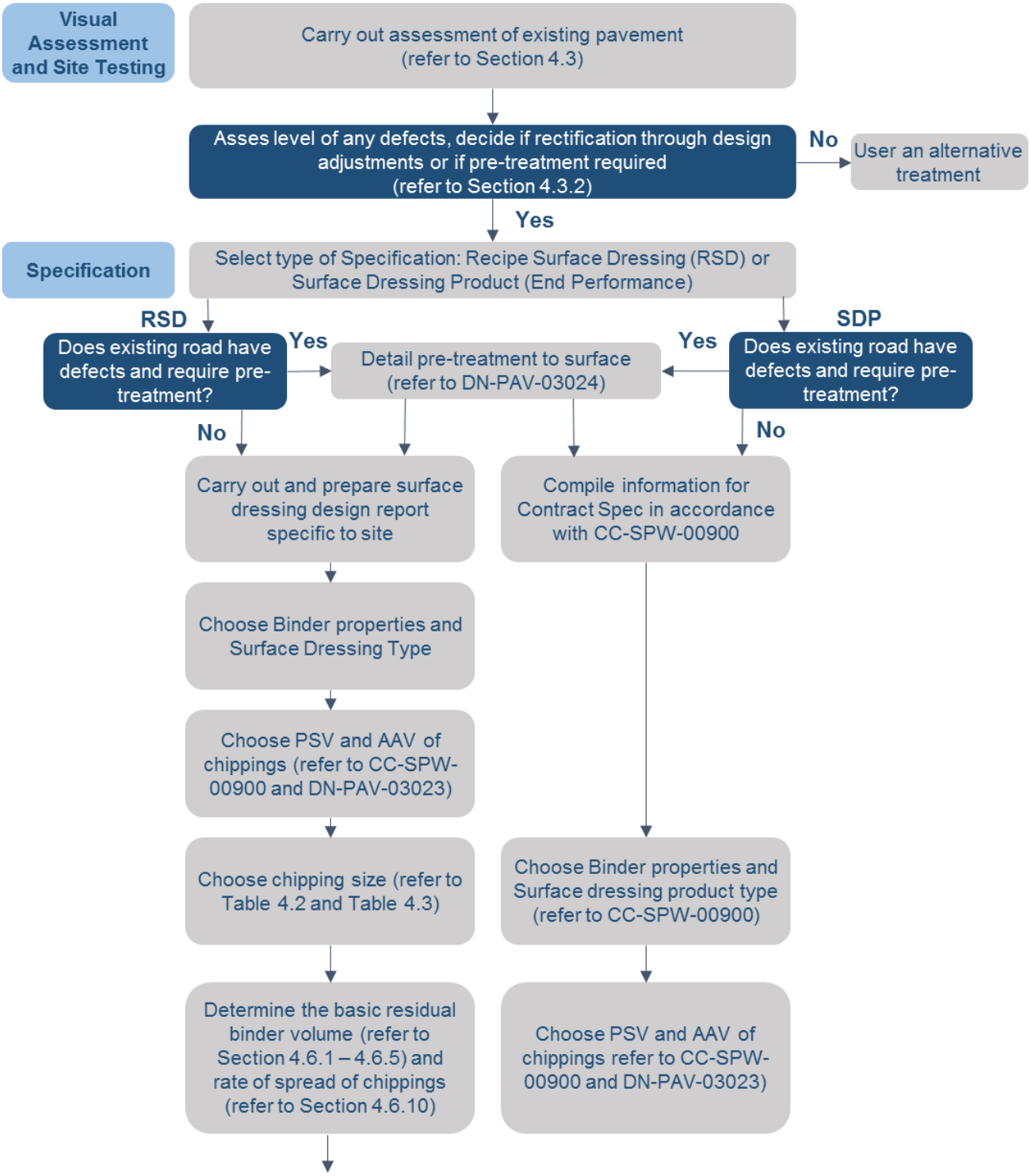
For general details, techniques and properties of surface dressing, refer to DN-PAV-03024.

4.2 Process Flowchart

Figure 4.1 contains a flowchart for specifying surface dressing. The flowchart makes reference to various TII Publications (Standards) documents that should be used to assist in designing recipe surface dressing and in determining the requirements and performance of surface dressing product (end performance).

The information that is required in the flowchart is the minimum that shall be included; other items may be included by the Purchaser depending on site-specific requirements.

The various stages shown in Figure 4.1 below are discussed in detail in the following Sections of this Standard.


Visual Assessment and Site Testing
Carry out assessment of existing pavement (refer to Section 4.3)
Asses level of any defects, decide if rectification through design adjustments or if pre-treatment required (refer to Section 4.3.2)
No
User an alternative treatment
Yes
Specification
Select type of Specification: Recipe Surface Dressing (RSD) or Surface Dressing Product (End Performance)
RSD
SDP
Does existing road have defects and require pre-treatment?
Yes
Detail pre-treatment to surface (refer to DN-PAV-03024)
Yes
Does existing road have defects and require pre-treatment?
No
No
Carry out and prepare surface dressing design report specific to site
Compile information for Contract Spec in accordance with CC-SPW-00900
Choose Binder properties and Surface Dressing Type
Choose PSV and AAV of chippings (refer to CC-SPW-00900 and DN-PAV-03023)
Choose chipping size (refer to Table 4.2 and Table 4.3)
Choose Binder properties and Surface dressing product type (refer to CC-SPW-00900)
Determine the basic residual binder volume (refer to Section 4.6.1 – 4.6.5) and rate of spread of chippings (refer to Section 4.6.10)
Choose PSV and AAV of chippings refer to CC-SPW-00900 and DN-PAV-03023)

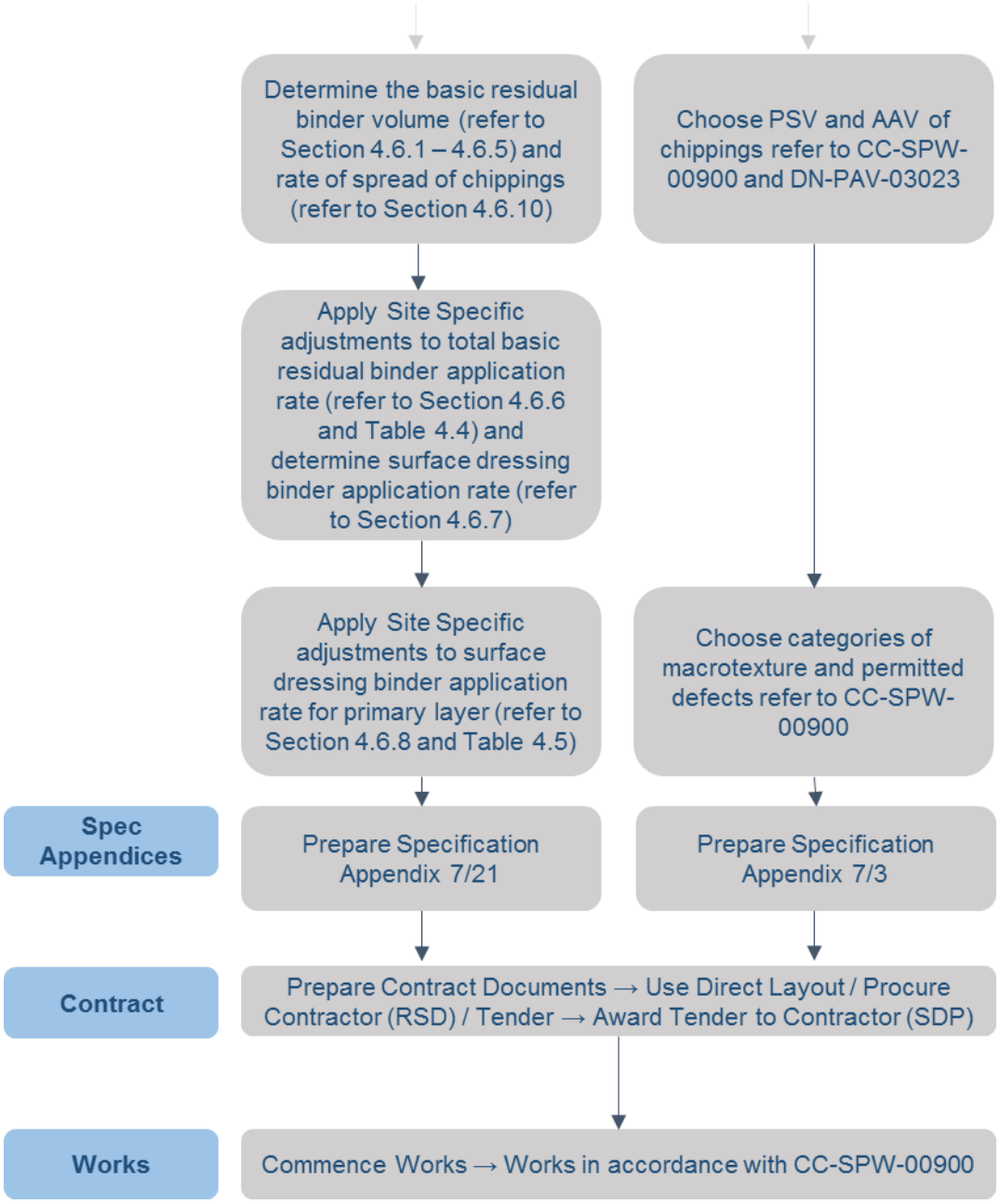


Figure 4.1 – Process Flowchart for Surface Dressing

4.3 Assessment

For surface dressing to be suitable there should be a high probability that the treatment will produce the level of performance required over the required lifetime. The factors affecting the decision include the condition of the existing pavement.

The overall condition of the existing surfacing is important in determining the most appropriate type of surface dressing in order to improve durability for certain surface conditions.

The party responsible for maintenance of the pavement should carry out routine inspections to assess the existing road surface. If works are deemed to be required, a representative of the Purchaser (Local Authority engineer, Consultant designer, etc.) shall carry out a detailed inspection of the site prior to compiling the Contract Documents. This inspection should include a detailed visual assessment of the surface, testing the hardness and macrotexture of the road surface, and noting site topography and the existing drainage system.

An assessment shall be carried out of the existing surfacing in accordance with AM-PAV-06050 - Pavement Assessment, Repair and Renewal Principles which will include a review of the existing data from the TII Pavement Asset Management System (PAMS Data), Visual Inspection Report and Scheme Level Surveys and Investigations. Particular focus should be paid to the results of the management of skid resistance and areas falling below the investigatory levels set out in AM-PAV-06045 – Management of Skid Resistance.

The structural condition of the road should be determined using the TII Pavement Management System. Requisite methodologies to confirm if the pavement is structurally sound are outlined in AM-PAV-06049- Pavement Asset Repair and Renewal – Scheme Approval Procedures and AM-PAV-06050.

4.3.1 Homogeneous Sections

The surface dressing design shall be applied to a homogeneous section of pavement in terms of traffic, texture, hardness and site conditions/stress.

If the road hardness, texture or substrate varies along a section of road, significant structural defects or visual differences in the surfacing are present, or there are significant differences in traffic or other factors the road should be dealt with as follows:

a) where practicable, pre-treatment of the existing road prior to surface dressing should be carried out to form homogeneous sections of sufficient length for surface dressing; or

b) alternatively, where possible sub-divide the road into homogeneous sections with similar engineering properties, with appropriate treatment identified and designs prepared for each subsection.

Wherever the surface condition changes, a new or modified surface dressing design or surface dressing type for the different condition in that section may need to be considered.

Local variations in the condition of the existing surfacing need to be allowed for in the design. The variations should be such that for all conditions, sufficient binder is present for the initial retention of the chippings prior to longer term embedment, and excess binder is avoided which could cause fatting up.

In assessing the homogeneity of a site, there are a number of criteria to be considered including the following factors:

i) Existing road assessment

ii) Road hardness

iii) Macrotexture/Texture variation

iv) Traffic volume

v) Traffic speed

vi) High stress sites

vii) Site topography and orientation

viii) Site category

ix) Structures

x) Drainage

xi) Any pre-treatments which may be required.

4.3.2 Visual Assessment

An assessment shall be carried out of the existing surfacing in accordance with AM-PAV-06050. Each site should be inspected on foot in accordance with Chapter 3 of AM-PAV-06050 to commence the process of detailed design of the road works. Inspections should be carried out to enable any defects to be recorded and rectified prior to the commencement of pavement works.

The visual assessment should be carried out to determine the homogeneity of the existing road surface and the degree of structural defects with a view to forming homogeneous sections of sufficient length for treatment.

When inspecting the road surface the extent of any of the following structural defects should be assessed:

i) Cracking (may include alligator cracking, edge cracking and breakup).

ii) Rutting/wheel tracking.

iii) Heterogeneity/variability (may include pavement deformation, surface distortion).

When inspecting the road surface condition, the extent of any of the following surface defects should be assessed:

i) Bleeding/Fatting Up.

ii) Ravelling/Fretting.

iii) Porosity/Absorptive surface

iv) Patching (may include potholes).

v) Degree of variability

For the purposes of the local corrections in Table 4.4, the five categories of surface condition are:

- Very binder rich
- Binder rich
- Normal
- Texture in wheel tracks
- Binder lean/Porous

Allocation to a particular category is a subjective assessment which should be carried out by an experienced person.

Allowance should be made for asphalt substrates less than one-year-old, which tend to have a relatively high binder demand. The texture depth of the existing surface can be used to assess the extent to which an asphalt surface is open-textured, thus requiring more binder.

Surface dressing can also be specified as a maintenance treatment for negative texture road surfaces. On such surfaces it is important to provide a pre-seal to the surface in order to ensure that the binder does not seep into the open textured surface, leaving insufficient binder to hold the chippings of the surface dressing in place. A pad coat surface dressing layer is recommended to normalise and seal porous road surfaces, followed by a surface dressing to provide the specified surface characteristics.

For recipe surface dressing, the Purchaser (i.e. the Designer of the recipe surface dressing) will need to assess the level of any defects and decide if, and to what extent, pre-treatment is required. Examples of pre-treatments include pre-gritting wheel tracks, pre-spraying oil tracks or sealing the entire road surface. For further details on pre-treatments refer to DN-PAV-03024.

The visual assessment should also note the presence and type of structures, and the condition of the existing road drainage. Refer to AM-PAV-06049 and AM-PAV-06050 for further assistance.

4.3.3 Road Hardness

Road hardness is a measure of the resistance of an existing road surface in a particular location to the embedment of chippings, and is particularly important for soft and very soft surfaces. Soft substrates can occur when overlaying multiple layers of surface dressing or when surface dressing over asphalt or pavement repairs that have not fully cured or hardened.

The road hardness is influenced by the local climate as well as the surfacing material because the hardness of asphalt surfacing material is temperature dependent. In addition, the hardness of the existing road surface is used in selecting the most appropriate size of chipping.

The road hardness should be measured using the Australian Modified Hammer ball penetration device in accordance with Austroads standard AG:PT/T251-10 ‘Ball Penetration Test’.

The Australian Modified Hammer consists of a built-in Marshall compaction hammer which is dropped from a given height onto a detachable 19mm ball bearing hemispherical foot at the bottom of the device, and a digital gauge to measure the depth of penetration of the steel ball after it has been subjected to a single blow of the Marshall hammer.

Road hardness readings should be made in areas of similar visual condition that represent the predominant condition of the existing road surface, and at least every 200 metres. Extreme conditions may be measured and recorded but must not be averaged to give an average road hardness.

For the test, the surface temperature, which should preferably be between 15°C and 30°C, is recorded and the hardness value determined from the mean of a set of 5 ball penetration tests at 100mm intervals at each location recorded in mm of penetration.

The mean hardness value is corrected to 25°C using the method outlined in the Austroads standard AG: PT/T251-10 and DN-PAV-03024. The corrected reading is used in the analytical design process.

The hardness measurements are best carried out when the road temperature is above 20°C and may in some situations need a lane closure. Ideally, hardness should be measured in the season prior to that in which the surface dressing is to be carried out. It should be noted that hardness readings taken at road temperature significantly below 20°C are likely to be less accurate than those taken between 20°C and 30°C.

For roads with asphalt concrete, unless the road surface is visibly binder rich, with low texture (e.g. < 0.5mm), or with very little coarse aggregate visible at the surface, then the road surface should be classified as ‘hard’ and a ball penetration figure of 1mm should be used for design purposes on such surfaces.

As it is not generally possible to take meaningful hardness readings on high void content asphalt surface courses such as porous asphalt and stone mastic asphalt, these surfaces should also be treated as hard.

Hardness readings should not be taken on unbound, stabilised or recycled layers as they are meaningless in terms of design for those materials.

Where road hardness measurements are made using the CTRA (Coal Tar Research Association) probe, which uses a spring-loaded penetrometer with a 4mm hemispherical head, refer to Annex A of this standard.

For general details on the Ball Penetration device and the CTRA probe, refer to DN-PAV-03024.

4.3.4 Macrotexture

Macrotexture measurements should be carried out using the volumetric path test in accordance with IS EN 13036-1 and recorded as mm of texture.

The volumetric path test measurements are made to determine the average and the two extremes which are representative of the length of road to be surface dressed. Texture depth measurements should be made both in the lowest textured wheelpath and between the wheelpaths of each lane at approximately 200 metre intervals along the road, or where there is visual change in texture, with a minimum of at least five locations being tested in each lane if the length of road being surface dressed is less than 1000 metres.

Note that macrotexture and hardness readings should be taken in the same location on the road surface which best represents the predominant condition of the existing road surface.

Although the standard method of measuring macrotexture is the volumetric patch test in IS EN 13036-1, alternative methods may be used (to speed up testing) provided that they have been calibrated against the volumetric patch test. Reference should be made to the laser based data available from the road surface profiler (RSP) from the annual surveys on National Road network. Refer to AM-PAV-06050 and CC-SPW-00900 for further details on laser based assessment of texture depth.

The standard length of section for recording texture data in both wheelpaths using the RSP is 10 metres, and the 10m data are averaged to 100m for the purpose of reporting network condition. At site level, it is recommended that the 10m data should be used as the basis for evaluating surface texture.

4.3.5 Texture Variation

The texture can vary both transversely and longitudinally along the length to be surface dressed, and it is therefore important to measure the texture depth in more than one measurement line. Pre-treatments can be used to prepare a surface before surface dressing to reduce any texture variation that has arisen during its life.

The results of the texture depth data both, in the wheelpaths and between/outside the wheelpaths, should be analysed to determine if pre-treatment is required or if the surface should be sub-divided to achieve the optimum matching of binder application rate to surface texture, without requiring an excessive number of short spray runs.

The design of the binder application rate has to provide a balance between applying too much binder and not applying enough. Sufficient binder is needed to securely hold chips on the lesser trafficked centreline, between wheelpaths and road edge areas. In addition, care should be taken to ensure that the application rate being used is not so high that premature bleeding results on low texture areas.

The situation can occur where the difference between the centreline texture and wheelpath texture is so great that the binder application rate required to hold chip in the wheelpaths will not be sufficient to hold chips either on the centreline or between the wheelpaths.

To assess the level of variability, the designer should check the texture variation between sections with coarsest and finest chip size to determine if the surface dressing can perform reasonably with the determined binder application rate.

As a rule of thumb for deciding whether the difference between wheelpath and centreline textures is excessive, apply the following 'ALD/16 rule' for single surface dressing and 'ALD/10 rule' for racked in or double surface dressing:

Single surface dressing

$Td_{(coarse)} – Td_{(average)}$ shall be < Min ALD/16 Equation 4.1

$Td_{(average)} – Td_{(fine)}$ shall be < Min ALD/16 Equation 4.2

Racked-in and Double surface dressing

$Td_{(coarse)} – Td_{(average)}$ shall be < Min ALD/10 Equation 4.3

$Td_{(average)} – Td_{(fine)}$ shall be < Min ALD/10 Equation 4.4

where:

$Td_{(average)}$ = average texture depth (mm) from all the measurements taken for each section

$Td_{(coarse)}$ = largest texture depth (mm)

$Td_{(fine)}$ = smallest texture depth (mm)

Min ALD = the minimum average least dimension of the proposed surface dressing chip (mm) (refer to Section 4.6.2)

If the difference between either $Td_{(average)}$ and $Td_{(coarse)}$ or $Td_{(fine)}$ is greater than the ALD/16 or ALD/10 as appropriate, then a pre-treatment should be considered to reduce texture variation. A worked example is given in Annex B.

If a pavement with significant texture variation is surface dressed, and the binder application rate is determined from the average texture depth, then sufficient binder rise may not have occurred by winter to ensure good chip retention. Racked in or Double surface dressings can tolerate a larger texture variation as they have increased strength through chip interlock that will assist under normal traffic loading to resist winter chip loss even if binder rise is less than desired.

Care should be taken to ensure that the binder application rate being used is not so high as to cause premature fatting up on low textured areas. Traditionally the texture depth derived from the average texture depth has been used in design. However, using the wheelpath texture for double surface dressing design rather than the average texture can result in a lower binder application rate being applied, and in this way assist in preventing fatting up while utilising the increased strength of this type of surface dressing to resist early chip loss.

If the texture variation is excessive, the following measures should be considered:

- Determine if the area can be subdivided practically;
- If different binder application rates can be applied to each area;
- Try the effect of using a larger chip;
- Pre-treat the extreme texture areas if they do not cover too much of the total area;
- Change design to another type of surface dressing.

4.3.6 Traffic Volume

Traffic volume has an important influence on the performance of surface dressing and plays a key role in the initial bedding down of the surfacing. Most embedment occurs in the wheelpaths and the amount of embedment varies depending on the traffic volume and traffic speed.

Aggregate particles in a surface dressing continue to reorientate under traffic. The rate of reorientation and amount of change in void volume is dependent on the traffic volume and, in particular, the number of heavy vehicles. This reorientation occurs mainly during the first one or two years of service. High traffic volumes result in the least dimension of nearly all particles being near vertical and interlocking with each other. The extent of reorientation is less at low traffic volumes resulting in greater random orientation of aggregate particles and greater void volume.

The volume of traffic that each lane of the road is required to carry is also an important factor is selecting the type of surface dressing. Traffic volumes may be obtained from the TII traffic data website or site specific traffic counts.

Traffic volume should be measured in terms of vehicles per lane per day (vehicle/lane/day) and commercial vehicles per lane per day (cv/lane/day) based on the Average Annual Daily Flow (AADF) and percent commercial vehicles. The AADF is the average daily traffic volume in one direction (AADT/2). On two-way roads with one lane in each direction, the traffic on each lane is assumed to be half the total traffic in both directions.

The following specific information is required:

i) AADF (Average Annual Daily Flow in vehicles/lane/day),

ii) Percentage of commercial vehicles, and

iii) Commercial vehicles per lane per day.

Refer to PE-SMG-02002 for further details of the traffic assessment for pavement design and maintenance.

4.3.7 Traffic Speed

The site shall be designated as a ‘high-speed’ or ‘low-speed’ road. For the purposes of this Standard, high-speed roads are defined as those with a posted speed limit above 80 km/h.

Where the surface dressing is likely to be subjected to regular high-speed traffic, consideration should be given to using a racked-in or double surface dressing with premium binders which are recommended on the more heavily-trafficked (≥ 250 cv/lane/day) high speed roads.

If the road has sections that carry different volumes of traffic or different traffic speeds, each of those sections must be investigated and designed separately. Examples of situations where it is always necessary to investigate sub-dividing the road into separate design sections are as follows:

- Wide shoulders and through-lanes;
- Fast and slow lanes of a multi-lane road;
- Turning areas and slip lanes at intersections;
- Parking lanes in urban areas;
- Uphill and downhill lanes on steep gradients (5% or greater).

In some cases, the sections may be too small or awkward to allow for separate spray runs. In those sections the design should still be checked to see how far the ideal design is likely to differ from the one chosen. The chosen design should be that which suits the section carrying the most traffic. If the designs differ significantly, the need for pre-treatment to make the surfaces more uniform should be investigated so that the binder application rate can be more efficiently designed.

4.3.8 High Stress Sites

The gradient, the tightness of bends and the extent of any super-elevation will affect the stresses imposed by vehicles on the road surfacing. Similarly, there are additional stresses due to sharp deceleration and turning at junctions and crossings. Therefore, when considering the appropriate type of surface dressing, these factors need to be considered to ensure that a sufficiently robust surface dressing is designed and constructed.

Although a site may appear to be suitable overall for a single surface dressing, it may include areas where turning traffic, junctions or sharp bends could impose high levels of stress. In these areas a different surface dressing, for example, a racked-in or double surface dressing, may be more appropriate.

These high stress areas are often small and can be accommodated in the spray run, and separate designs may not be required.

4.3.9 Site Topography

Features of the site topography and orientation such as steep gradients (5% or greater), shaded areas (due to building and trees, roads on an east west orientation), north facing slopes and altitude should be noted during the visual assessment and taken into account during the surface dressing design process.

4.3.10 Site Category

The site category based on Table 4.1 of DN-PAV-03023 shall also be determined.

4.4 Suitability of Road for Surface Dressing

For surface dressing carried out on National Roads, areas to be treated will be prompted by TII as part of the TII programme of works for Management of Skid Resistance (AM-PAV-06045) or through the asset renewals programme. The suitability of an existing road surface to receive a particular type of surface dressing may be based on local knowledge of the site by representatives of the Purchaser (Local Authority engineer, Consultant designer, etc.) but the principles outlined below should be used as the defining basis to whether or not a particular type of surface dressing is a suitable treatment for a particular site.

Following the completion of the existing road assessment in accordance with Section 4.3, the Purchaser should carefully consider if surface dressing is an appropriate treatment for the surface or if rectification works need to be carried out to enable a high confidence level in its long term life expectancy.

Examples of where surface dressing may not be a suitable treatment are as follows:

- If the existing road surface has a poor profile (transverse and longitudinal) or is deformed in the wheel tracks (a rut depth greater than 10mm) then pre-treatment by planing (milling) or surfacing may be required. Thin asphalt surfacing overlays in these circumstances may have greater economic benefits as they have some ability to improve profile, subject to compatibility with the prevailing surfacing type.
- Where it is not possible to provide controlled low speed trafficking which is normally used to settle a surface dressing down prior to sweeping and opening to unrestricted traffic e.g., where the traffic flows and speeds are such that convoying could be dangerous.

Depending on the level of defects, budget available and timeframe for any proposed works, treatment options may include pavement reconstruction, pavement overlay (for both refer to Chapter 2) and surface dressing. The Purchaser should determine the cost of each option and carry out an economic assessment to determine the most cost effective option. If the road surface is found not to be suitable for surface dressing, an alternative treatment must be found.

Should surface dressing be deemed the most cost effective option, the Purchaser shall seek approval from the TII Network Management section for its use.

Table 4.1 provides guidance on the suitability of surface dressing works, based on existing surface characteristics found during visual inspection and testing. It should be noted that the type of defect and in particular surface variability, substrate hardness, patching and bleeding, and increased traffic volume can have an adverse effect on the suitability of surface dressing works.

For works involving surface dressing (end performance), the Purchaser shall also use the detail provided in Table 4.1 in deciding on suitability of the surface dressing.

If the road surface is found not to be suitable for surface dressing, an alternative treatment must be found.

Table 4.1 – Suitability of Existing Road Surface for Surface Dressing

Existing Surface Characteristic	**Traffic Category (cv/lane/day)**					
	< 250	**251-500**	**501-1000**	**1001-2000**	**2001-3000**	**Over 3000**
Very Hard and homogeneous						
Hard and homogeneous						
Normal and homogeneous						
Soft and homogeneous						
Very Soft and homogeneous						
Bleeding in wheel tracks						
High macrotexture or fretted						
Porous						
Very variable along lane width						
Extensive patching						
Severe bleeding & extensive blackening						

Key to Table 4.1

	Existing surface may be suitable for surface dressing subject to the requirements of DN-PAV-03074.
	Existing surface may be suitable for surface dressing subject to the requirements of DN-PAV-03074 but extra care in execution is required.
	Surface dressing is not an appropriate treatment.

4.5 Surface Dressing Season

Surface dressing is a seasonal activity primarily as the long-term stability of the dressing is dependent upon the chippings becoming embedded into the substrate and/or reoriented into a stable mosaic before the onset of cold weather. If a stable mosaic does not form the chippings may be easily removed by traffic.

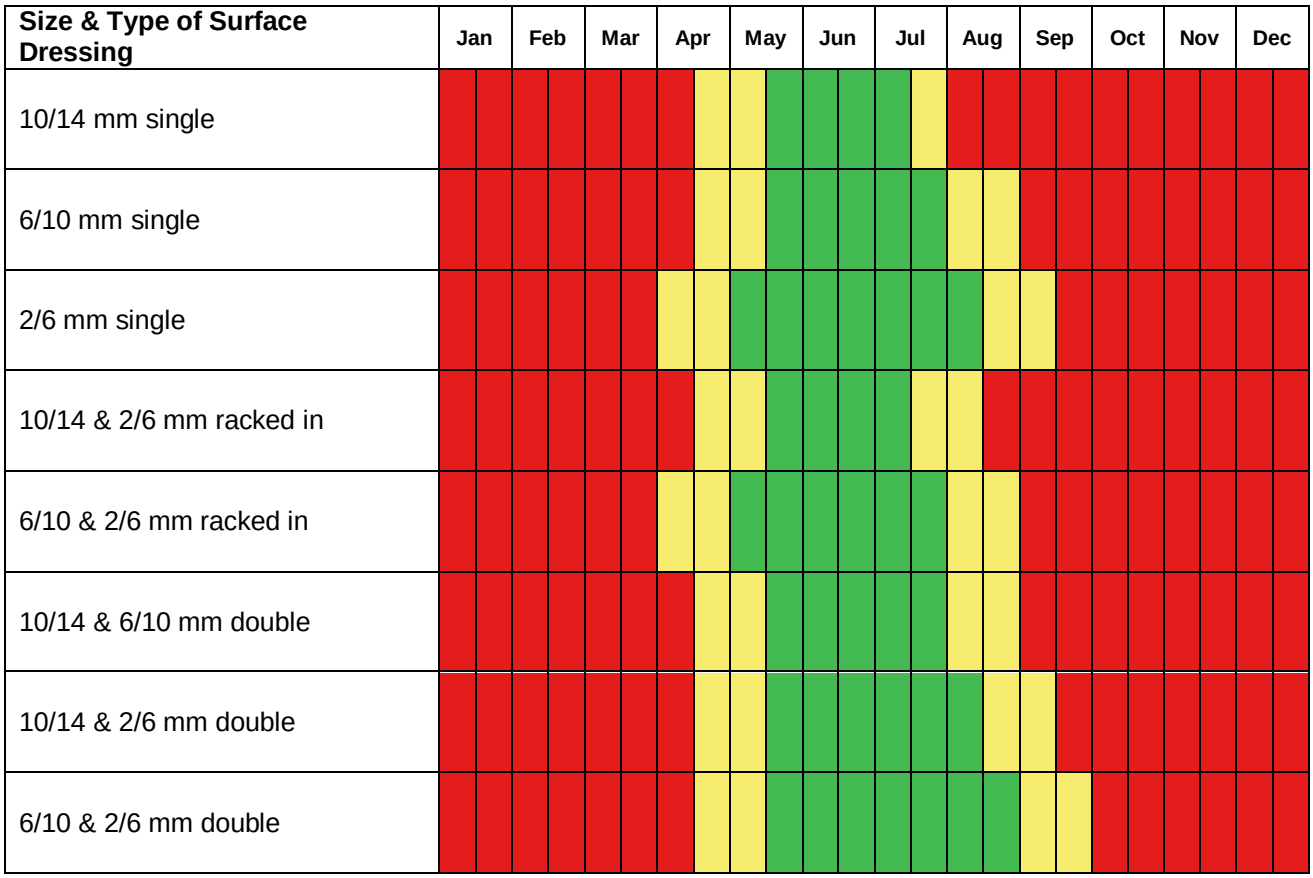
As stated in CC-SPW-00900 Clause 10.2.3.1.8, surface dressing works shall be carried out between April and August, unless otherwise specified in Appendix 7/21. The onset of the Autumnal frosts in Ireland is unpredictable and although ground frosts can occur in both August and September, it is generally October until the first heavy autumnal frosts occur.

The general principle is that larger chipping sizes should be used as early in the season as possible because they are more dependent on embedment for stability. An increase in the rate of spread of binder will be required for late season work and consideration should be given to the use of modified binders which may reduce the susceptibility of a surface dressing to early failures, and to double surface dressings which have better aggregate interlock and are therefore less susceptible to failures due to lack of embedment. If skid resistance is required for the winter period and it is late season, then a single 2/6 surface dressing will form the bottom layer for the application of double surface dressing the following year.

The seasons that apply for the surface dressing are given in Figure 4.3. There are regional differences in temperature within Ireland with typically the South and East being on average warmer than the remainder of the country. For further details on regional air temperatures, refer to the Irish Meteorological Service Online at www.met.ie. Although Figure 4.3 takes account of the effect that different surface temperature can have on the surface dressing season, it should be regarded as a guide and it should be understood that the season can also be affected by other regional and climatic variations. Weather forecasts should always be obtained before carrying out surface dressing operations.

Any sites surface dressed in the ‘significant risk’ periods at the end of the season should be viewed as late season work and, therefore, more susceptible to winter failures. Accommodation for this can be made by increasing the rate of application of binder. However, the application of additional binder, whilst increasing the probability of surviving the following winter, will also increase the risk of fatting up during subsequent summers.

In the analytical design approach, accommodation for season is dealt with through the number of days to the first major frost. Surface dressing constructed in the middle of the season will have around 100 days until the first major frost occurs, with a reduced number of days for work carried out in the latter part of the season.



	High Risk	Surface dressing should not be undertaken because of the probability of failure.
	Significant Risk	There is some risk of failure (higher in late season) so extra care in the design and execution of the system required. There is a good possibility of success in favourable weather conditions
	Low Risk	Normally successful provided the weather conditions are appropriate for the product.

Figure 4.3: Surface Dressing Season

Notes:

1. Late season work is very risky especially with 10/14 chip.

2. Late season work on high speed, heavily-trafficked roads is not recommended because of the consequences of any failure.

3. 2/6 chippings should not be substituted for 6/10 chippings just to allow late season working.

4.6 Recipe Surface Dressing Analytical Design Procedure

4.6.1 Introduction

This section describes an analytical design approach that shall be adopted to determine the rate of application of the surface dressing binder and the rate of spread of chippings.

Recipe Surface Dressing shall be designed by the Purchaser in accordance with this Chapter of DN-PAV-03074. The design of recipe surface dressing shall only be carried out by a competent designer (who may or may not be directly employed by the Purchaser).

The approach is based on the principles set out in the New Zealand Chipsealing Manual using the Average Least Dimension (ALD) of the chipping to be used together taking consideration of traffic,

texture depth and hardness of the existing pavement to calculate the optimum rates of spread of binder and chippings.

The basic binder application rate is adjusted by a series of site specific adjustment factors to determine the final surface dressing binder application rates. A flow chart illustrating the procedure is shown on Figure 4.2.

The most commonly used sizes of chipping are 2/6, 6/10 and 10/14. The recommended sizes of chippings for each type of surface dressing is shown in Table 4.2. The hardness of the road surface also influences the choice of chipping size to be used in the surface dressing. The use of chippings which are too small will result in early embedment of the chippings in to the underlying road surface leading to a loss of texture depth and possibly fatting up. The choice of chipping size (or primary chipping in multiple layers) based on the hardness of the existing surface and the commercial vehicle traffic is shown in Table 4.3.

The analytical design procedure can be used for single, double and racked-in surface dressing. For single surface dressing the use of the method is currently limited to a minimum chipping size of 6/10.

For further details on the background and underlying engineering principles to the analytical design approach, refer to DN-PAV-03024.

4.6.2 Average Least Dimension (ALD) of Surfacing Chippings

The average least dimension (ALD) of the surface dressing chipping is an essential parameter in the analytical design of surface dressing. The ALD provides a better measure of chip shape than the flakiness index alone. It takes account of the flakiness index and grading of the surfacing chippings and allows the designer to better determine the rate of application of binder and rate of spread of chippings necessary for a particular shape of chip.

The ALD can be determined by direct measurement of a representative batch of surface chippings or can be more easily and accurately calculated using the Dumas Method from the results of the standard grading analysis and flakiness index tests on a sample of chippings.

The ALD of the chippings shall be computed using the Dumas method. The Dumas calculation has been developed as a Microsoft Excel spreadsheet, with the calculated ALD derived directly from the full gradation analysis and the flakiness index data. An example of the Dumas calculation is given in Annex C. The Microsoft Excel spreadsheet is available from the Downloads section of the TII Publications website.

The full Dumas equation and values required for this computational method are outlined in the South Africa test standard TMH1 Method B18(b)T.

For further details on Average Least Dimension (ALD), refer to DN-PAV-03024.

4.6.3 Analytical Design Method

The analytical method has been developed as a Desktop Application (for Windows), based on the inputs of ALD, traffic, texture, hardness, days to first frost together with a number of site specific adjustment factors. A screenshot of the Desktop Application is shown in Annex D and is available for download from the Downloads section of the TII Publications website.

Wherever the surface condition changes or constituent materials change, a new or modified surface dressing design or surface dressing type for the different condition in that section may need to be considered.

4.6.4 Traffic

Traffic shall be calculated in terms of the Equivalent Light Vehicles (ELV) per lane per day using the following formula which assumes the influence of a commercial vehicle as equivalent to ten light vehicles.

T_{ELV} = AADF x (1 + (0.09 x %HCV)) Equation 4.5

where:

T_{ELV} = Equivalent Light Vehicles per lane per day

AADF = Annual Average Daily Flow (vehicles per lane per day)

%HCV = Percentage of heavy commercial vehicles

Table 4.2: Surface Dressing Type

Surface Dressing Type	Chipping Size (mm)		
	Pre-treat	**First Layer**	**Second Layer**
Single Surface Dressing	If required	10/14	n/a
		6/10	
		2/6	
Racked-In Surface Dressing	If required	10/14	2/6 rack-in
		6/10	
Double Surface Dressing	If required	10/14	2/6
		10/14	6/10
		6/10	2/6

Table 4.3: Chipping Size (mm)

Road Hardness: Ball Penetration Device (mm to 25oC)	Traffic Category (cv/lane/day)					
	<250	**251-500**	**501-1000**	**1001 – 2000**	**2001 – 3000**	**Over 3000**
0 to 1	6/10	6/10	6/10 or 10/14	10/14	10/14	10/14
1 to 3	6/10 or 10/14	10/14	10/14	10/14	Not Rec	Not Rec
>3	10/14	10/14	10/14	Not Rec	Not Rec	Not Rec

Not Rec = not recommended

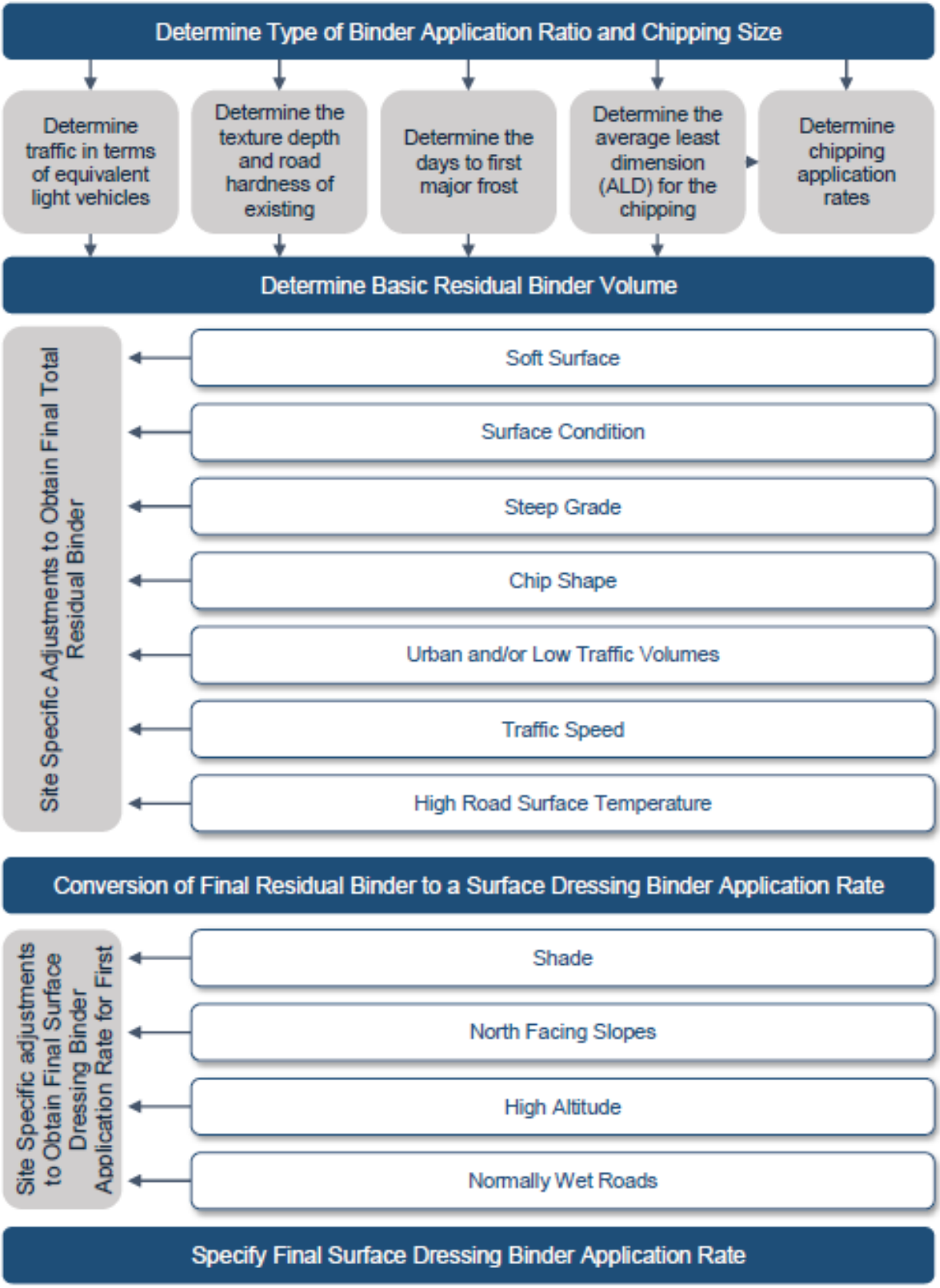


Figure 4.2: Process Flow Chart for Surface Dressing Analytical Design Procedure

4.6.5 Determination of Basic Residual Binder Volume

Based on the requirement to have 35% of the voids filled at the beginning of winter, the surface dressing algorithm for determining the basic residual binder volume (i.e. the bituminous residue after the evaporation of water and any particulates within the binder) is:

Single surface dressing

$V_B = (ALD + (0.7 \times T_D)) \times (0.291 - 0.025 \log_{10} (T_{ELV} \times D_F))$ Equation 4.6

Racked-in and Double surface dressing

$V_B = (ALD + (0.7 \times T_D)) \times (0.347 - 0.029 \log_{10} (T_{ELV} \times D_F))$ Equation 4.7

where:

V_B = Basic residual binder volume (L/m^2)

ALD = average least dimension of the surfacing chippings

T_D = is the texture depth (mm) of the existing surface

T_{ELV} = ELV per lane per day

D_F = Number of days to first major frost (max 100 days, refer to Section 4.5).

The amount that the chip interlocks is a function of the chip sizes being used. The design assumes 30% interlock embedment and the ALD of the chip is therefore increased by 0.7 x T_D, in the algorithm, where TD is the texture depth of the existing substrate.

4.6.6 Site Specific Adjustment Factors to Basic Residual Binder Volume

Site Specific adjustment factors will be applied to the basic residual binder volume (i.e. total for one layer in single or for both layers in double surface dressing) as follows:

$R = V_B + S_S + S_c + G_S + C_S + U_S + T_S + T_R$ Equation 4.8

where:

R = Final total residual binder application rate (L/m2)

V_B = Basic residual binder application rate (L/m2) - from Equation 4.6 or 4.7

S_S = Allowance for soft substrate

S_c = Allowance for surface condition

G_S = Allowance for steep grade

C_S = Allowance for chip shape

U_S = Allowance for urban and/or low traffic volumes

T_S = Allowance for traffic speed

T_R = High road surface temperature

Soft Substrate (Ss)

The hardness of the road surface influences the rate of spread of binder required for a given size of chipping. The rate of spread is reduced where the road surface is soft in order to compensate for the increased embedment of chippings in the existing road surface under traffic. Soft substrates can occur when surface dressing over asphalt or pavement repairs that have not fully cured or hardened, or on weakened pavement. The hardness of the existing pavement surface should be measured using the Ball Penetration device and an adjustment made to the chipping ALD used to calculate the basic application rate for binder as shown in Table 4.4. Where hardness measurements are made using the CTRA probe, the equivalent adjustment is given in Annex A. The adjustment for soft substrate is made to the chipping ALD based on the measured road hardness.

Surface Condition (Sc)

On some surfaces, there can be an excess of existing binder, and a lower application rate is required. On other surfaces binder can be absorbed due to absorptive/porous surface, which in effect results in a lower application rate. Surfaces that may exhibit this condition include open graded bituminous materials and first coat surface dressing over an unbound granular base. There is currently no method available for assessing the degree of absorption/porosity on the existing surface, the preferred procedure is to first use a pad coat surface dressing with a small chip.

Steep Grade (Gs)

On steep uphill grades, slow moving heavy vehicles can cause premature fatting up of the surface as the chipping are under traffic loading for longer and as a result more embedment occurs. Traffic travelling uphill tends to push chippings into the road surface and an adjustment is required to the binder application rate. An adjustment is also required to the binder application rate for climbing lanes (when these are provided) to minimise the chance of binder pick-up from the truck tyres, which causes tracking and potential for fatting up. On downhill gradients, traffic travelling downhill has the opposite effect and can provide more surface stress due to braking. The gradient can be measured on site using a 1 metre straight edge or obtained from RSP machine data from the annual survey on the National network.

Chip Shape (Cs)

The volume of voids is higher when more cubical chips are used, and the binder application rate needs to be increased to allow for chips with more cubical shape. The size and shape of chip is assessed using the grading, flakiness index and ALD. In addition, TII are also considering the introduction of the average greatest dimension (AGD) to improve the evaluation of chip shape. Research is needed to investigate the AGD and ALD/AGD ratio used to assess chip shape for Irish aggregates.

Urban and/or Low Traffic Volumes (Us)

The amount of embedment varies depending on the traffic volume and traffic speed, and some areas of a road may be subject to significantly less traffic. On Urban streets with moderately low traffic volumes (≤ 50 veh/lane/day), surface dressed with normal application rates may suffer from chip loss along centrelines and in parking lanes. Un-trafficked areas, such as hatched sections, and also between the wheel tracks and edges of carriageways, may require more binder. Hard shoulders, and sizeable areas with hatched lines to exclude traffic are effectively untrafficked and the rate of application of binder should be increased in order to compensate for the lack of embedment of chippings. Generally, chip loss will be solved by increasing binder application rates from 10% up to 20%. However, apply this solution with caution especially in areas with higher traffic volumes, otherwise shortened surface dressing life caused by fatting up in the wheel paths may result. It may also be possible to spray higher binder application rates on the centreline and parking lanes on their own. This option is more easily used on very wide streets.

Traffic Speed (Ts)

The site shall be designated as a 'high-speed' or 'low-speed' road. For the purposes of this Standard, high-speed roads are defined as those with a posted speed limit above 80 km/h. Where the surface dressing is likely to be subjected to regular high speeds (i.e. ≥ 80 km/h), consideration should be given to increasing the binder application rate and to using a double surface dressing with premium binders which are recommended on the more heavily-trafficked roads.

High Road Temperature (T_R)

The road surface temperature is a critical factor at the time of surface dressing and immediately afterwards. At lower temperatures, there is less opportunity for the chippings to be embedded in the substrate and, hence, more binder is required and/or a different type of surface dressing may be preferable to hold the chippings during the winter. Adjustment should be made for high road surface temperature at spraying of between 35°C and 45°C. Surface temperatures should always be measured on site but reference might also be made to www.TIItraffic.ie which provides details of road surface temperature at sites throughout the Network.

Details of the above site specific adjustments are shown on Table 4.4.

The above formula (Equation 4.6) provides a basic design only. Site conditions and other site-specific factors will dictate whether or not the application rate may need to be adjusted further.

4.6.7 Conversion of Final Residual Binder to an Emulsion Binder Application Rate

The final residual binder volume is converted to an emulsion binder application rate as follows:

$V_E = R/(V_S)$ Equation 4.9

where:

R = Final total residual binder application rate (L/m^2)

V_E = Surface dressing emulsion binder application rate (L/m^2)

V_S = Proportion of solids in the emulsion (%)

The bitumen content of the emulsion can be obtained from the binder Supplier.

4.6.8 Site Specific Adjustments to Surface Dressing Binder Application Rate for First Layer

The following site specific adjustment factors will be carried out to the surface dressing binder application rate for the primary layer only. Local adjustments should be considered for the following:

a) Effects of shade, or North facing slopes
b) High altitude
c) Normally wet roads

Effects of Shade and North Facing Slopes

Areas of road surface shaded by trees, or in the shadow of building, bridges or tunnels, tend to be cooler and thus more resistant to chipping embedment than areas in the sun. The pavement in the sun could be at 35°C, but in the shade or on north facing slopes could be below 20°C. Thus while the chip in the sunlit areas may have adhered by the end of the working day, the area in the shade may take significantly longer to adhere, and is thus vulnerable to chip loss. To account for this effect, the rate of spread of binder should be increased in shady areas.

If surface dressing is performed near the end of the day followed by a drop in temperature overnight, chip loss may also occur. Surface dressing constructed earlier in the day will adhere and perform better, while those constructed late in the day may lose chippings.

High Altitude

The Designer must make an appropriate adjustment for altitude taking into account lower daily temperatures and increased cloud at higher altitudes (over 200 m above sea level) and on exposed eastern slopes particularly in the uplands of the west of Ireland.

Normally Wet Roads

Drainage along roads should always be inspected and repairs carried out in advance of surface dressing operations. However, this may not always be possible and for continuously wet roads a double surface dressing shall be applied with an additional binder. A continuously wet road is one where water is still ponded on the surface to a width of more than 0.5m or more, 30 minutes after a heavy rainstorm.

Further details of these site specific adjustment factors are shown in Table 4.5. These adjustment factors are applied to the first layer only.

The maximum cumulative adjustment to rate of spread of binder is + 0.4 L/m^2 or – 0.2 L/m^2.

Where the total of the adjustment per layer becomes excessive (> 0.4 L/m^2), the Designer shall reassess the surface dressing design, and consideration should be given to changing the size of aggregate and/or if surface dressing is the appropriate treatment.

4.6.9 Division of Binder Application Rate for Double Surface Dressing

For single and racked in surface dressing the total binder is applied as a single application before any chip is added.

For double surface dressing, the total amount of binder is applied in two applications immediately before the application of each chipping layer. The binder will be split 55% for the bottom layer and 45% for the top layer.

The Designer may wish to amend this to 60% for the bottom layer and 40% for the top layer, particularly if the bottom layer is trafficked prior to the application of the second layer.

$R_B = BAR_B \times V_E$ Equation 4.10

$R_T = BAR_T \times V_E$ Equation 4.11

where:

V_E = Surface dressing emulsion binder application rate (L/m^2)

R_B = emulsion binder application rate for the bottom layer (L/m^2)

R_T = emulsion binder application rate for the top layer (L/m^2)

BAR_B = Proportion of binder application rate on the bottom layer

BAR_T = Proportion of binder application rate on the top layer

The above procedure is based on both layers of the double surface dressing being constructed in succession on the same day.

Table 4.4: Site Specific Adjustments to the Total Basic Binder Application Rate

Allowance	Property	Adjustment (L/m^2)	Comments
Soft Substrate (Ss)	Road hardness (Ball penetrometer @ 25°C)		Road hardness measured using the Ball penetrometer device. The adjustment is made to the chipping ALD based on road hardness.
	1mm or lower	Increase ALD by 1 mm	
	>1mm and <3mm	No change to ALD	
	3mm to 4mm	Decrease ALD by 1mm	
	>5mm		Substrate too soft for normal surface dressing, pre-treatment required
Surface Condition (Sc)	Very binder rich	-0.2	Large chipping should be considered for the wheelpaths as part of a double surface dressing
	Binder rich	-0.1	
	Normal	0	
	Texture in wheel tracks	+0.1	
	Binder lean/porous	+0.2	A pad coat is recommended to normalise and seal
	Very binder lean/and porous, high macrotexture, or variable and hard	Consider design	Double surface dressing is recommended for variable hard and binder lean substrates.
Steep Grade (Gs)	>5% uphill	-0.1	The gradient affects the traffic stress on the surface dressing and, therefore, the rate of embedment. The adjustment is applicable to both layers of a double surface dressing.
	<5%	0	
	>5% downhill	+0.1	
	>10% downhill	+0.2	
Chip Shape (Cs)	ALD/AGD ratio	0	Default value currently set to 0. Research is needed to investigate the ALD/AGD ratio for Irish aggregates.
Urban and /or low traffic volumes (Us)	≤50 cv/lane/day and / or effectively un-trafficked	+0.2	Urban streets surface dressed with normal application rates may suffer from chip loss along centrelines and in parking lanes; and un-trafficked areas, such as hatched sections, and also between the wheel tracks and edges of carriageways, may require more binder.
Traffic Speed (Ts)	High speed (≥80 km/h)	+0.1	Roads subject to high-speed traffic induce greater surface stress. Double surface
	Low speed (<80 km/h)	0	

Allowance	Property	Adjustment (L/m^2)	Comments
			dressings with premium binders are recommended.
High Road Temperature (T_R)	At spraying, 35°C to 45°C	-0.1 to -0.2	Apply to single surface dressing and both layers of double surface dressing.

Table 4.5: Site Specific Adjustment Factors to the Final Binder Application Rate for First Layer

Allowance	Property	Adjustment (L/m^2)	Comments
Shade	Unshaded, open to sun	0	Shaded areas are cooler and, therefore, the road is effectively harder to more binder is required
	Shaded areas	+0.1 for 2/6 +0.2 to +0.3 for 6/10 +0.2 to +0.4 for 10/14	Double surface dressing is recommended for fully shaded areas.
North Facing	North facing slopes	+0.1 for 2/6 or 6/10 +0.2 for 10/14	North facing slopes are cooler and, therefore, the road is effectively harder so more binder is required. Double surface dressing is recommended.
High Altitude	Effects of altitude	+0.1 to +0.3	Adjustment single surface dressing, or first layer of double surface dressing is recommended
Normally Wet Roads	Continuously wet roads	+0.2	Double surface dressing should be adopted for these roads.

Notes

1. The total combined adjustments per layer for Shade, North Facing and High Altitude should not exceed:

- 0.2 L/m^2 for 2/6
- 0.3 L/m^2 for 6/10
- 0.4 L/m^2 for 10/14

4.6.10 Chip Application Rates for Surface Dressing

For the binder application rate to fill the voids in the aggregate mosaic to a depth of about two thirds up the aggregate, it is essential that the aggregate is spread at the design rate.

The rate of spread of chipping shall be calculated as outlined below. The actual quantity required will depend upon factors such as the size, shape and relative density of the chippings.

(i) Single Surface Dressing

For single surface dressing, the quantity of chippings applied must be sufficient to cover the film of binder. The chippings should be spread at a rate to achieve 100 to 105% shoulder to shoulder coverage. The rate of application of chippings for 10/14 and 6/10 shall be calculated as follows.

R_C (Single Surface Dressing) = 1.18 x ALD Equation 4.12

where: R_C = Volume of loose chippings (L/m^2)

(ii) Racked in Surface Dressing

In a racked-in surface dressing, it is very important that the bottom layer of chippings is spread out enough to allow the top layer space to interface and lock into the lower layer. The chipping application rate of the bottom layer should be calculated as follows:

R_{CB} (Racked in Surface Dressing) = 0.95 x ALD Equation 4.13

where: R_{CB} = Volume of loose chippings for the bottom layer (L/m^2)

In accordance with Table 4.2, the top layer will adopt a chipping size of 2/6. The secondary chippings should be spread on the surfacing so that there is an excess, and typically in the range 3.5 to 4.5 L/m^2. The amount necessary will depend on the ratio of the two sizes used, location and the method of spreading. At minor junctions and other locations where traffic will turn across the new surface dressing, it is advantageous to use a greater excess of smaller chippings in order to reduce the possibility of damage from turning traffic in the early life of the surface dressing.

(iii) Double Surface Dressing

For double surface dressing, the rate of spread of the first layer of chippings should be about 95% shoulder-to-shoulder coverage. The second layer should be about 100 to 105% shoulder-to-shoulder coverage. The first chipping is spread at about 90% of the single surface dressing rate to provide a slightly more open mosaic to allow the second application of chippings to more firmly interlock. The rate of application of chippings for bottom layer shall be calculated as follows.

R_{CB} (Double Surface Dressing) = 1.05 x ALD Equation 4.14

where: R_{CB} = Volume of loose chippings for the bottom layer (L/m2)

After the first surface dressing layer has been well rolled, and after the second binder application has been made, the second chipping layer is added. In accordance with Table 4.3, the top layer will adopt a chipping size of 6/10 or 2/6. For the top layer, the chipping application rate should be as follows.

R_{CT} (Double Surface Dressing) = 1.18 x ALD for 6/10 Equation 4.15

R_{CT} (Double Surface Dressing) = 4 to 5.5 L/m^2 for 2/6

where: R_{CT} = Volume of loose chippings for the top layer (L/m^2)

The compatibility of sizes between the two layers of chip is important. Figure 4.4 shows a guide that can be used, based on the second chip being approximately half the size of the first chip. The intersection of the size of the first chip and the size of the second chip should lie within the shaded area on Figure 4.4. This should be checked using the chips that will be used on the job. Chip combinations with ALD intersections above the shaded area should be used very cautiously.

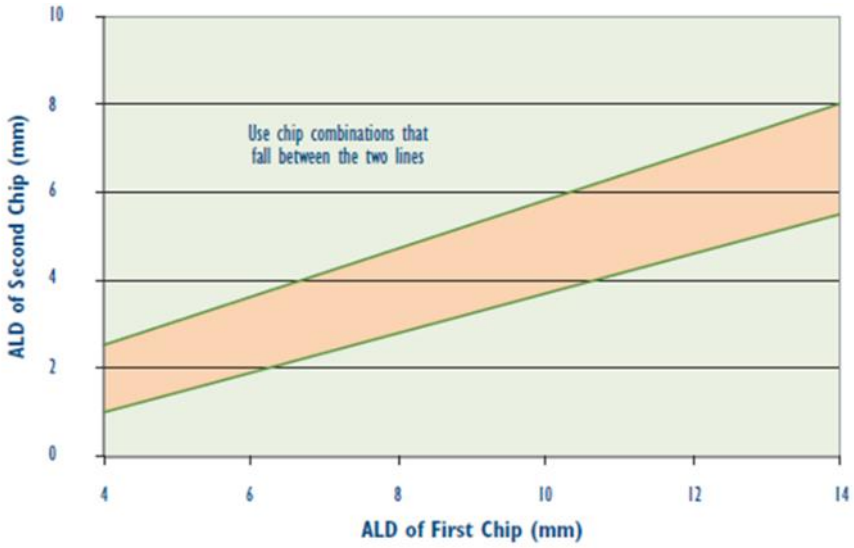


Figure 4.4: Compatibility of First Chip and Second Chip of a Two Coat Surface Dressing

4.7 Recipe Surface Dressing Specification Appendix Requirements

TII Specification for Works Series 900 CC-SPW-00900 Clause 7.2.2 and Clause 10.3.2.1 provide requirements pertaining to the specification and installation of recipe surface dressing.

Recipe Surface Dressing shall be designed by the Purchaser in accordance with this Chapter of DN-PAV-03074.

The design of recipe surface dressing shall only be carried out by a competent designer (who may or may not be directly employed by the Purchaser). If the recipe surface dressing specification is to be followed in this case, the designer shall carry out and prepare a surface dressing design report specific to site (refer to 4.7 (a) to (j))

The Producer is entirely responsible for the supply of all labour, plant, materials along with installation and supervision of the Surface Dressing Works. The Purchaser is responsible for the design and specification of the binder and chippings, when to work depending on weather conditions and aftercare. It has considerable risk for the Purchaser, especially in terms of delegating responsibility for supervision. Appendix 7/21 shall identify the specific requirements and the responsibility for other items including Traffic Management.

The Producer is only responsible if there are defects arising from deficiencies in materials, workmanship and aftercare up until the end of the maintenance period.

Should recipe surface dressing be deemed the most cost effective/optimal option, the criteria outlined below need to be established. These criteria shall be compiled in Appendix 7/21 if the Works, or part thereof, are to be tendered. A sample Specification Appendix 7/21 is provided in CC-GSW-00700.

(a) Location

Details of the road name, number, ITM grid reference of start and finish, lanes to be treated including drawings where appropriate. Site category shall be as defined in Table 4.1 of DN-PAV-03023.

(b) Traffic Volume

As determined under Section 4.3.

(c) Traffic Speed & Site Category

As determined under Section 4.3.

(d) Description of Existing Surface

To include the pertinent items found under Section 4.3 to 4.3.5.

(e) Pre-Treatment

If the assessment under Section 4.3 to 4.4 highlighted the need for pre-treatment, then the requirements shall be clearly defined by the Purchaser. The responsibility for the installation of any pre-treatment works shall be clearly defined as that of the Producer or the Purchaser.

The range of surfacing types that may be encountered and possible pre-treatments to overcome the constraints of the existing surface are discussed in DN-PAV-03024. Pre-treatment works may include surface preparation works to achieve the minimum macrotexture required prior to application of the surface dressing and/or surface/structural repair in accordance with CC-SPW-00900. Examples of pre-treatments include pre-gritting wheel tracks, pre-spraying oil tracks, high pressure water treatments to reinstate texture or sealing the entire road surface. Pre-treatment prior to surface

dressing works on asphalt concrete shall follow the requirements of DN-PAV-03024. Such pre-treatment methods should not adversely affect the existing surface.

For further details on pre-treatments refer to DN-PAV-03024.

(f) Type of Recipe Surface Dressing

The choice of type of recipe surface dressing will depend on the existing site conditions, traffic volumes, traffic speeds, site category and stresses. Choose the type of Recipe Surface Dressing for the site, based on the design traffic and site category parameters as detailed in DN-PAV-03024 taking cognisance of the notes contained with the table.

For descriptions of surface dressing types refer to DN-PAV-03024. The option to choose a higher category of surface dressing type, above the minimum criteria detailed in DN-PAV-03024, shall be open to the Designer. This choice shall only be based on the existing site being at the higher end of a particular traffic category, specific local conditions or a high predicted traffic growth for the site.

(g) Binder

Choose the binder type, based on the site categories, traffic volume and minimum peak cohesion as detailed in DN-PAV-03024, taking cognisance to the notes contained with the table, and Clause 7.2.2.1.1 of the CC-SPW-00900.

Generally, the more stressed the site the higher the cohesivity required but to some extent it is possible to compensate for low cohesivity values by using a more stress resistant surface dressing system. Not all standard binders necessarily meet the lowest level, so that test certificates should always be required. It is always open for a Producer to use a higher grade than that specified.

The rate of application of binder for each type of surface dressing will be calculated using the analytical design procedure set out in Section 4.6 of this Standard.

(h) Aggregate Chippings

Unless otherwise stated in Appendix 7/21, all chippings shall comply with Clause 7.2.2.1.2 of the CC-SPW-00900.

The minimum PSV of aggregate is required to ensure adequate microtexture to provide suitable frictional properties to the road surface and the values in DN-PAV-03023 should be used.

The maximum AAV of aggregate is required to ensure adequate resistance to abrasion by traffic and the values in DN-PAV-03023 should be used.

The average least dimension (ALD) of the chippings shall comply with Clause 7.2.2.1.2 of the CC-SPW-00900.

The most commonly used sizes of chipping are 2/6, 6/10 and 10/14. The recommended sizes of chippings for each of the surface dressing types is shown in Tables 4.2 and 4.3 of this Standard.

The rate of application of surface chippings for each type of surface dressing shall be calculated using the analytical design procedure set out in Section 4.6 of this Standard.

(i) Macrotexture

Requirements for higher speed roads are generally higher than those for lower speed roads. Similarly, high traffic levels require a higher texture at one year than lightly trafficked roads as more embedment occurs under heavier traffic after the one-year measurement point.

The design approach in this Standard has been developed on a method to consistently achieve a texture depth that is acceptable after embedment under trafficking. By using this Standard, a retained texture of 1.0 to 1.5mm would be expected for recipe surface dressing.

(j) Accuracy of Equipment

The recipe surface dressing design shall also state the accuracy of the binder sprayer and chipping spreader. For requirements on the accuracy to be achieved and tolerance permitted, refer to Clause 10.2.3.1 and Table 22a of CC-SPW-00900.

4.8 Surface Dressing Product (End Performance) Specification Appendix Requirements

DN-PAV-03058 Clause 7.2.3 and Clause 10.2.3.2 provides requirements pertaining to the specification and installation of Surface Dressing Product (End Performance).

Surface Dressing Product shall be designed and installed by the Producer in accordance with this Chapter of DN-PAV-03074 and shall be CE marked in accordance with IS EN 12271.

The Producer is also responsible for the supply of all labour, plant, materials along with supervision of the Works.

The Producer is responsible for the design and specification of the binder and chippings, the installation and aftercare of the surface dressing product.

The Producer shall take into account the performance requirements relating to macrotexture and defects and ensure that the values are achieved and retained for the ‘Design Working Life’ period.

The proposed surface dressing shall have been subject to a Type Approval Installation Trial (TAIT) for the intended use in accordance with IS EN 12271.

The Purchaser is responsible for providing information relating to the site including site category, traffic speed, traffic volume, description of existing surface, texture depth and road hardness. The description, texture depth and road hardness of the existing surface are date and location specific and should be regarded only as a guide by the Producer. The final design by the Producer should reflect any changes to the existing substrate in the interim, and the Producer is responsible for ensuring that the visual assessment, texture and hardness data used in the design are representative of the site to be surface dressed.

The Purchaser may limit the type of surface dressing permitted and shall detail the performance requirements in Appendix 7/3.

On very difficult sites only the highest quality, best performing materials coupled with the highest standards of workmanship will be successful. The surface dressing design and installation of the Works needs careful, informed assessment particularly with regard to safety aspects.

Should Surface Dressing Product be deemed the most cost effective/optimal option, the criteria outlined below need to be established for the compilation of Appendix 7/3. A sample Specification Appendix 7/3 is provided in CC-GSW-00700.

(i) Location

Details of the road name, number, ITM grid reference of start and finish, lanes to be treated including drawings where appropriate. Site category shall be as defined in Table 4.1 of DN-PAV-03023.

(ii) Traffic Volume

As determined under Section 4.3.6.

(iii) Traffic Speed & Site Category

As determined under Section 4.3.7 and 4.3.10.

(iv) Description of Existing Surface

To include the pertinent items found under Section 4.3.

(v) Pre-Treatment

The Producer shall be responsible for the design and installation of any pre-treatment works prior to the actual surface dressing works.

(vi) Type of Surface Dressing Product

The Purchaser shall state the type of Surface Dressing based on the criteria detailed in Table 4.2. For descriptions of surface dressing types refer to DN-PAV-03024.

(vii) Binder

The binder shall be polymer modified cationic bituminous emulsion with a peak cohesion as specified in Appendix 7/3.

The Producer shall propose a rate of spread of binder, based on the traffic volume and site category detailed by the Purchaser, to meet the performance requirements of the Contract.

(viii) Aggregate Chippings

The Producer shall propose a chipping type and rate of spread, based on the PSV and AAV requirements detailed by the Purchaser in Appendix 7/3, to meet the performance requirements of the Contract.

The minimum PSV of aggregate is required to ensure adequate microtexture to provide suitable frictional properties to the road surface and the values in DN-PAV-03023 should be used.

The maximum AAV of aggregate is required to ensure adequate resistance to abrasion by traffic and the values in DN-PAV-03023 should be used.

(xi) Adjustments to Design

Adjustments to the rate of spread of binder shall be made by the Producer so as to meet the performance requirements of the surface dressing product.

(xii) Design Working Life

The Purchaser shall detail the 'Design Working Life' period over which the surface dressing product, as designed by the Producer, shall perform. The 'Design Working Life' shall be the period for which the surface dressing product is to be used for its intended purpose without repair being necessary. The 'Design Working Life' period, or period specified in Appendix 7/3, will normally be of 5 years in duration, with the period to commence once the surface is opened to unrestricted traffic. Each site where surface dressing product is installed shall be subject to assessment over the 'Design Working Life'. Further details on the Performance Requirements and 'Design Working Life' period are specified in CC-SPW-00900 Clause 7.2.3.4 and Clause 10.2.3.2.3.

The Purchaser shall be aware that the 'Design Working Life' is different to the 'Defects Period', as defined in the Public Works Contract - Conditions of the Contract. Identification and rectification for defects within the 'Defects Period' shall be treated in accordance with the Conditions of Contract.

(xiii) Macrotexture

Requirements for higher speed roads are generally higher than those for lower speed roads. Similarly, high traffic levels require a higher texture at one year than lightly trafficked roads as more embedment occurs under heavier traffic after the one-year measurement point.

The category of macrotexture to be achieved after eleven months and before thirteen months shall be demonstrated by means of a previously successful TAIT (Type Approval Installation Trial) on the surface dressing product and maintained throughout the 'Design Working Life'.

The required macrotexture, measured in accordance with IS EN 13036-1 and CC-SPW-00900 after eleven months and before thirteen months, shall be chosen from the categories in Table 4.6. These have been derived from IS EN 12271 Table 2. The category appropriate to the site should be specified in Appendix 7/3.

(xiv) Visual Assessment of Defects

The categories of area defects to be achieved by visual assessment after eleven months and before thirteen months shall be demonstrated by means of a previously successful TAIT on the surface dressing product and maintained throughout the 'Design Working Life'. The categories of area defects shall be chosen from Tables 4.7 – 4.10 appropriate to the site. These have been derived from IS EN 12271 Table 2. The category appropriate to the site should be specified in Appendix 7/3.

(xv) Other Requirements

An appropriate special requirement shall be included in the Conditions of Contract drawing particular attention if a 'Design Working Life' duration of longer than five years is required.

The Purchaser should set out any limitations on the availability of a site in Appendix 1/13.

(xvi) Producer Supplied Information

The Producer shall provide additional information as required in CC-GSW-00700 Sample Appendix 7/3.

Table 4.6 – Minimum Macrotexture Levels at the End of the TAIT Period

Traffic (cv/lane/day)	Single or Racked-in surface dressings		Double and multiple surface dressings
	Speed limit ≥ 80 km/h	**Speed limit < 80 km/h**	**All Speeds**
> 3000	≥ 1,5 (Category 4)	≥ 1,5 (Category 4)	≥ 1,0 (Category 3)
251 to 3 000	≥ 1,5 (Category 4)	≥ 1,5 (Category 4)	≥ 1,0 (Category 3)
51 to 250	≥ 1,0 (Category 3)	≥ 1,0 (Category 3)	≥ 0,7 (Category 2)
≤ 50	≥ 1,0 (Category 3)	≥ 0,7 (Category 2)	≥ 0,7 (Category 2)

Table 4.7 – Defect Category: Fatting up, tracking and bleeding

Site Category	Site Definition	Fatting up, tracking and bleeding: % Area P1
B	Dual carriageway	≤ 0,5 (Category 3)
G1/G2	Gradients >5% longer than 50m	
K	Approaches to traffic signals, pedestrian crossings	
Q	Approaches to and across major and minor junctions on dual carriageways and single carriageways where frequent or sudden braking occurs but in a generally straight line	
R	Roundabout circulation areas	
S1/ S2	Bends (radius <250m) on all dual and single carriageways; other hazards that require combined braking and cornering	
C	Single Carriageway (cv/lane/day > 50)	≤ 1,0 (Category 2)
	Single Carriageway (cv/lane/day ≤ 50)	≤ 2,5 (Category 1)

Table 4.8 – Defect Category: Scabbing and tearing

Site Category	Site Definition	Scabbing and tearing: % Area P2
B	Dual carriageway	≤ 0,5 (Category 2)
G1/G2	Gradients >5% longer than 50m	
K	Approaches to traffic signals, pedestrian crossings	
Q	Approaches to and across major and minor junctions on dual carriageways and single carriageways where frequent or sudden braking occurs but in a generally straight line	
R	Roundabout circulation areas	
S1/ S2	Bends (radius <250m) on all dual and single carriageways; other hazards that require combined braking and cornering	
C	Single Carriageway (cv/lane/day > 50)	≤ 0,5 (Category 2)
	Single Carriageway (cv/lane/day ≤ 50)	≤ 1,0 (Category 1)

Table 4.9 – Defect Category: Fretting

Site Category	Site Definition	Fretting: % Area P3
B	Dual carriageway	≤ 3,0 (Category 3)
G1/G2	Gradients >5% longer than 50m	
K	Approaches to traffic signals, pedestrian crossings	
Q	Approaches to and across major and minor junctions on dual carriageways and single carriageways where frequent or sudden braking occurs but in a generally straight line	
R	Roundabout circulation areas	
S1/ S2	Bends (radius <250m) on all dual and single carriageways; other hazards that require combined braking and cornering	
C	Single Carriageway (cv/lane/day > 50)	≤ 6,0 (Category 2)
	Single Carriageway (cv/lane/day ≤ 50)	≤ 10,0 (Category 1)

Table 4.10 – Defect Category: Streaking

Site Category	Site Definition	Streaking: % Area P4
B	Dual carriageway	≤ 10 (Category 3)
G1/G2	Gradients >5% longer than 50m	
K	Approaches to traffic signals, pedestrian crossings	
Q	Approaches to and across major and minor junctions on dual carriageways and single carriageways where frequent or sudden braking occurs but in a generally straight line	
R	Roundabout circulation areas	
S1/ S2	Bends (radius <250m) on all dual and single carriageways; other hazards that require combined braking and cornering	
C	Single Carriageway (cv/lane/day > 50)	≤ 30 (Category 2)
	Single Carriageway (cv/lane/day ≤ 50)	≤ 90 (Category 1)

4.9 Product Approval

4.9.1 TAIT – General

For each surface dressing product to be incorporated into the Works the TAIT report, DoP and CE Mark shall be supplied to the Employer's Representative for review prior to commencement of the Works.

Any proposed surface dressing product shall have an approved TAIT in accordance with IS EN 12271 and the CC-SPW-00900.

If a proposed surface dressing product (end performance) has received an approved TAIT, it shall have been carried out on a site with the same characteristics below to that to be treated in the Contract. The site characteristics are detailed in Table 4.11. The characteristics are defined in terms of non-event/event sites, traffic volumes (in terms of cv/lane/day) and surface dressing types as a means of limiting the number of TAITs and defining families.

The TAIT shall have been installed in accordance with the Producer's certified Factory Production Control system.

4.9.2 TAIT – Performance

It is important for the Purchaser to ensure that the correct performance levels of the surface dressing product are specified and obtained, in particular any parameters specified must be measured to demonstrate compliance.

The Producer shall continue to monitor the TAIT site and declare the period for which the performance characteristics have been retained in his TAIT certificate. This will aid the Purchaser in satisfying themselves that there is minimum risk of failure during the designed life, which may be much longer than the 'Design Working Life'.

Table 4.11 – Limiting Number of TAITs and Defining Families for Surface Dressing Product (End Performance)

Column	1	2	3	4	5	6	7
Line	Parameters that limit the application of a TAIT	Site Categories[1]					
1		Non Event Site				Event Site	
2	Traffic Category (cv/lane/day)	≤ 250			> 250	≤ 250	> 250
3	Type of Binder	Polymer Modified Cationic Bituminous Emulsion					
4	Type of Surface Dressing[2]	S	R	D	D/M	D/M	D/M
5	TAIT family	1	2	3	4	5	6
Notes							
[1] Site categories, and corresponding Investigatory Levels, as defined in DN-PAV-03023 Table 4.1.							
[2] For further advice on surface dressing types refer to DN-PAV-03024.							

4.9.3 Design Working Life

While the surface dressing TAIT is carried out on a defined section and classified in a TAIT family, each site where surface dressing product is installed shall be subject to assessment over the 'Design Working Life'. The same performance tests as detailed in the TAIT shall be used to assess the surface dressing over the duration of the 'Design Working Life'.

The Producer shall be responsible for these performance tests after one year of completion of the installation and at one year intervals thereafter for the five year 'Design Working Life' period, or period specified in Appendix 7/3. Permitted categories of defects shall be in accordance with the requirements of Appendix 7/3. The Purchaser shall monitor the performance levels of the surface dressing product during 'Design Working Life', and bring any defects to the attention of the Purchaser

5. High friction surfacing

5.1 Introduction

The design and performance requirements of high friction surfacing shall be determined in accordance with this Chapter of DN-PAV-03074.

High friction surfacing should only be considered at sites with the highest risk of skid related collisions. The factors to be considered include:

i) Traffic levels and speed;

ii) Difficulty of the site in relation to braking and stopping or frictional forces; and

iii) The existing road surface.

The use of high friction surfacing should be in accordance to DN-PAV-03023.

For high friction surfacing to be suitable there should be a high probability that the treatment will produce the level of performance required over a reasonable lifetime. The factors affecting the decision are: traffic levels and speed, difficulty of the site and the existing road surface.

As would be expected, the heavier the traffic the more critical is the condition of the current surface. On very lightly trafficked roads a successful outcome is possible in virtually all cases subject only to proper design and installation.

For general details on high friction surfacing, refer to DN-PAV-03024.

5.2 Process Flowchart

Figure 5.1 contains a flowchart for specifying high friction surfacing. The flowchart makes reference to various documents contained within TII Publications (Standards) that should be used to assist in determining its use and the requirements and performance of the high friction surfacing.

The information that is required in the flowchart is the minimum that shall be included; other items may be included by the Purchaser depending on site-specific requirements. The information is normative; the layout is informative.

The various stages shown in Figure 5.1 below are discussed in detail in the following Sections of this Standard.

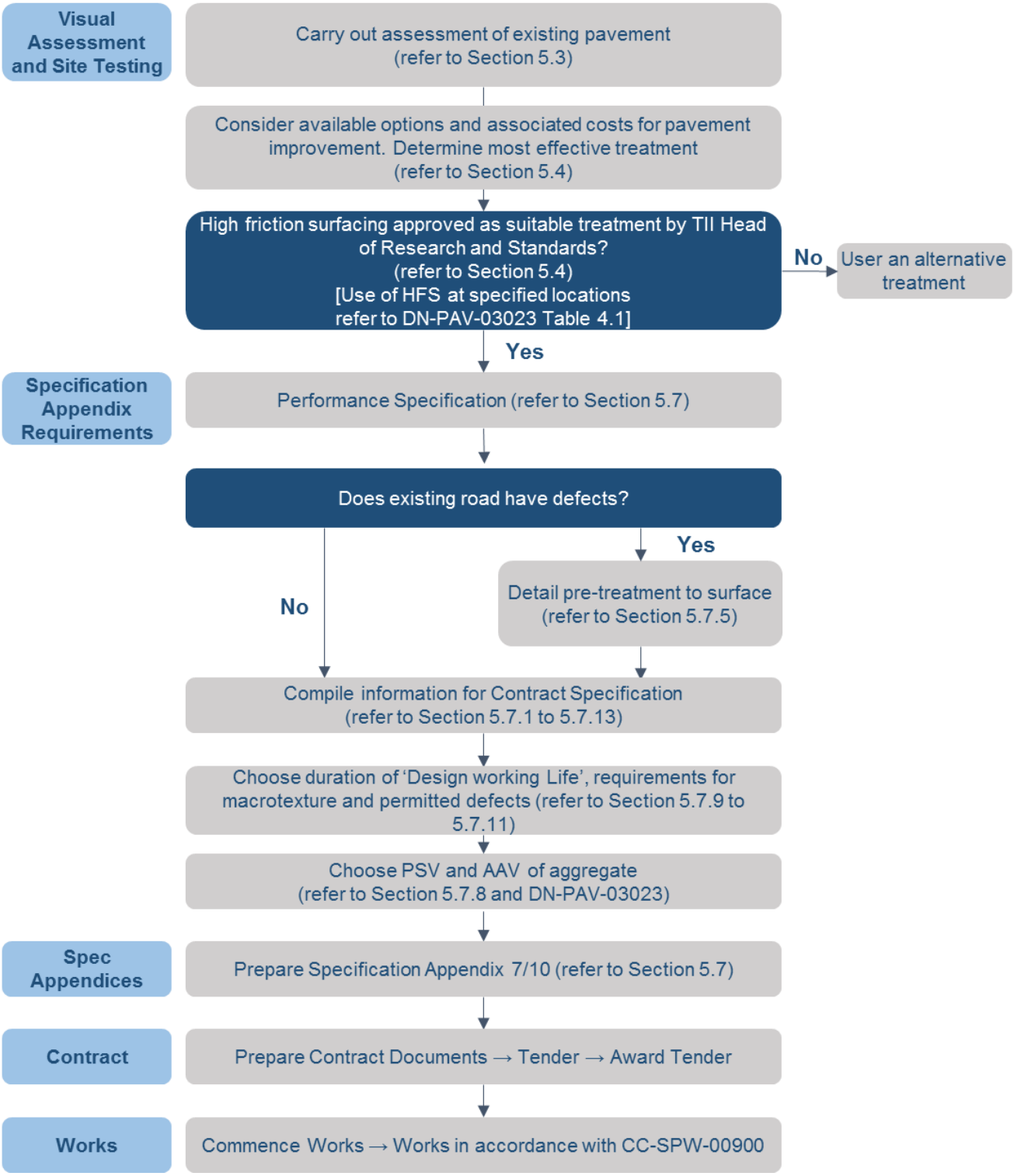


Figure 5.1 – Process Flowchart for High Friction Surfacing

5.3 Assessment

5.3.1 Introduction

The party responsible for maintenance of the pavement should carry out routine inspections to assess the existing road surface. If works are deemed to be required, a representative of the Purchaser (Local Authority engineer, Consultant designer, etc.) should carry out a detailed inspection of the site prior to compiling the Contract Documents. This inspection should include a detailed visual assessment of the existing surface, testing the macrotexture of the road surface, and noting the existing drainage system.

5.3.2 Visual Assessment

A visual assessment of each site where high friction surfacing is proposed should be carried out in accordance with Sub-section 3.3.2. Similar to Sub-section 3.3.2, when high friction surfacing design is being carried out on National Roads, the structural condition of the road should be determined using the TII Pavement Management System.

The Purchaser will need to assess the level of any defects and decide if pre-treatment is required.

5.3.3 Macrotexture

Macrotexture measurements should be carried out in accordance with Sub-section 3.3.3. The minimum macrotexture prior to application of the high friction surfacing shall comply with the requirements of CC-SPW-00900 Clause 10.2.4.2.

5.3.4 Traffic Volume

Traffic volumes shall be determined in in accordance with Sub-section 3.3.4.

5.3.5 Site Category

The site category should be recorded as it relates to the anticipated frictional demand at a site.

The site category based on Table 4.1 of DN-PAV-03023 shall be determined. The investigatory level should be noted in accordance with AM-PAV-06045.

5.4 Suitability of Road for High Friction Surfacing

Following the completion of the assessment of the existing road in accordance with Section 5.3, the Purchaser should document the assessment and seek the approval of TII for use of high friction surfacing.

Sites where high friction surfacing is suitable may contain the following, or a combination of the following criteria:

i) High risk areas where the skid resistance is below required investigatory level satisfactory for a specific site and traffic category;

ii) High stress sites where a large degree of braking and turning are anticipated based on the site and traffic categories; and

iii) High traffic based on the volume of commercial vehicles per lane per day at a site.

Surfaces not suitable for high friction surfacing include microsurfacing, fatted and multilayer surface dressings and surface dressings over soft or unsound bases.

Depending on the level of defects, budget available and time frame for any proposed works, treatment options may include the use of engineering measures to reduce the risk and/or stresses (e.g. minor realignment, improved signage, marking or street lighting), pavement reconstruction and pavement overlay (refer to Chapter 2), microsurfacing and surface dressing with a high PSV aggregate bonded with a binder capable of withstanding the braking forces, and high friction surfacing. The Purchaser should determine the cost of each option and carry out an economic assessment to determine the most cost effective option. If the road surface is found not to be suitable for high friction, an alternative treatment must be found.

Should high friction surfacing be deemed the most cost effective option, the Purchaser shall seek prior approval of the Head of Research and Standards of TII.

The use of high friction surfacing shall only be permitted at the locations specified in Table 4.1 of DN-PAV-03023.

5.5 Length of Application

In accordance with DN-PAV-03023, the minimum treatment length of high friction surfacing shall be 50m. Any extension to this length shall comply with DN-PAV-03023 and be specified in Appendix 7/11.

5.6 Design of Special Applications

5.6.1 Overlaying Concrete

The bond to concrete substrates and therefore the long term performance can be inferior to that achieved on bituminous surfacings. The Contractor shall ensure the performance requirements of the Contract are met in this case.

5.6.2 Overlaying Bituminous Surface Course

Where cold applied high friction surfacing is to be installed over bituminous surface courses at approaches to roundabouts and other highly stressed sites, the deep ‘negative’ texture in the surface can reduce the coverage of resin binder to such an extent that the adherence of the aggregate is reduced, resulting in premature aggregate loss.

To alleviate this problem, and where surface course is installed in accordance with CC-SPW-00900 directly before high friction surfacing, the texture of the area of surface course to be covered by high friction surfacing should be reduced during or after laying to between 1 to 2 mm as measured by the volumetric patch test per IS EN 13036-1. This may be achieved by suitable means, for example by additional compaction with vibrating rollers whilst the thin surfacing is still hot or by the substitution of a smaller aggregate size in these areas. Alternatively, a suitably sized grit may be applied and rolled in.

If the surface course system is to be trafficked prior to the application of high friction surfacing, then 3mm grit should be applied and rolled in to provide enhanced short-term skid resistance. Temporary warning signs may be appropriate in such circumstances.

5.7 Specification Appendix Requirements

Should high friction surfacing be deemed the most cost effective option and the TII Head of Research and Standards has granted approval for its use, the criteria outlined below need to be established for the compilation of Appendix 7/11. A sample Specification Appendix 7/11 is provided in CC-GSW-00700

CC-SPW-00900 Clause 7.3 provides requirements pertaining to high friction surfacing products/systems. High friction surfacing shall be designed and installed by the Contractor and shall have an approved prTAIT in accordance with DN-PAV-03075.

The Contractor is also responsible for the supply of all labour, plant, materials along with supervision of the Works. The Contractor shall take into account the performance requirements relating to macrotexture, tensile adhesion/adhesive strength (using the pull-off test), and defects and ensure that the values are achieved and retained for the 'Design Working Life'. The proposed high friction surfacing shall have been subject to a provisional Type Approval Installation Trial (prTAIT) for the intended use in accordance with DN-PAV-03075.

The Purchaser is responsible for providing information relating to the site, specifying the PSV and AAV of the aggregate and specifying performance requirements; all of which shall be detailed in Appendix 7/11. The following sub-sections detail the items to be included in Appendix 7/11.

5.7.1 Location

Details of the road name, number, ITM grid reference of start and finish, lanes to be treated including drawings where appropriate.

5.7.2 Traffic Volume

As determined under Sub-section 5.3.4.

5.7.3 Site Category and Investigatory Level

As determined under Sub-section 5.3.5.

5.7.4 Description of existing surface

To include the pertinent items found under Sub-sections 5.3.2 and 5.3.3.

5.7.5 Pre-Treatment

If the assessment under Section 5.3 highlighted the need for pre-treatment, then the requirements shall be clearly defined by the Purchaser. The responsibility for the installation of any pre-treatment works shall be clearly defined as that of the Contractor or the Purchaser. Pre-treatment works may include surface preparation works to achieve the minimum macrotexture required prior to application of the high friction surfacing and/or surface/structural repair in accordance with CC-SPW-00900 Clause 10.2.4.2.

Cleanliness of the existing surface is extremely important. The high friction surfacing will only adhere to the top layer of the material on which it is placed and if there is deleterious material then the surfacing may fail due to delamination. It may be necessary to use high pressure washing to remove strongly adherent material or the substrate may be prepared using a milling machine with a fine mill drum. Pre-treatment such as shot blasting may also be necessary to increase the adhesion of the binder to the existing surface.

Any requirement for 'fine milling' i.e., a tool spacing of maximum 8mm, should be specified in Appendix 7/9.

Such pre-treatment methods should not adversely affect the existing surface.

On new surfaces the binder in all high friction surfacing systems can run down into the voids and this may possibly leave insufficient material to ensure even adhesion of the aggregate. It also uses considerably more resin than is necessary for adhesion as it effectively grouts up the surface. Pre-treatment involving gritting may be considered in this case.

5.7.6 Length of Application

As determined under Section 5.5.

5.7.7 Binder

Unless otherwise stated in Appendix 7/11, the Producer shall propose a binder in accordance with CC-SPW-00900 Clause 7.3.1.1 to meet the performance requirements of the Contract.

5.7.8 Aggregate

The Producer shall propose an aggregate type, based on the PSV and AAV requirements detailed by the Purchaser, to meet the performance requirements of the Contract.

The minimum PSV of aggregate is required to ensure adequate frictional properties and the values in CC-SPW-00900 should be used.

The maximum AAV of aggregate is required to ensure adequate resistance to abrasion by traffic and the values in CC-SPW-00900 should be used.

5.7.9 Design Working Life

The Purchaser shall detail the ‘Design Working Life’ period over which the high friction surfacing, as designed by the Producer, shall perform. The ‘Design Working Life’ shall be the period for which the high friction surfacing is to be used for its intended purpose without repair being necessary. This will normally be of 5 years in duration, with the period to commence once the surface is opened to unrestricted traffic. Each site where high friction surfacing is installed shall be subject to assessment over the ‘Design Working Life’.

The Purchaser shall be aware that the ‘Design Working Life’ is different to the ‘Defects Period’, as defined in the Public Works Contract - Conditions of the Contract. Identification and rectification for defects within the ‘Defects Period’ shall be treated in accordance with the Conditions of Contract.

5.7.10 Macrotexture

The category of macrotexture to be achieved shall be demonstrated by means previously successful prTAIT on the high friction surfacing system and maintained throughout the ‘Design Working Life’. The minimum required macrotexture, measured in accordance with IS EN 13036-1, shall be chosen from the categories in Table 5.1. The category appropriate to the site should be specified in Appendix 7/11.

The Purchaser should be aware that the Producer shall ensure that the high friction surfacing has sufficient initial macrotexture depth to enable the performance levels to be achieved.

Table 5.1 – Macrotexture Performance Requirements

Technical requirement	Reference	Unit	Minimum level
Macrotexture minimum for broadcast systems	IS EN 13036-1 (or IS EN ISO 13473-1)	mm	≥ 0.7 for individual measurement and ≥ 1.0 mean
Macrotexture minimum for screeded systems			≥ 0.5 for individual measurement and ≥ 0.8 mean

5.7.11 Visual Assessment of Defects

The categories of defects to be achieved by visual assessment shall be demonstrated by means previously successful prTAIT on the high friction surfacing system and maintained throughout the 'Design Working Life'. The levels of allowable defects shall be chosen from Table 5.2. These levels should be specified in Appendix 7/11.

Table 5.2 – Defect Performance Requirements

Defect	Reference	Unit	Defects within the wheel tracks [1]	Defects outside the wheel tracks [1]
P_1 – fatting up	IS EN 12272-2	%	≤ 0.5	≤ 2
P_2 – delamination	IS EN 12274-8 [2]	%	≤ 0.5	≤ 2
P_3 – fretting	IS EN 12272-2	%	≤ 3	≤ 6
P_4 – grinning	IS EN 12274-8 [2]	%	≤ 3	≤ 6
Notes				
[1] Where the location of the wheel track is indeterminate, the whole area shall meet the wheel track criteria.				
[2] The assessment is carried out using two separate standards, surface dressing and microsurfacing, because the failure mechanisms for high friction surfacing include delamination and wear.				

5.7.12 Other Requirements

An appropriate special requirement shall be included in the Conditions of Contract drawing particular attention if a 'Design Working Life' duration of longer than five years is required.

Appendix 7/11 shall specify the timing of the when the pull-off test shall be carried out. The test shall be carried out at two locations within the Works area, with at least one of these to be in the wheel track zone.

The Purchaser should set out any limitations on the availability of a site in Appendix 1/7.

5.7.13 Producer Supplied Information

The Producer shall provide additional information as required in CC-GSW-00700 Sample Appendix 7/11.

6. Low energy bound mixtures

6.1 Introduction

The design and performance of Low Energy Bound Mixtures (LEBM) shall be determined in accordance with this Chapter of DN-PAV-03074.

LEBM utilise 'cold' aggregates bound with low energy binders such as cement, foamed bitumen, or bitumen emulsions. The aggregates may be a blend of quarried sources, arising from the excavation of roads, or other aggregates. LEBM shall be produced ex situ, in either fixed or mobile mixing plants, or in situ by machinery capable of pulverising the existing road pavement and uniformly mixing controlled amounts of water and binder agents to the full depth in one pass.

This Standard shall allow the use of LEBM as an option on suitable road schemes in Ireland. LEBM may be considered for use in the subbase, base, and binder courses. LEBM should be viewed as a substitute for conventional bituminous mixtures when the risk of failure is minimal and the comparative economic assessment is advantageous.

Once compacted and shaped, the LEBM layer shall be overlaid with a bituminous surfacing or a surface dressing. When LEBM is overlaid with a minimum 40mm of bituminous surfacing, its use is limited to roads carrying up to 10 million standard axles (msa). When LEBM is overlaid with a surface dressing, its use is limited to roads carrying up to 0.5 msa.

LEBM are climate-sensitive products and to date their use in Ireland has been limited. Therefore, the Section below provides all parties involved in LEBM works with a description of the permitted LEBM materials (referred to as 'families'), their constituents, potential benefits and disadvantages. For general details on LEBM families, refer to DN-PAV-03024.

6.2 Process Flowchart

Figure 6.1 contains a flowchart for specifying LEBM. The flowchart makes reference to various documents contained within TII Publications (Standards) that should be used to assist in determining the requirements and performance of LEBM.

The information that is required in the flowchart is the minimum that shall be included; other items may be included by the Purchaser depending on site-specific requirements. The information is normative; the layout is informative.

The various stages shown in Figure 6.1 below are discussed in detail in the following Sections of this Standard.

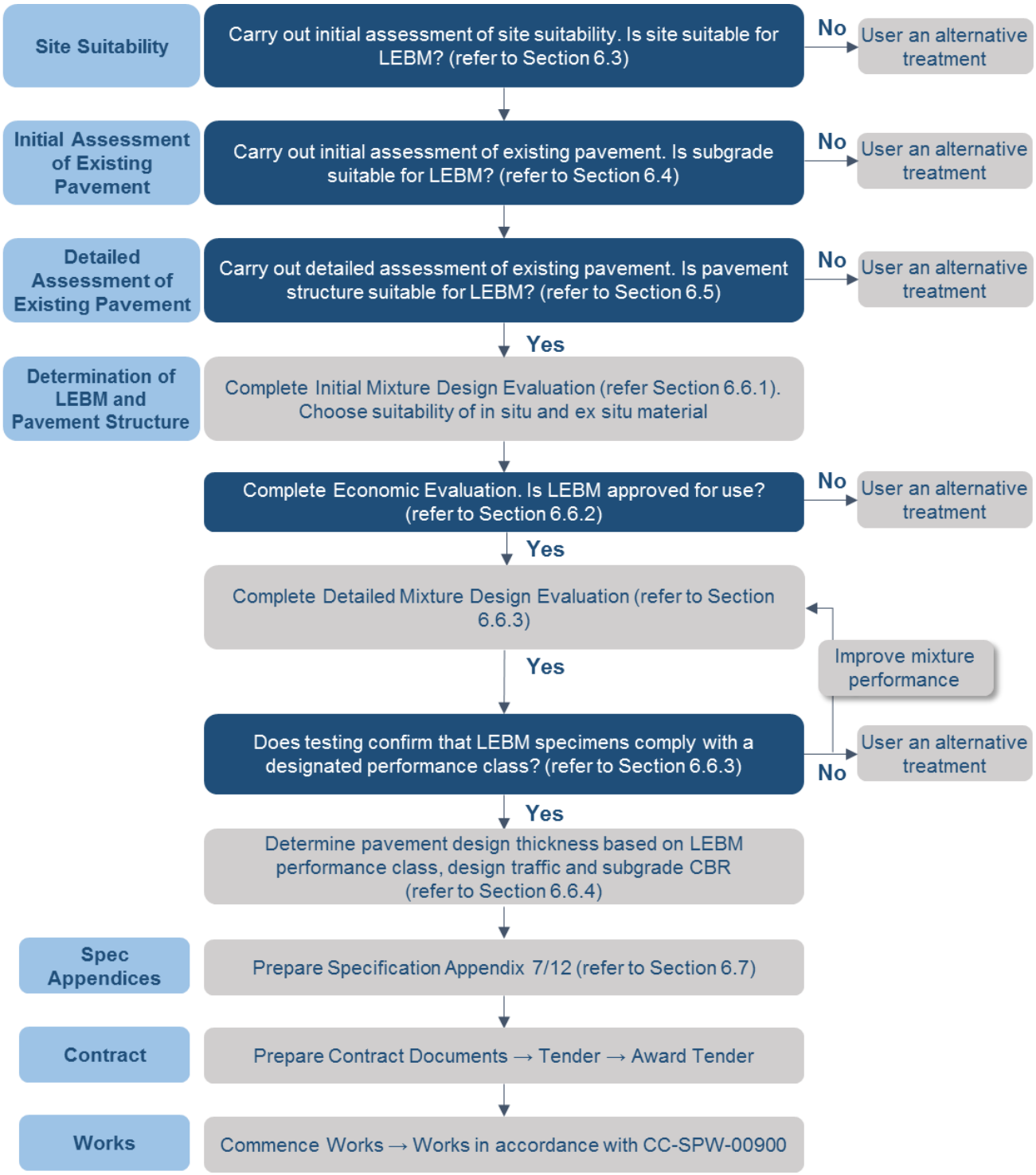


Figure 6.1 – Process Flowchart for the use of Low Energy Bound Mixtures

6.3 Initial Assessment of Site Suitability

6.3.1 Introduction

The party responsible for maintenance of the pavement should carry out routine inspections to assess the existing road pavement. If works are deemed to be required, a representative of the Purchaser (Local Authority engineer, Consultant designer, etc.) should carry out a detailed inspection of the site prior to compiling the Contract Documents. This inspection should include a detailed visual assessment of the existing pavement noting the existing drainage system and an assessment of the anticipated traffic loading.

6.3.2 Visual Assessment of Site

Each site should be inspected on foot to commence the process of detailed design of the road works. The visual assessment should be also carried out to determine the consistency of the existing pavement. Such inspections should be carried out to enable any defects to be recorded and their cause determined.

Observations concerning geological changes and geometric features (e.g. steep grades, sharp curves, cuttings and high embankments) should be recorded. The visual assessment should also note the condition of the existing road drainage. Refer to AM-PAV-06049 and AM-PAV-06050 for assistance on this issue.

When inspecting the road, the extent of any of the following structural defects should be assessed and recorded:

i) Cracking (may include alligator cracking, edge cracking and breakup).
ii) Rutting/wheel tracking.
iii) Heterogeneity/variability (may include pavement deformation, surface distortion).

When inspecting the road, extent of any of the following surface defects should be assessed and recorded:

i) Bleeding.
ii) Fatting up.
iii) Ravelling/fretting.
iv) Patching (may include potholes).

6.3.3 Design Traffic

The design traffic shall be calculated in accordance with PE-SMG-02002. Traffic volumes at the time of the design work may be obtained from the TII traffic data website or site specific traffic counts.

The pavement to be treated shall be given a corresponding road type category, based on the values given in Table 6.1. LEBM shall not be permitted where design traffic exceeds 10msa.

Table 6.1 – Road Type Categories

Road Type Category	Design Traffic (msa) for 20-year design life
1	Roads carrying over 5 to 10 msa
2	Roads carrying over 2.5 to 5 msa
3	Roads carrying over 0.5 to 2.5 msa
4	Roads carrying up to 0.5 msa

Following the completion of the initial assessment of site suitability, the Purchaser should determine if the site conditions are advantageous for the use of LEBM. The use of LEBM shall be deemed as not suitable in the following cases:

i) Design traffic within works area is greater than 10msa;

ii) Use on motorways;

iii) Where only replacement of the surface course is deemed to be required.

6.4 Initial Assessment of Existing Pavement

When LEBM design is being carried out on National Roads, the structural condition of the road should be determined using the TII Pavement Management System. Requisite methodologies to assess the pavement structurally are outlined in AM-PAV-06049 and AM-PAV-06050.

6.4.1 Existing Pavement Subgrade

The subgrade shall be assessed in detail. In situ testing to be carried out shall determine the mechanical strength of the subgrade. The strength of the subgrade shall be classified by using the FWD test method (refer to AM-PAV-06050).

Significant changes in the subgrade shall be detected and boundaries of uniform sections of the subgrade identified using as built records, FWD testing, Ground Penetrating Radar (GPR), and, as needed, coring and trial pits.

The Designer shall be aware that undetected weak areas in the subgrade could adversely affect the performance of the LEBM pavement structure.

Within the proposed limits of the Works, the following shall be identified and recorded:

i) California Bearing Ratio (CBR) of the subgrade;

ii) Significant changes in subgrade CBR; and

iii) Boundaries of uniform sections of subgrade.

Following the completion of the initial existing pavement assessment, the Purchaser should determine if the subgrade condition is of sufficient quality to advantageously utilise LEBM. The use of LEBM shall not be deemed as suitable in the following case:

i) Where subgrade CBR is less than 2%, unless improved in accordance with the requirements of DN-PAV-03021.

6.5 Detailed Assessment of Existing Pavement

A comprehensive site investigation shall be carried out to minimise the design risks using LEBM within the pavement structure. The condition and construction of the existing pavement will have a significant bearing on the methods of assessment as well as the Contract-specific details such as extents of the Works and risk.

6.5.1 Existing Pavement Structure

As built records, where available, should be reviewed to provide an understanding of the existing pavement structure. Coring the existing pavement and excavating trial pits along with non-destructive test methods such as Ground Penetrating Radar (GPR) and Falling Weight Deflectometer (FWD) shall be used to verify the existing pavement structure and determine limits of uniform pavement sections. Refer to AM-PAV-06050 for requirements relating to these test methods.

Within the proposed limits of the Works, the following shall be identified and recorded regarding the existing pavement structure:

i) Individual pavement layer thickness;

ii) Significant changes in the pavement structure;

iii) Boundaries of uniform sections of pavement;

iv) Location of the water table within the pavement structure;

v) Condition of the material in the various layers (e.g., the degree of cracking, cementation or carbonation of any cement-stabilised layer).

Following the completion of the detailed assessment of the existing pavement, the Purchaser should carefully consider if LEBM is a suitable alternative material to traditional bituminous mixture to enable a high confidence level in its long term life expectancy. The use of LEBM shall not be deemed as suitable in the following cases:

i) Where overlay or inlay works propose to retain part or all of the existing bound material;

ii) Where a high water table, within 300mm of formation, is present.

6.5.2 Existing Pavement Material

The assessment of the suitability of materials in an existing pavement structure will only be required if it is anticipated that the LEBM will contain aggregate from the existing pavement structure.

The investigation should determine the opportunity of the existing pavement to produce physically consistent, high quality aggregate for production of LEBM in accordance with CC-SPW-00900.

The assessment shall be carried out in accordance with Table 6.2. The method of sampling should consider the condition and consistency of the existing pavement. Higher inconsistency of the existing pavement requires more intensive sampling. If this fieldwork is not possible, an alternative method of obtaining material for the assessment, such as a limited coring survey, should be investigated.

The assessment may be carried out at the same time as the assessment of the subgrade.

Within the proposed limits of the Works, the following shall be identified and recorded for each pavement layer:

i) Moisture content of the in situ material; and

ii) Grading envelope of the in situ material

Table 6.2 – Site Investigation Requirements

Pavement Type	Fieldwork Proposals	Sampling and Testing
Designed pavement structure comprising standard materials of known thickness and consistency	Excavate full-depth 200mm diameter cores at a target frequency of 1 per 200m in each of the lanes within the Works area, with a minimum of three cores for any scheme. Record details of each construction layer, including any unbound foundation. Obtain separate representative samples of each distinct material.	Collect sufficient representative material from each construction layer to produce a 100kg bulk sample comprising proportionally recombined mixture of materials from all samples. Use bulk sample for design and trial mix tests.
Designed pavement structure comprising standard materials of known thickness and consistency - but with reinstatement of openings or pavement repairs that could locally affect the consistency of the pulverised aggregate.	As above. Plus one full-depth 200mm diameter core from each distinct reinstatement/repair that has an area greater than 25m^2 or extends full width for more than 5m in any lane. Plus minimum of one full-depth 200mm diameter core from smaller, closely spaced and recurrent areas of reinstatements, where their combined area locally, accounts for more than 20% of the paved area in any lane.	As above, with additional representative bulk samples from each distinct area of reinstatement/repair, used to produce additional recombined bulk samples to assess any mixture design changes that may be needed in these areas.
Undesigned pavement structure comprising a variety of standard and/or non-standard materials built over time by maintenance processes, in layers/zones of unknown thickness or continuity.	Carry out an initial evaluation by extracting full-depth 200mm diameter cores at target frequency of 1 per 100m in each lane within the Works area. If materials are consistent proceed with design using the material from the cores as the test samples. If pavement structure is inconsistent, carry out further investigations to determine the extent and/or thickness changes of the different materials using GPR testing. This may be useful to target the position of further cores. Investigate each section using a minimum of three sets of three full-depth 200mm diameter cores, dispersing evenly throughout the section, with at least one core in each lane to be recycled. Obtain representative samples from each layer from each section.	Visually assess the material retrieved from the initial cores to decide on the consistency of materials. For a consistent material profile use the materials from the cores to produce a proportionally representative 100 kg bulk sample for overall design and trial mix tests. For inconsistent material profiles, collect sufficient representative material from each construction layer in each of the defined sections to produce 100 kg bulk samples comprising proportionally recombined mixtures of materials from each section. Use bulk sample from each section for separate design and trial mix tests.

6.6 Determination of appropriate LEBM and Pavement Structure

The LEBM shall be designed within the requirements of CC-SPW-00900 Clause 8.1. Pavement design methods developed by the Purchaser are dependent on the type of contract and may give the Contractor a choice of construction materials. The extent of this choice, including use of ex situ or in situ LEBM, shall be specified in Appendix 7/1.

6.6.1 Initial Mixture Design Evaluation

Using the results of the assessment and materials sampled in accordance with sub-section 6.5.2, an initial exercise shall be undertaken to establish a target grading and suitable moisture content. This shall determine compatibility of the existing in situ material with potential binders and demonstrate suitable workability and compaction is achievable for the Works. In accordance with the requirements of CC-SPW-00900, trial mixtures should be produced utilising different binder compositions and proportions with the target grading and moisture content. The mixture design methods should be fully documented and used as part of the compliance procedure during the Works.

The minimum number of trial mixtures shall be such to determine an indicative trend between proportions of constituent and performance properties. The mix design stage should be as detailed as is economically feasible. Commonly, the greater investment in the mix design stage, the less the risk will be at construction stage.

This preliminary exercise and analysis of trial mixtures shall determine if the in situ material is suitable to be re-used within the production of the LEBM as follows:

i) If the in situ material is deemed suitable, the LEBM works shall be carried out using the in situ material in accordance with the requirements of CC-SPW-00900.

ii) If the in situ material is deemed unsuitable, the LEBM works shall be carried out using ex situ materials in accordance with the requirements of CC-SPW-00900.

6.6.2 Economic Evaluation

Depending on the pavement structure, in situ materials, budget available and time frame for any proposed works, treatment options may include pavement reconstruction (refer to Chapter 2) with or without LEBM. The Purchaser should determine the cost of each option and carry out an economic assessment to determine the most cost effective option.

The assessment shall consider the following:

i) Proximity of suitable location for setting up ex situ plant;

ii) Proximity and availability of source(s) of alternative materials, if required.

In order to compare with conventional treatments, a default analysis period of 20 years should be used. Longer durations may be analysed e.g., where a full-depth reconstruction may need to be assessed over 40 years to be compared with long-life fully flexible pavements. The risks associated with any particular pavement recycling scheme will need to be included in any whole-life cost analysis.

Should LEBM be deemed cost effective, the Purchaser shall seek approval from the National Roads Authority Network Management section for its use. If the use of LEBM is deemed to be uneconomic, the case for its use may still be viable within a wider sustainability campaign. If the site is found not to be suitable for LEBM, an alternative treatment must be found.

Based on this decision, mix designs shall progress to develop a LEBM in accordance with the requirements of CC-SPW-00900.

6.6.3 Detailed Mixture Design Evaluation

Where the site investigation has identified significant variations in existing pavement materials and or bearing capacity of the underlying support layer to the LEBM, a mix design shall be submitted for each differing section.

The mixture design trials should be carried out on aggregates and binders representative of those to be used on the Works. The principle feedstock of aggregate for the mix design process should be the same feedstock of aggregate for the permanent works. If sufficient aggregate from the same source as for the permanent works is not available, the mix design should be performed on aggregate with physical and geological properties that will affect the performance of the mixture as close as is reasonably possible to the aggregate in the permanent works.

For designs utilising reclaimed asphalt, aggregate should ideally be representative of the aggregate obtained by pulverisation or planing for both grading and particle shape. Where a representative component is unavailable, a replacement component of similar physical and geological properties to the representative aggregate shall be used in the mix design stage. The design evaluations may be carried out on LEBM mixed either in the laboratory or on a pilot basis on a full scale plant.

Mixture design trials should consider the early life of the material. Additives may be necessary in order to improve adhesion of the binder to the aggregate, improve dispersion of the binder, modify plasticity of the natural materials, increase the stiffness of the mix and rate of strength gain, and accelerate curing of the compacted mix.

For each trial mixture, cylinder test specimens should be prepared. These cylindrical test specimens shall be 150mm in diameter and 75mm in height. Specimens shall be prepared in sets of six and shall be compacted by vibratory compacting to refusal in accordance with IS EN 12697-8. Compaction of the samples shall be completed within 2 hours after mixing.

Immediately after compaction, the specimens shall be placed in a mould for 24 hours. Samples shall be removed from the mould. Mixtures containing cement only shall be placed in a sealed plastic bag. Care shall be taken when handling the specimens not to damage the specimens.

The specimens shall then be conditioned to simulate the likely curing over the first year in the pavement structure. Conditioning shall occur at 40°C for 72 hours. The specimens shall be stored in air or water at a temperature within 2°C of the nominal conditioning temperature.

After conditioning, the specimens shall be tested in accordance with the requirements of Table 24g of CC-SPW-00900. The following properties/characteristics of the LEBM specimens shall be determined and recorded:

i) In situ density relative to refusal density;

ii) Moisture content;

iii) Indirect tensile stiffness modulus (ITSM); and

iv) Percentage air voids content.

Based on these test results, the expected performance class shall be declared in accordance with Table 6.3. This expected performance class shall be used to determine the pavement thickness design.

6.6.4 Pavement Design

Tables 6.4, 6.5, and 6.6 provide the LEBM thickness design required based on subgrade CBR, design traffic and surfacing type. These designs assume minimum performance requirements for stiffness as shown in Table 6.3.

Table 6.3 – Requirements for LEBM performance classes

Performance Class	Requirement (MPa)
Class 1	≥ 1000
Class 2	≥ 1750
Class 3	≥ 2500

The types of surfacing that are permitted to overlay LEBM are as follows:

i) Surface dressing only;

ii) SMA surface course, 40mm depth; and

iii) Bituminous mixture 100mm depth.

If the adjoining surfacing is HRA, type (iii) shall apply.

The stiffness of the selected surfacing affects the required thickness of the LEBM layer in the pavement structure.

Surface dressing and bituminous mixtures shall be designed per their respective design processes.

The Designer shall be aware that:

i) The pavement thickness design assumes the primary pavement failure criteria is fatigue of the bituminous surfacing and LEBM layer, both have been assumed to behave as in a flexible pavement;

ii) Failure due to permanent deformation has not been considered;

iii) LEBM with higher bituminous content displays fatigue behaviour similar to bituminous mixtures; and

iv) Mixes with lower binder content behave more as unbound materials, thus cumulated permanent deformations are important.

Table 6.4 – Pavement thicknesses for LEBM utilising Performance Class 1

LEBM Stiffness Class 1: ≥ 1000 MPa												
Subgrade CBR (%)	**Thickness of LEBM (mm)**											
	Road Type 4			**Road Type 3**			**Road Type 2**			**Road Type 1**		
≤ 2	n/r	n/r	260	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
≤ 5	n/r	300	220	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
≤ 8	n/r	280	190	n/r	n/r	280	n/r	n/r	n/r	n/r	n/r	n/r
≤ 15	n/r	250	160	n/r	n/r	250	n/r	n/r	270	n/r	n/r	n/r
Surfacing thickness	Surface dressing	40 mm	100 mm	Surface dressing	40 mm	100 mm	Surface dressing	40 mm	100 mm	Surface dressing	40 mm	100 mm
Notes												
n/r: not recommended												
Minimum layer thickness for CTM is 150mm												

Table 6.5 – Pavement thicknesses for LEBM utilising Performance Class 2

LEBM Stiffness Class 2: ≥ 1750 MPa												
Subgrade CBR (%)	**Thickness of LEBM (mm)**											
	Road Type 4			**Road Type 3**			**Road Type 2**			**Road Type 1**		
≤ 2	n/r	275	200	n/r	n/r	290	n/r	n/r	n/r	n/r	n/r	n/r
≤ 5	n/r	250	170	n/r	n/r	250	n/r	n/r	290	n/r	n/r	n/r
≤ 8	n/r	230	150	n/r	n/r	230	n/r	n/r	270	n/r	n/r	300
≤ 15	n/r	200	130	n/r	270	200	n/r	n/r	240	n/r	n/r	275
Surfacing thickness	Surface dressing	40 mm	100 mm	Surface dressing	40 mm	100 mm	Surface dressing	40 mm	100 mm	Surface dressing	40 mm	100 mm
Notes												
n/r: not recommended												
Minimum layer thickness for CTM is 150mm												

Table 6.6 – Pavement thicknesses for LEBM utilising Performance Class 3

LEBM Stiffness Class 3: ≥ 2500 MPa												
Subgrade CBR (%)	**Thickness of LEBM (mm)**											
	Road Type 4			**Road Type 3**			**Road Type 2**			**Road Type 1**		
≤ 2	n/r	240	180	n/r	n/r	250	n/r	n/r	290	n/r	n/r	n/r
≤ 5	280	220	150	n/r	280	210	n/r	n/r	250	n/r	n/r	n/r
≤ 8	260	200	130	n/r	260	200	n/r	295	230	n/r	n/r	260
≤ 15	240	175	110	n/r	240	170	n/r	270	220	n/r	n/r	240
Surfacing thickness	Surface dressing	40 mm	100 mm	Surface dressing	40 mm	100 mm	Surface dressing	40 mm	100 mm	Surface dressing	40 mm	100 mm
Notes												
n/r: not recommended												
Minimum layer thickness for CTM is 150mm												

6.7 Specification Appendix Requirements

Should LEBM be deemed the most cost effective option and the TII Network Management section has granted approval for its use, the criteria outlined below need to be established for the compilation of Appendix 7/12. A sample Specification Appendix 7/12 is provided in CC-GSW-00700 and should be complied with reference to CC-SPW-00900 Clause 8.1 which provides the requirements pertaining to LEBM constituents and composition.

The Producer is responsible for the supply of all labour, plant, materials along with supervision of the Works. The Producer shall take into account the performance requirements relating to stiffness and strength and ensure that the values are achieved and retained in accordance with the requirements of CC-SPW-00900 and Appendices to the Specification.

The Purchaser is responsible for providing information relating to the site, product testing requirements, and specifying performance requirements; all of which shall be detailed in Appendix 7/12. Depending on the Contract, the Purchaser may also provide details on existing pavement structure, subgrade and material. The following sub-sections detail the items to be included in Appendix 7/12, subject to the Contract.

6.7.1 Location

Details of the road name, number, ITM grid reference of start and finish, extents of the Works including drawings where appropriate.

6.7.2 Design Traffic

As determined under sub-section 6.3.3.

6.7.3 Description of existing surface

To include the pertinent items found under sub-section 6.3.2.

6.7.4 Existing Pavement Subgrade

As determined under sub-section 6.4.1, detail the following:

a) CBR;
b) Significant changes in CBR;
c) Boundaries of uniform sections of subgrade;
d) Condition of the material.

6.7.5 Existing Pavement Structure

As determined under sub-section 6.5.1, detail the following:

a) Individual pavement layer thickness;
b) Significant changes in the pavement structure (if any);
c) Boundaries of uniform sections of pavement;
d) Location of the water table within the pavement structure.
e) Condition of the material in the various layers (e.g., the degree of cracking, cementation or carbonation of any cement-stabilised layer).

6.7.6 Existing Pavement Material

As determined under sub-section 6.5.2, detail the following:

a) Moisture content of in-situ material;

b) Grading envelope of in-situ material.

6.7.7 Binder

Unless otherwise specified in Appendix 7/12, a binder in accordance with CC-SPW-00900 Clause 8.1.1.1 to meet the performance requirements of the Contract shall be used.

6.7.8 Conditioning for Mixture Design Evaluation

If specified in Appendix 7/12, the conditioning requirements specified in paragraph 7 of sub-section 6.6.3 may be altered based on information from previous works with similar material and methods or where other equivalent curing regimes have been used to simulate the first year curing of the material.

6.7.9 Sealant

Unless otherwise specified in Appendix 7/12, the Producer shall apply a bitumen emulsion sealant on completion of compaction of the LEBM to comply with the requirements of CC-SPW-00900 Clause 10.3.1.9.

6.7.10 Other Requirements

Unless otherwise specified in Appendix 7/12, the testing regime to demonstrate the LEBM performance shall comply with CC-SPW-00900 Clause 10.3.1.11.

The Purchaser should set out any limitations on the availability of a site in Appendix 1/7.

6.7.11 Producer Supplied Information

In addition to the Purchaser providing the requirements contained in sub-sections 6.7.1 to 6.7.11, the Producer shall provide additional information and this shall also be contained in Appendix 7/12. The Purchaser shall detail the specific information required, as contained in CC-GSW-00700 sample Appendix 7/12.

7. Geotextiles and Geotextile-Related products

7.1 Introduction

The requirements for using geotextiles and geotextile related products in pavement rehabilitation or strengthening shall be determined in accordance with this Chapter of DN-PAV-03074.

The use of geotextiles and geotextile-related products is to be considered as a part of an interlayer and asphalt overlay system. The products shall not be incorporated between a binder course and surface course.

The intended use of these geotextiles and geotextile-related products is to fulfil one or more of the functions in the following sub-sections.

7.1.1 Reinforcement

Reinforcement at low strain – binding the asphaltic layer together to resist crack propagation in either direction, spanning the potential crack

7.1.2 Barrier

Sealing – prevention of water penetration into lower layers and the avoidance of associated problems due to freeze/thaw effects and the need for lower drainage to remove subsurface water; potential reduction of oxidation of lower bitumen layers.

7.1.3 Stress relief

Stress Absorption – absorb transient stress in all directions.

For general details on geotextiles and geotextile-related products, refer to DN-PAV-03024.

7.2 Process Flowchart

Figure 7.1 contains a flowchart for specifying geotextiles.

The information that is required in the flowchart is the minimum that shall be included; other items may be included by the Purchaser depending on site-specific requirements. The information is normative; the layout is informative.

The various stages shown in Figure 7.1 below are discussed in detail in the following Sections of this Standard.

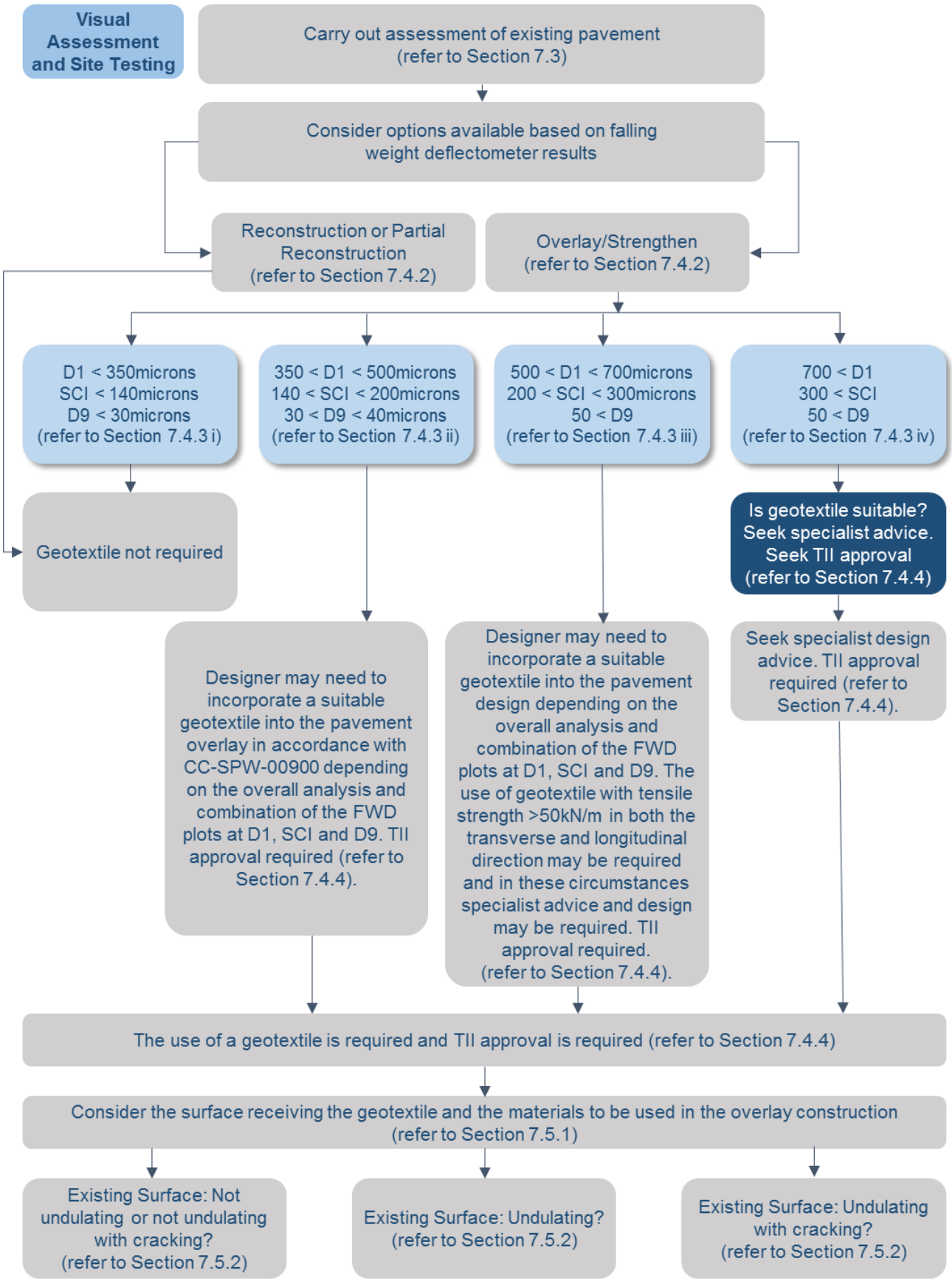


Figure 7.1 – Process Flowchart for the use of Geotextile and Geotextile-related Products

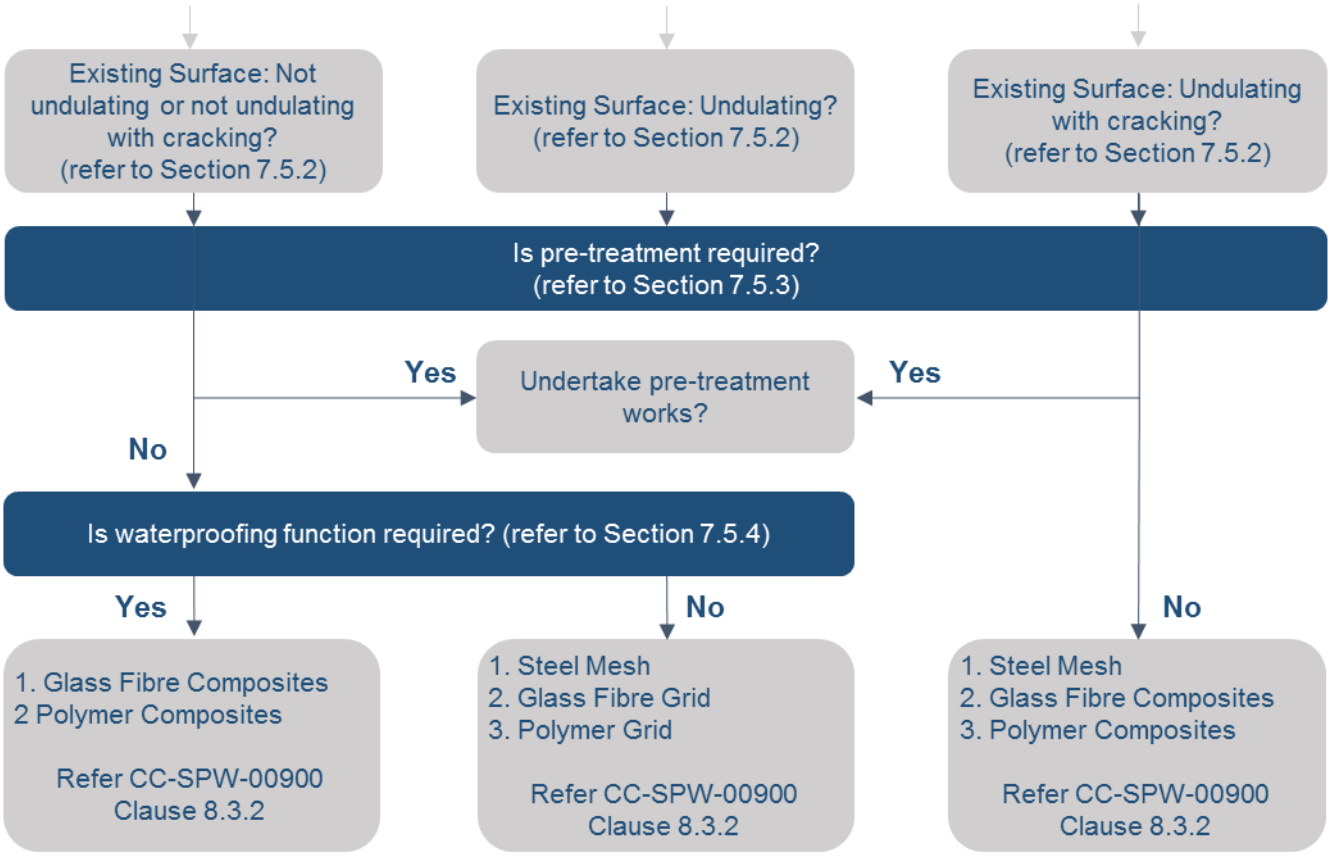


Figure 7.1 – Process Flowchart for the use of Geotextiles and Geotextile-related Products (contd.)

7.3 Assessment

7.3.1 Introduction

The party responsible for maintenance of the pavement should carry out routine inspections to assess the existing road pavement. If works are deemed to be required, a representative of the Purchaser (Local Authority engineer, Consultant designer, etc.) should carry out a detailed inspection of the site prior to compiling the Contract Documents. This inspection should include a detailed visual assessment of the existing pavement and noting the existing drainage system.

Along with a detailed inspection of the project site, site-specific records of the existing pavement conditions shall be gathered. These records are outlined below.

7.3.2 Surface Cracking and Profile

Information on surface cracking should be recorded as follows:

i) Number and length of cracks greater than 5mm with spalling and bifurcation.
ii) Number and length of cracks less than 5mm wide.
iii) Location of cracks (e.g. only in wheel tracks or over the entire road surface).
iv) Photographs 1m from road surface.

Other information required on the conditions and history of the existing pavement to be gathered include:

i) Type and details of existing road construction.
ii) Location of service trenches.
iii) Temperature variations in time (day, night, season), if relevant.
iv) Pavement and soil properties.
v) Drainage and groundwater information.

The existing surface shall be termed as ‘not undulating or not undulating with cracking’, ‘undulating’ or ‘undulating with cracking’. A surface shall be defined as ‘not undulating’ when the surface profile, both longitudinally and transversely, allows the product to achieve full contact with the surface. Where a surface is defined as ‘undulating’, pre-treatment may be required.

7.3.3 Pavement Testing

The Falling Weight Deflectometer (FWD) test provides information on the material properties of the pavement layers and the strength of the underlying subgrade. The area where use of a geotextile is proposed shall undergo FWD testing prior to a decision on the type of pavement works being made.

For requirements on the use of the FWD test refer to AM-PAV-06050.

7.4 Suitability of Road for Geotextiles

7.4.1 Economic Assessment

Following the completion of the assessment of the existing road in accordance with Section 7.3, the Purchaser should carefully consider if use of a geotextile is appropriate treatment for the pavement.

Depending on the level of defects, budget available and time frame for any proposed Works, treatment options may include pavement reconstruction, partial reconstruction, pavement overlay or pavement strengthening. The Purchaser should determine the cost of each option and carry out an economic assessment to determine the most cost effective option.

Primary factors to be included in any economic assessment of a proposed geotextile product are:

i) Cost of geotextile product.

ii) Cost of specialised installation equipment and road/lane closures.

iii) Recycling characteristics of the product, including removal at end of its working life.

iv) Cost of alternative treatment options.

v) Cost of maintenance during pavement service life for both treatment options.

vi) Regional experience.

7.4.2 New Pavement Construction

Geotextiles and geotextile-related products shall not be deemed suitable where full or partial reconstruction is determined as the most cost effective option.

Geotextiles and geotextile-related products shall be deemed suitable where overlay or strengthening of the existing pavement is determined as the most cost effective option.

7.4.3 FWD Test Results

The results from the FWD survey should be assessed for guidance on the appropriateness of geotextiles for the proposed Contract. As detailed in Figure 7.1, the FWD results may be used as criteria where a geotextile may be suitable.

i. Where the deflection results are very low i.e., where D1 < 350 microns, SCI < 140 microns and D9 < 30 microns:

a) Pavement typically classed as ‘very strong to reasonably strong’;

b) Subgrade typically classed as ‘stiff to moderate subgrade’; and

c) Geotextile is not required.

ii. Where D1 ranges between 350 – 500 microns, SCI ranges between 140 – 200 microns, and D9 ranges between 30 – 40microns:

a) Pavement typically classed as ‘moderate pavement probably requires overlay depending on traffic volume’;

b) Subgrade typically classed as ‘moderate to weak subgrade’; and

c) Suitable geotextile may need to be incorporated as defined in Figure 7.1.

iii. Where D1 ranges between 500 – 700 microns, SCI ranges between 200 – 300 microns and D9 > 50:

a) Pavement typically classed as ‘moderate to weak pavement requiring overlay’;

b) Subgrade typically classed as ‘very weak subgrade’; and

c) Suitable geotextile may need to be incorporated as defined in Figure 7.1.

iv. Where the deflection results are very high i.e., where D1 > 700 microns, SCI > 300 microns and D9 > 50:

a) Pavement typically classed as 'poor';

b) Subgrade typically classed as 'very weak subgrade'; and

c) The Designer shall seek specialist design advice to determine if a geotextile should be incorporated.

The Designer should use the guidance outlined below to determine if a geotextile is suitable, based on results from the FWD survey.

7.4.4 Approval

Should a geotextile be proposed for use in the pavement design, the Purchaser shall seek approval from the TII Network Management section for its use.

7.5 Product Requirements

Should the use of geotextiles be deemed part of the most suitable treatment option and the TII Network Management section has granted approval for its use, the criteria outlined in the sub-sections below need to be established to determine the type and characteristics of the appropriate geotextile product for a given Contract.

7.5.1 Required Performance and Limitations

The following points should be considered when choosing a suitable geotextile product for a given application:

a) The required life of the solution – acceptable level of cracks over a specified time table.

b) The presumed life of any alternative solution.

c) Any practical limitations on overlay thickness.

d) Details of any other planned works which will impinge on, or compromise the chosen solution.

e) Details of any likely changes in traffic characteristics with time.

f) Any limitations on carriageway possessions in terms of time or space.

7.5.2 Description of Existing Surface

To include the pertinent items found under sub-section 7.3.2.

7.5.3 Pre-Treatment

If the assessment under Section 7.3 highlighted the need for pre-treatment, regulating works in accordance with CC-SPW-00900 shall be undertaken to allow the product achieve full contact with the surface. Surface cracks greater than 5mm with spalling and bifurcation shall be sealed as part of pre-treatment works.

7.5.4 Sealing of Existing Surface

For the existing surfaces classified as 'not undulating or not undulating with cracking' or 'undulating', the requirement for waterproofing of the pavement shall also be confirmed.

7.6 Product Selection

Based on the criteria requirements and the decisions outlined in Figure 7.1, a suitable geotextile product shall be chosen. Any such product chosen shall comply with the requirements of CC-SPW-00900.

8. Retexturing

8.1 Introduction

The requirements for use of retexturing shall be determined in accordance with this Chapter of this standard.

For retexturing to be suitable there should be a high probability that the treatment will produce the level of performance required over a reasonable lifetime.

For general details on retexturing refer to DN-PAV-03024.

8.2 Process Flowchart

Figure 8.1 contains a flowchart for specifying retexturing.

The information that is required in the flowchart is the minimum that shall be included; other items may be included by the Purchaser depending on site-specific requirements. The information is normative; the layout is informative.

The various stages shown in Figure 8.1 below are discussed in detail in the following sections of this Standard.

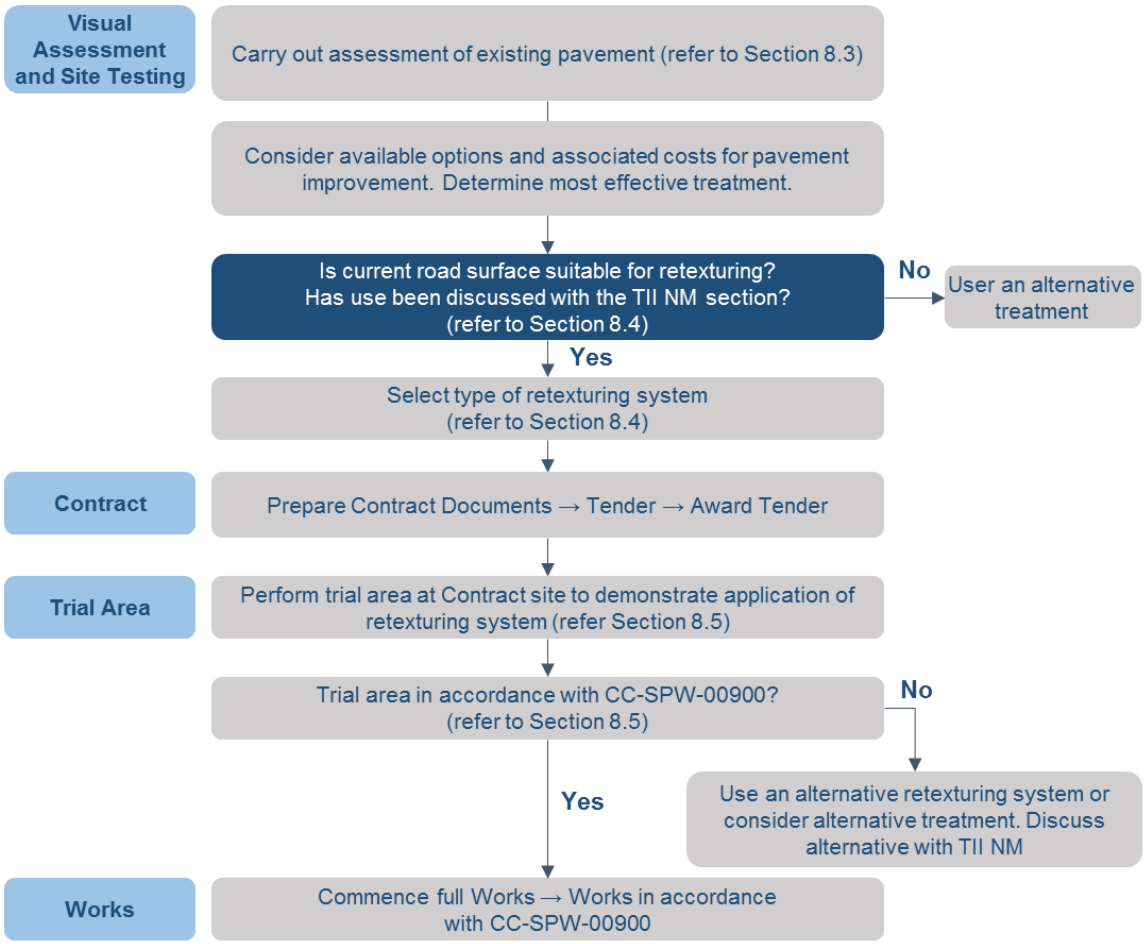


Figure 8.1 – Process Flowchart for Retexturing

8.3 Assessment

8.3.1 Introduction

The party responsible for maintenance of the pavement should carry out routine inspections to assess the existing road surface. If works are deemed to be required, a representative of the Purchaser (Local Authority engineer, Consultant designer, etc.) should carry out a detailed inspection of the site prior to compiling the Contract Documents. This inspection should include a detailed visual assessment of the existing surface and noting the existing drainage system.

8.3.2 Visual Assessment

A visual assessment of each site where retexturing is proposed should be carried out in accordance with sub-section 3.3.2. Similar to sub-section 3.3.2, when retexturing is being carried out on National Roads, the structural condition of the road should be determined using the TII Pavement Management System.

The visual assessment shall record the existing surface course material and any surface defects in the area proposed for treatment.

8.3.3 Traffic Volume

Traffic volumes shall be determined in in accordance with sub-section 3.3.4.

8.3.4 Site Category

The site category based on Table 4.1 of DN-PAV-03023 shall be determined. The investigatory level should be noted in accordance with AM-PAV-6045.

8.4 Suitability of Road for Retexturing

Following the completion of the assessment of the existing road in accordance with Section 8.3, the Purchaser should carefully consider if retexturing is an appropriate treatment for the surface or if rectification works need to be carried out to enable a high confidence level in its long term life expectancy. The Purchaser should be aware that retexturing is not suitable where surface and/or structural defects are recorded in the area proposed for treatment.

Depending on the level of defects, budget available and time frame for any proposed Works, treatment options may include pavement reconstruction, pavement overlay (for both refer to Chapter 2) and retexturing. The Purchaser should determine the cost of each option and carry out an economic assessment to determine the most cost effective option. If the road surface is found not to be suitable for retexturing, an alternative treatment must be found. Before on suitability of the road, it is recommended that the Purchaser discuss the use of retexturing with the TII Network Management section.

CC-SPW-00900 Table 25b shall be used to select the appropriate retexturing treatment. The existing surface course and defects recorded shall be used as criteria to choose the appropriate procedure.

8.5 Trial Area

In accordance with CC-SPW-00900 Clause 8.2, the Contractor shall perform a trial area prior to the commencement of the Works. This trial shall demonstrate the consistency of the specified treatment in both the transverse and longitudinal directions.

9. Permanent Repair Material Systems and Localised Surface Repair Systems

9.1 Introduction

The requirements for use of Permanent Repair Material Systems (PRMS) and Localised Surface Repair Systems (LSRS) shall be determined in accordance with this Chapter of this standard. The prTAIT requirements for PRMS and LSRS are detailed in DN-PAV-03075.

Surface defect repairs that may be appropriate for remedial treatment with PRMS/LSRS include potholes, delamination, surface cracks, joint failures and previously patched areas.

All sites with such surface defects should be considered suitable for treatment with PRMS/LSRS. However, these systems should not be seen as a long-term alternative to rectifying defects and they shall be used as part of routine maintenance works only. Any PRMS/LSRS shall be registered with TII through the Pilots and Trials process as per RE-PTP-07003 before the commencement and after the completion of the prTAIT process. Procedures for the prTAIT process of PRMS and LSRS are outlined in DN-PAV-03075.

9.2 Descriptions

9.2.1 Permanent Repair Material Systems

PRMS utilise a cold-lay bituminous material which shall be used for the permanent repair of surface defects, filling of road stud cavities and core holes, filling around ironworks, and utility cuttings/openings conforming to the requirements of CC-SPW-00900.

PRMS shall be produced in plants that are independently accredited to IS EN ISO 9001 or an equivalent quality management system.

PRMS may be proprietary products.

As PRMS are currently not covered by a harmonised European standard, product/system manufacturers or Contractors may provide a European Technical Assessment (ETA) to enable a PRMS to be CE Marked in accordance with the requirements of CC-SPW-00900.

Until such time as a PRMS has been CE marked through the ETA process, the requirements of this standard, CC-SPW-00900 and DN-PAV-03075 shall apply.

PRMS shall not be permitted for use in trench reinstatements.

PRMS used shall comply with all the testing requirements of CC-SPW-00900and DN-PAV-03075.

In conducting the works, the Employer may engage their own resources or a suitable external party to install the PRMS. Inspections after the Works are carried out shall be in accordance with DN-PAV-03075.

9.2.2 Localised Surface Repair Systems

LSRS utilise an infra-red process that reconstitutes the surfacing material in-situ to provide a permanent repair and which conforms to the requirements of CC-SPW-00900.

LSRS may be proprietary systems.

As LSRS are currently not covered by a harmonised European standard, Contractors may provide a European Technical Assessment (ETA) to enable a LSRS to be CE Marked in accordance with the requirements of CC-SPW-00900.

Until such time as a LSRS has been CE marked through the ETA process, the requirements of this standard, CC-SPW-00900 and DN-PAV-03075 shall apply.

LSRS shall not be permitted for use in trench reinstatements.

Additional materials for LSRS works shall comply with all the testing requirements of CC-SPW-00900.

LSRS used shall comply with all the testing requirements of CC-SPW-00900 and DN-PAV-03075.

In conducting the works, the Employer may engage their own resources or a suitable external party to install the LSRS. Inspections after the Works are carried out shall be in accordance with DN-PAV-03075.

9.3 General Requirements

Given the intended use of PRMS and LSRS, the maximum advised individual area of repair allowed using PRMS shall be approximately $2m^2$.

The Employer should be aware that PRMS and LSRS may not be suitable for treatment of extensive surface defects or defects within the unbound layers of the pavement structure.

The design and manufacture of the PRMS and LSRS are the responsibility of the product/system manufacturer. The installation of PRMS and LSRS are the responsibility of the Contractor/Employer's Agent where appropriate.

Where applicable, an appropriate special requirement shall be included in the Contract Conditions or the Works Requirements which draws particular attention to CC-SPW-00900 Clause 10.3.3.9 and DN-PAV-03075.

9.4 Process Flowchart

Figure 9.1 contains a flowchart for specifying PRMS/LSRS. It details the steps for the Employer and Contractor to follow in assessment, preparation, monitoring, replacement (if required) and agreement of PRMS/LSRS.

The information that is required in the flowchart is the minimum that shall be included; other items may be included by the Employer depending on site-specific requirements. The information is normative; the layout is informative.

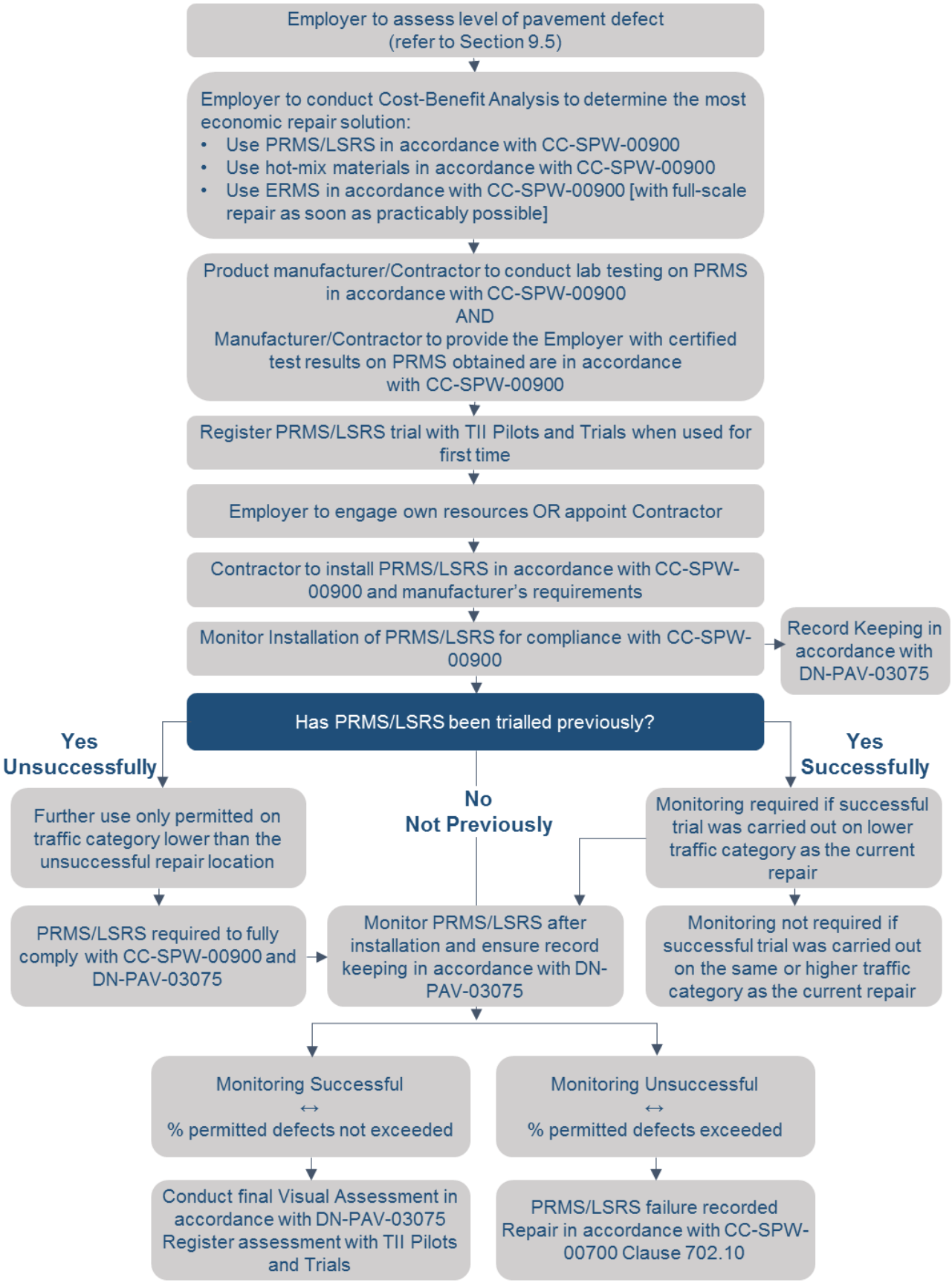


Figure 9.1 – Process Flowchart for the use of PRMS/LSRS

9.5 Assessment

The Employer and (if applicable) their Designers should be aware that PRMS and LSRS may not be suitable for treatment of extensive surface defects, defects such as pavement settlement/subsidence or defects within the unbound layers of the pavement structure.

Once a surface defect is detected or reported, the Employer should assess the extent of the defect as soon as possible. Plans should be developed to match the level of the defect to the most suitable type of repair.

Preparing a cost-benefit analysis prior to any works being undertaken should provide guidance as to the most economic repair solution. This analysis should take into account the whole life cost of the repair, budget available, physical work to be undertaken, available resources, consultation with external Contractors and the timeframe allowed for works.

In some cases, along the route network, specific areas may need more detailed assessment if surface defects occur. Examples of these locations include:

i. Areas with a history of pavement distress
ii. Areas that have received emergency repairs and failed repeatedly
iii. High stress sites such as:
    a) Approaches to roundabouts and traffic signals
    b) Turning lanes within junction areas

Further surveying of traffic loading, percentage of commercial vehicle usage and existing pavement material characteristics may be required in these areas before a final decision is made on the repair to be installed.

The assessment should conclude whether use of PRMS/LSRS is appropriate or whether a full-scale repair using imported hot-mix bituminous material is required.

9.6 Specification of Performance Criteria

As part of the Contract with the Contractor, the Employer (i.e., the compiler) shall provide the traffic category required for the performance of the PRMS/LSRS. This category shall be based on the traffic volumes at the time of the proposed works and chosen from DN-PAV-03075 Table 5C.1.

The traffic volumes may be obtained from the TII traffic data website or site specific traffic counts. The traffic flow shall be the maximum volume of traffic measured as commercial vehicles per lane per day (cv/lane/day) based on the Average Annual Daily Flow (AADF). Refer to PE-SMG-02002 for further details.

In the case of a prTAIT site, the PRMS/LSRS shall be required to meet the performance criteria for the monitoring period (refer to DN-PAV-03075). Where the PRMS/LSRS has previously met the requirements of DN-PAV-03075, any further repairs on the same or lower traffic category shall not be required to undergo the requirements of DN-PAV-03075. However, the system shall continue to meet the testing and workmanship requirements of CC-SPW-00900.

10. Emergency Repair Material Systems

10.1 Introduction

The requirements for use of Emergency Repair Material Systems (ERMS) shall be determined in accordance with this Chapter of DN-PAV-03074.

Surface defect repairs that may be appropriate for remedial treatment with ERMS include potholes, delamination, surface cracks, joint failures and previously patched areas.

All sites with such surface defects should be considered suitable for treatment with ERMS. However, ERMS shall only be seen as a short-term alternative to rectifying defects and they shall be used as part of routine maintenance works only.

Replacement of ERMS works shall be carried out as soon as practicably possible after installation. This work involves full-scale rectification in accordance with CC-SPW-00700, and replacement with an approved surface course in accordance with DN-PAV-03023.

10.2 Description

ERMS utilise a cold-lay bituminous material which shall be used for the emergency/temporary patching and repair of surface defects, filling of road stud cavities, filling around ironworks, and utility cuttings/openings conforming to the requirements of CC-SPW-00900. Patching shall be defined as replacement of surface course, binder course and base where the materials are installed in small areas.

ERMS shall be produced in plants that are independently accredited to IS EN ISO 9001 or an equivalent quality management system.

ERMS may be proprietary products.

10.3 General Requirements

Given the intended use of ERMS, the maximum advised individual area of repair allowed using PRMS shall be approximately 2m^2.

The Employer should be aware that ERMS may not be suitable for treatment of extensive surface defects or defects within the unbound layers of the pavement structure.

Within the constraints of CC-SPW-00900, the design, manufacture and installation of the ERMS are the responsibility of the product/system manufacturer and Contractor.

Where applicable, an appropriate special requirement shall be included in the Contract Conditions or the Works Requirements which draws particular attention to CC-SPW-00900 Clause 10.3.4.6 and DN-PAV-03075.

11. References

11.1 TII Publication (Standards)

AM-PAV-06045 (NRA HD 28): Management of Skid Resistance.

AM-STR-06049 (NRA HD 30): Pavement Asset Repair and Renewal – Scheme Approval Procedures.

AM-PAV-06050 (NRA HD 31): Pavement Assessment, Repair and Renewal Principles.

CC-CMG-04001(NRA GD 101): Preparation and Delivery Requirements for As-Built Records.

CC-GSW-00010 (NRA NG Series 000): Notes for Guidance on the Specification for Works NG 000 – Introduction.

CC-GSW-00700 (NRA NG Series 700): Notes for Guidance on the Specification for Road Works, Series NG 700: Road Pavements – General.

CC-GSW-00900 (NRA NG Series 900): Notes for Guidance on the Specification for Road Works Series NG 900 - Road Pavements - Bituminous Materials.

CC-SPW-00010 (NRA Series 000): Specification for Works Series 000 – Introduction.

CC-SPW-00700 (NRA Series 700): Specification for Road Works, Series 700 Road Pavements – General.

CC-SPW-00900 (NRA Series 900): Specification for Road Works, Series 900: Road Pavements – Bituminous Materials.

DN-PAV-03021 (NRA HD 25-26): Pavement & Foundation Design.

DN-PAV-03023 (NRA HD 36): Surfacing Materials for New and Maintenance Construction, for Use in Ireland.

DN-PAV-03024 (NRA HD 37): Bituminous Mixtures, Surface Treatments, and Miscellaneous Products and Processes.

DN-PAV-03075 (NRA HD 301): Approval of Specific Products.

PE-SMG-02002 (NRA HD 24): Traffic Assessment.

11.2 Other Publications

National Standards Authority of Ireland Publications:

IS EN ISO 9001, Quality management systems - Requirements

IS EN 12272-2, Surface dressing - Test methods - Part 2: Visual assessment of defects.

IS EN 12273, Slurry Surfacing – Requirements.

IS EN 12274-8, Slurry Surfacing – Test Requirements.

IS EN 12697-8, Bituminous mixtures – Test methods for hot mix asphalt – Part 8: Determination of void characteristics of bituminous specimens.

IS EN 13036-1, Road and airfield surface characteristics - Test methods - Part 1: Measurement of pavement surface macrotexture depth using a volumetric technique.

IS EN 13108-4, Bituminous mixtures – Material specifications – Part 4: Hot Rolled Asphalt.

IS EN 13108-20, Bituminous mixtures – Material specifications – Type Testing.

IS EN 13108-21, Bituminous mixtures – Material specifications – Factory Production Control.

IS EN 13473-1, Characterization of Pavement Texture by use of Surface Profiles - Part 5: Determination of Megatexture.

Annex A:

Assessment of Road Hardness using The CTRA Probe

Assessment of Road Hardness using The CTRA Probe

The CTRA (Coal Tar Research Association) probe uses a spring-loaded penetrometer with a 4mm hemispherical head to measure road hardness. The hardness test using the CTRA probe is carried out in accordance with BS 598: Part 112.

Hardness readings should be made in areas that represent the predominant condition of the existing road surface, and at least every 200 metres, with 10 measurements at about 0.5 m intervals at each location.

For the test, the surface temperature, which should preferably be between 15°C and 30°C, is recorded and the hardness value determined from the mean of a set of ten penetration readings recorded in mm of penetration.

The mean hardness value is corrected to 25°C using the graphical method in Figure A.1. The figure is based on surface temperature Category B in Road Note 39 representing Central England, Wales and Northern Ireland which would be the most similar to Irish climatic conditions.

The hardness measurements are best carried out when the road temperature is above 20°C and may in some situations need a lane closure. Ideally, hardness should be measured in the season prior to that in which the surface dressing is to be carried out. It should be noted that hardness readings taken at road temperature significantly below 20°C are likely to be less accurate than those taken between 20°C and 30°C.

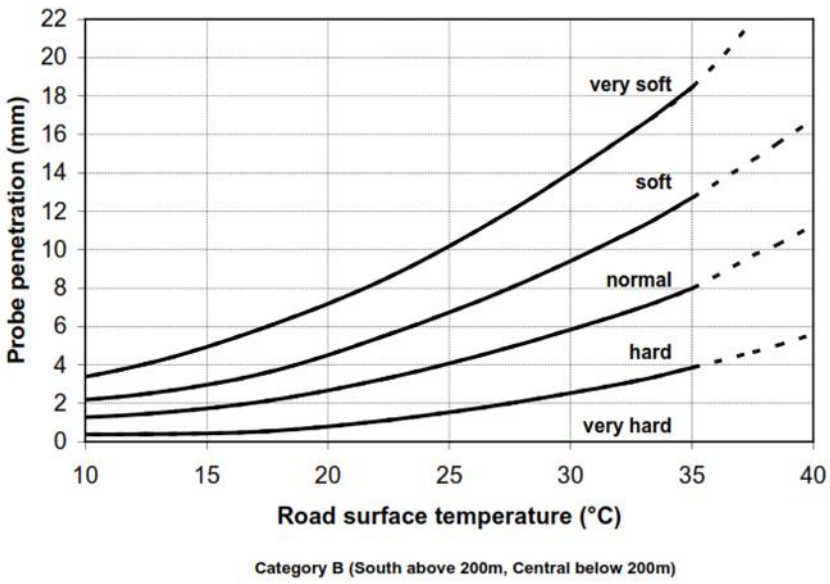


Figure A.1: Temperature Correction for CTRA Road Hardness (TRL RN39)

In the absence of the Ball penetration device, the corrected CTRA reading can used in the analytical design process as follows.

Where the hardness of the existing pavement surface is measured using the CTRA probe device, the chipping size (or primary chipping in multiple layers) based on the hardness and the commercial vehicle traffic can be taken from Table A.1.

For the site specific allowance for Soft Substrate in the design process based on hardness measured using the CTRA probe, an adjustment is made to the chipping ALD used to calculate the basic application rate for binder as shown in Table A.2.

For further details on the CTRA probe, refer to DN-PAV-03024.

Table A.1: Chipping Size (mm)

Road Hardness: Ball Penetration Device (mm to 25°C)	Traffic Category (cv/lane/day)					
	<250	251-500	501-1000	1001 – 2000	2001 – 3000	Over 3000
0 to 2	6/10	6/10	6/10	10/14	10/14	10/14
2 to 4	6/10	6/10	10/14	10/14	10/14	10/14
4 to 7	6/10	10/14	10/14	10/14	10/14	10/14
7 to 10	10/14	10/14	10/14	10/14	Not Rec	Not Rec
>10	10/14	10/14	10/14	Not Rec	Not Rec	Not Rec

Not Rec = not recommended

Table A.2: Site Specific Adjustment based on CTRA Hardness to the Total Basic Binder Application Rate

Allowance	Property	Adjustment (L/m^2)	Comments
Soft Substrate (Ss)	Road hardness (CTRA @ 25°C)		Road hardness measured using the CTRA probe. The adjustment is made to the chipping ALD based on road hardness
	3mm or lower	Increase ALD by 1mm	
	4mm to 9mm	No change to ALD	
	10mm to 14mm	Decrease ALD by 1mm	
	>14mm		Substrate too soft for a normal surface dressing, pre-treatment required

Annex B:

Worked Example for Assessment of Texture Variation

Worked Example for Assessment of Texture Variation

The texture depth was measured using the volumetric patch test at 200m intervals along the road to be surface dressed. At each interval, one test in the finest textured wheelpath, and another along the centreline (i.e. between the wheelpaths) because prior visual inspection has shown that the extreme texture levels are in these locations. The results of the tests are in Table B.1.

Table B.1: Texture Depth Data

Chainage	Texture Depth Td (mm)	
	Wheelpath	Centreline
0	1.65	2.82
200	2.45	2.61
400	2.11	1.43
600	1.80	2.38
800	1.86	2.25
1000	1.69	1.95
$Td_{(fine)}$	1.43	
$Td_{(coarse)}$	2.82	
$Td_{(average)}$	2.08	

The $Td_{(average)}$ for both centreline and wheelpath is 2.08 mm.

The smallest and largest texture depths are taken from the table as $Td_{(fine)}$ and $Td_{(coarse)}$ as 1.43 mm and 2.82 mm, respectively.

To determine whether the difference between wheelpath and centreline texture is excessive, for a double surface dressing the 'ALD/10 rule' (Section 4.3.5) is applied:

$Td_{(average)} - Td_{(fine)} = 2.08 - 1.43 = 0.65$ mm

$Td_{(coarse)} - Td_{(average)} = 2.82 - 2.08 = 0.74$ mm

From the ALD/10 rule, the greatest difference is 0.74 mm. The road is to surface dressed with a primary 10/14 chipping with an ALD of 8.2mm. With an 8.2 mm ALD chip the maximum allowable value is calculated as:

$$\frac{8.2}{10} = 0.82$$

The texture depth difference of 0.74 is less than this value and, therefore, the texture variation is not excessive for the sized chip.

Annex C:

Computational Method for Average Least Dimension (ALD)

Computational Method for Average Least Dimension (ALD)

The ALD of the chippings shall be computed using the Dumas method. The Dumas calculation has been developed as a Microsoft Excel spreadsheet, with the calculated ALD derived directly from the full gradation analysis and the flakiness index data. A sample output from the Excel spreadsheet is given below. The full Dumas equation and values required for this computational method are outlined in the South Africa test standard TMH1 Method B18(b)T.

For further details on Average Least Dimension (ALD), refer to DN-PAV-03024.

ALD Calculator

Local Authority:

Engineering Area:

Chip Size (mm):

Chip Source:

Road Number:

Location / Chainage: to

Sample Reference:

Flakiness Index (%): 13

Input the % (by mass) Passing through each sieve below:

E.N. Sieve Size (mm)	% Passing
40	
31.5	
25	
20	100
16	
14	91
12.5	
10	16
8	
6.3	
5	
4	0.4
2	
1	
0.5	
0.425	
0.25	
0.15	
0.125	
0.063	0.37

ALD Dumas Eqn Value: 8.4

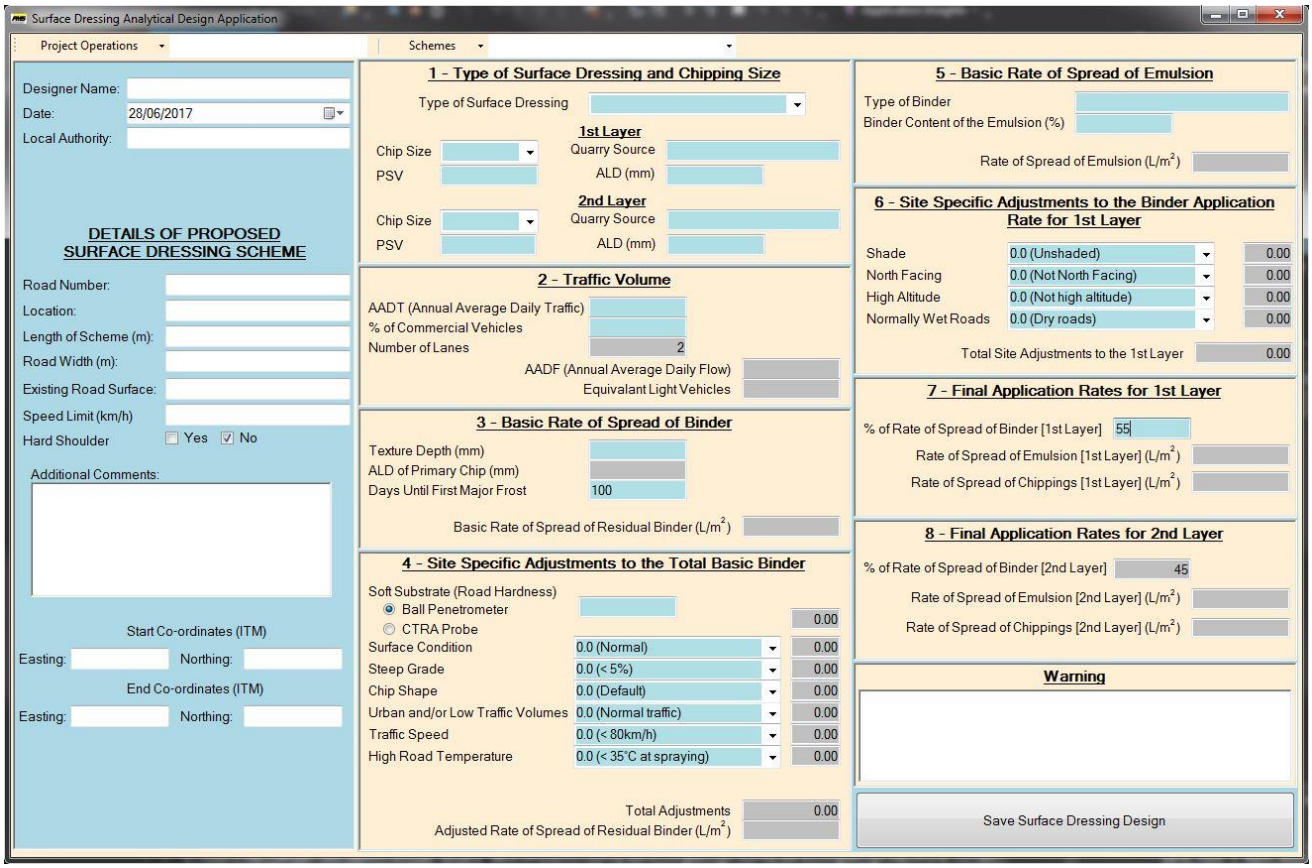
Prepared By:

Date:

Annex D:

Analytical Design Template

Analytical Design Template



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