

# Design and Specification of Pavement - Update CC-SPW-00900 (Series 900 )

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Transport Infrastructure Ireland

## TII Standards Training 2017

Athlone	09 <sup>th</sup> May 2017
Carrick on Shannon	11 <sup>th</sup> May 2017
Cork	16 <sup>th</sup> May 2017
Dublin	18 <sup>th</sup> May 2017

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- Current Status Hot Mixes
  - Material performance issues (HRA)
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# Series 900 – Current Status

## Circular letters and other correspondence

- AC 20dense bin - *PRDAir9,0*
  - HRA 35/14 F - *RDAir7,0*
1. INAB or equivalent testing on parameters that currently have a “to be recorded” in Series 900 Tables 3, 6 and 9”, and
  2. to allow the 200mm Wheel tracking core for Base and Binder mixes to be taken in the centre of the lane rather than the wheel track zone.
1. AC 20 dense bin 70/100 des
  2. AC 20 dense bin 40/60 des
  3. AC 32 dense bin 70/100 des
  4. AC 32 dense bin 40/60 des
  5. SMA 14 surf PMB 65/105-60 des
  6. SMA 10 surf PMB 65/105-60 des
  7. SMA 10 bin 70/100 des
  8. HRA 35/14 F surf 40/60 des
  9. HRA 35/14 F surf 40/60 des (with PSV 60 coarse aggregate)

Withdrawal of the OLD SERIES 900

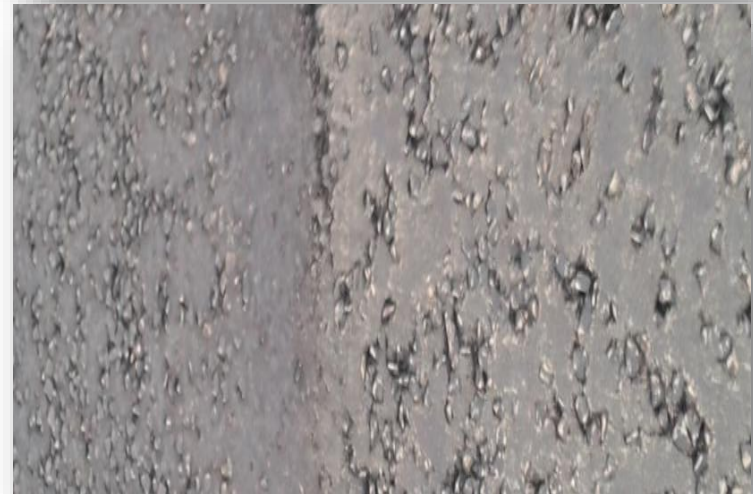
# Series 900 – Current Status

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- Make a clear distinction between products and the works
- Testing information gathered from the works ensure;
  - As “laid” performance testing needed to confirm that the products supplied are consistent with the declared performance
  - Also to ensure the products will perform to meet the CPR Basic Requirements for Construction Works which include;
  - Safety, Mechanical resistance, sustainable use of natural resources etc.

**Assess the data gathered from the works to determine and set future achievable performance criteria**

# Material Performance Issues HRA



# Performance Characteristics HRA

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**HRA by definition – positive texture, in contact with the tyres to provide friction**

- TII Investigations of new HRA projects constructed over the last 12 months.  
– It's a Nationwide problem
- We have looked at old sites – no issue!
- PCC specification hasn't changed fundamentally!
- Neither has the mix!
- It has manifested itself in skidding resistance performance issue
- Where / Why has it all gone wrong
  - Macrotexture measurement !
  - Lack of skills !
  - Supervision and testing !
  - Materials (mix and PCC) !

# Performance Issues HRA

Site 1

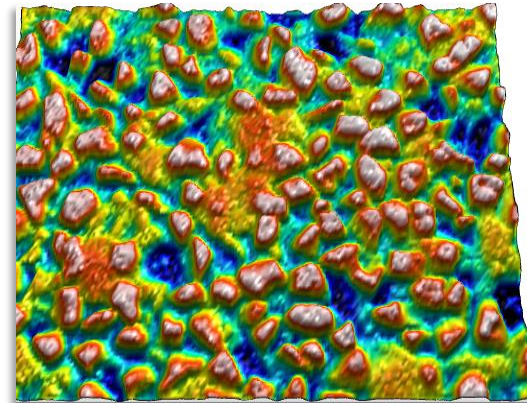


Site 2

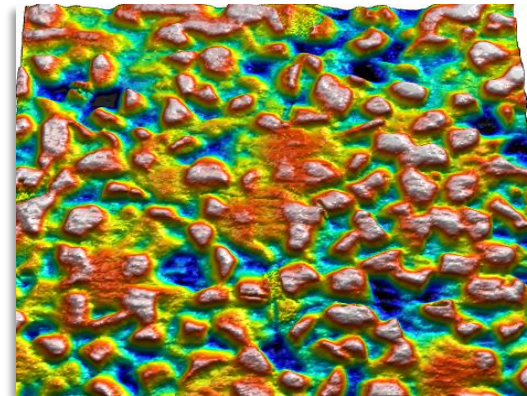


# Performance Issues HRA

Currently researching an enduring solution to be able to detect reoccurrence



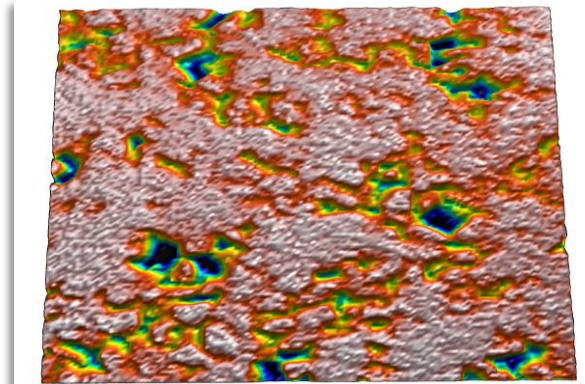
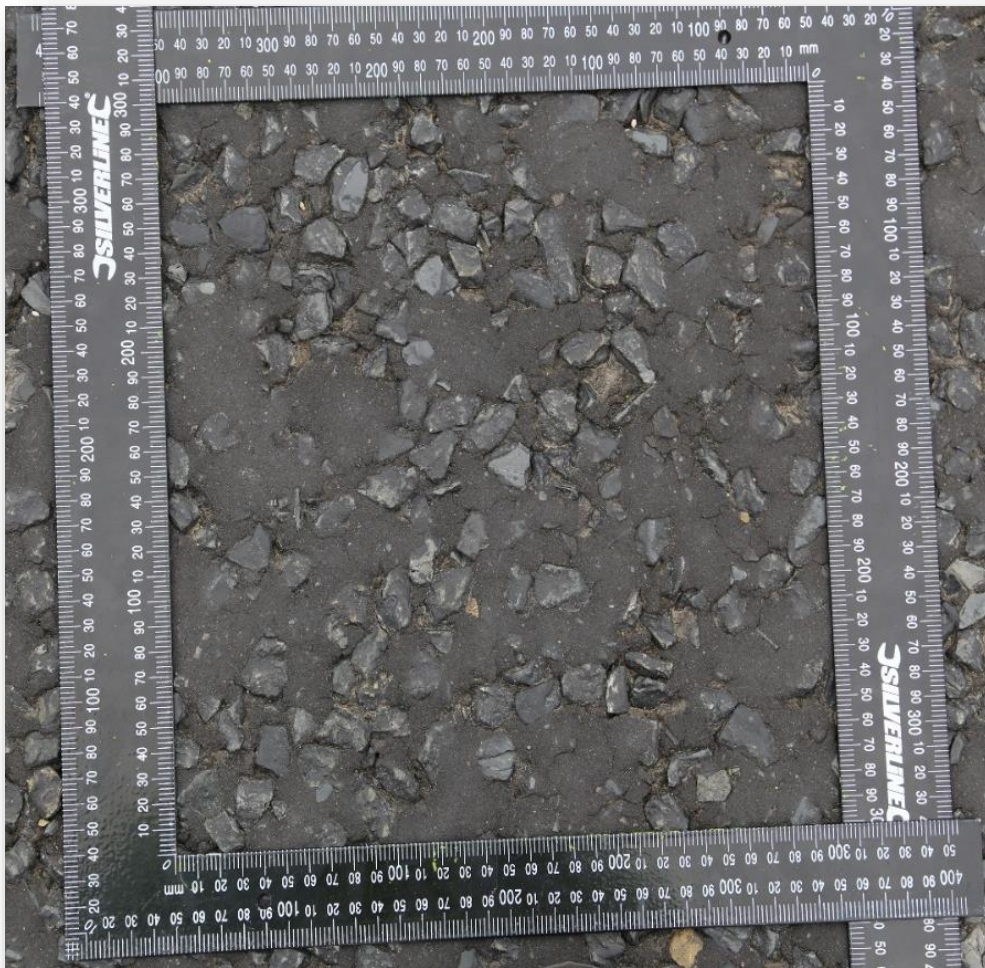
LCMS 3D Model



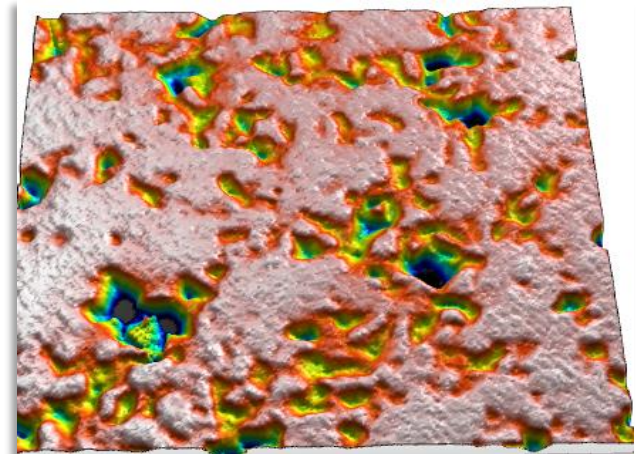
Photogrammetry 3D Model



# Performance Issues HRA



LCMS 3D Model



Photogrammetry 3D Model

# Specific Responsibilities | Producer

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- Type Testing per design
- Declare the Performance of the design based on the mechanical properties of that design (not just the B/C and Grading)
- CE Mark the product
- Test Results
- TAIT's

# DN-PAV-03021 (HD25/26) Analytical approach. Pavement Design

## Developing an Analytical Approach to Pavement Design

The general approach is;

- Define pavement structure loading
- Define pavement structure model
- Determine pavement structural response to the applied traffic load
- Determine pavement distress development
- Determine whether levels of pavement distress are within acceptable levels.
- Updating existing DN-PAV-03021 (HD25/26) with Mechanistic-Empirical Pavement material models
- For New Construction
- Adding requirement for structural Overlay and Inlay rehabilitation
- The structural properties of the pavement layer materials will be required to be characterised based on laboratory and field testing.

Feedback of test results from current schemes is critical

# Analytical Approach | Surface Dressing design

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Engineering design is the process of devising a system, component, or **process** to meet desired needs. It is a decision-making process (often iterative), in which the **basic science** and **mathematics** and engineering sciences are applied to convert resources **optimally** to meet a stated objective.

# Performance Issues | Surface Dressing

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# Analytical Approach to Surface Dressing Development

## TII Trials | Outcomes



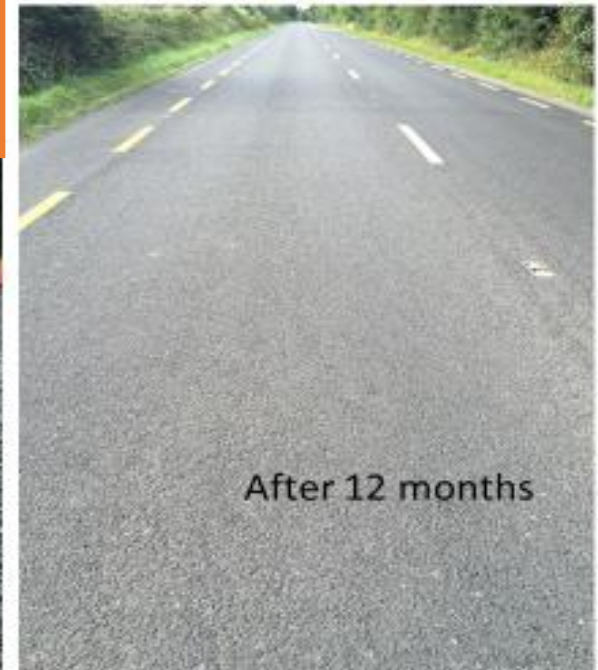
# Analytical Approach to Surface Dressing Development

## TII Trials | Outcomes



### Site 3

- Performing reasonably well
- Some loss of 2<sup>nd</sup> layer
- Very minor/localised defects



# Analytical Approach to Surface Dressing Development

## TII Trials | Outcomes



### Site 12

- Failure (2<sup>nd</sup> Layer)
- Late Season
- Non-compliant binder
- Non-compliant chips





# Analytical Approach to Surface Dressing Development - TII Trials

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- **Pre-Construction Designs:** carried out using available data from the LAs for each site and the proposed constituent materials.
- **Site Measured Data:** Site characteristics; Sampling of materials; and Rates of spray of binder and rates of spread of chippings, measured on site during construction.
- **Post-Construction Designs:** carried out using data measured on site for the site characteristics and properties of constituent materials actually used on site.

## Analysis

- Outputs from Pre-construction designs, Post-construction designs and Site measured data were compared
- Quality of materials assessed

# Analytical Approach to Surface Dressing Development - TII Trials

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## **10/14 Chippings (1st layer on 8 sites)**

- Gradings were reasonably consistent, All complied with grading limits.
- Very good shape, all < FI20 (FI ranged from 7 to 16%)

## **6/10 Chippings (6 sites, 1st layer on 3 sites, 2nd layer on 3 sites)**

- Gradings were very inconsistent; 3 of 6 sites failed the grading specification
- Poor shape, FI ranged from 15 to 25% with 4 of 6 sites >FI20
- 5 of 6 sites failed either the grading and/or FI

## **2/6 Chippings (2nd layer on 8 sites)**

- Gradings were very inconsistent, range of 15 to 38% passing the 4mm sieve
- Shape was typically poor and very inconsistent (FI ranged from 19 to 49%)

Overall, quality and consistency of the 6/10 and 2/6 chippings was an issue

# Analytical Approach | Surface Dressing - Objective

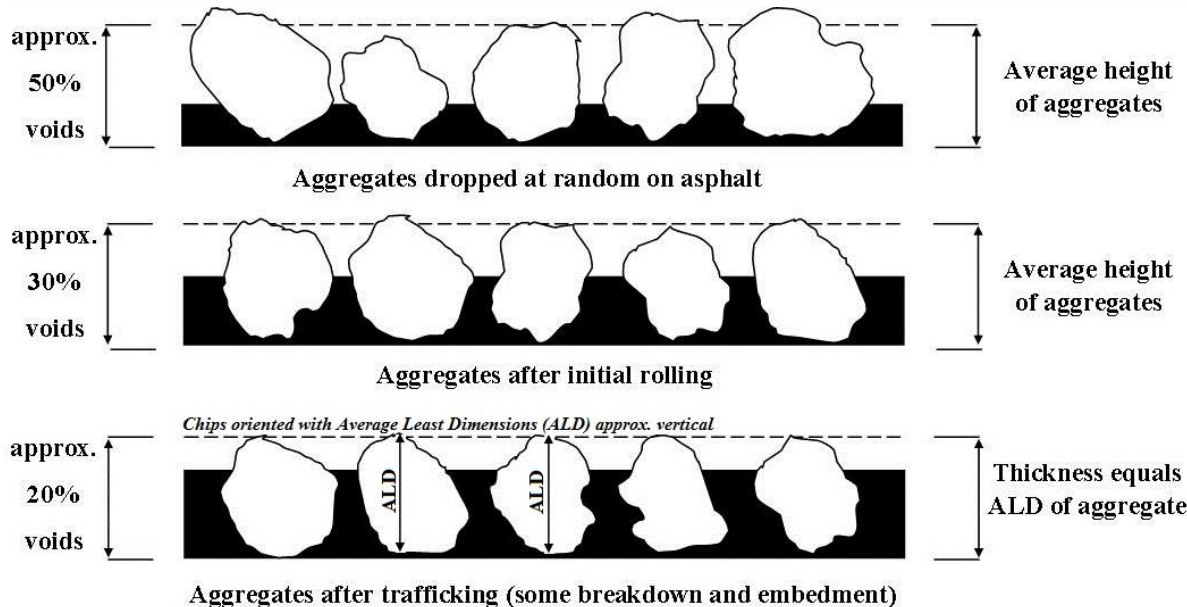
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- Engineering Design
  - having the ability to see behind decisions made
- Ability to identify the sensitivities within the process
- React to these with confidence based on measured data
- Consistency in;
  - Site Homogenisation
  - design and specification
  - Pre / Post construction Testing, supervision
  - Post construction analysis where problems arise

Ultimately we need to avoid a Loss of skills

# Analytical Approach to Surface Dressing - Theory

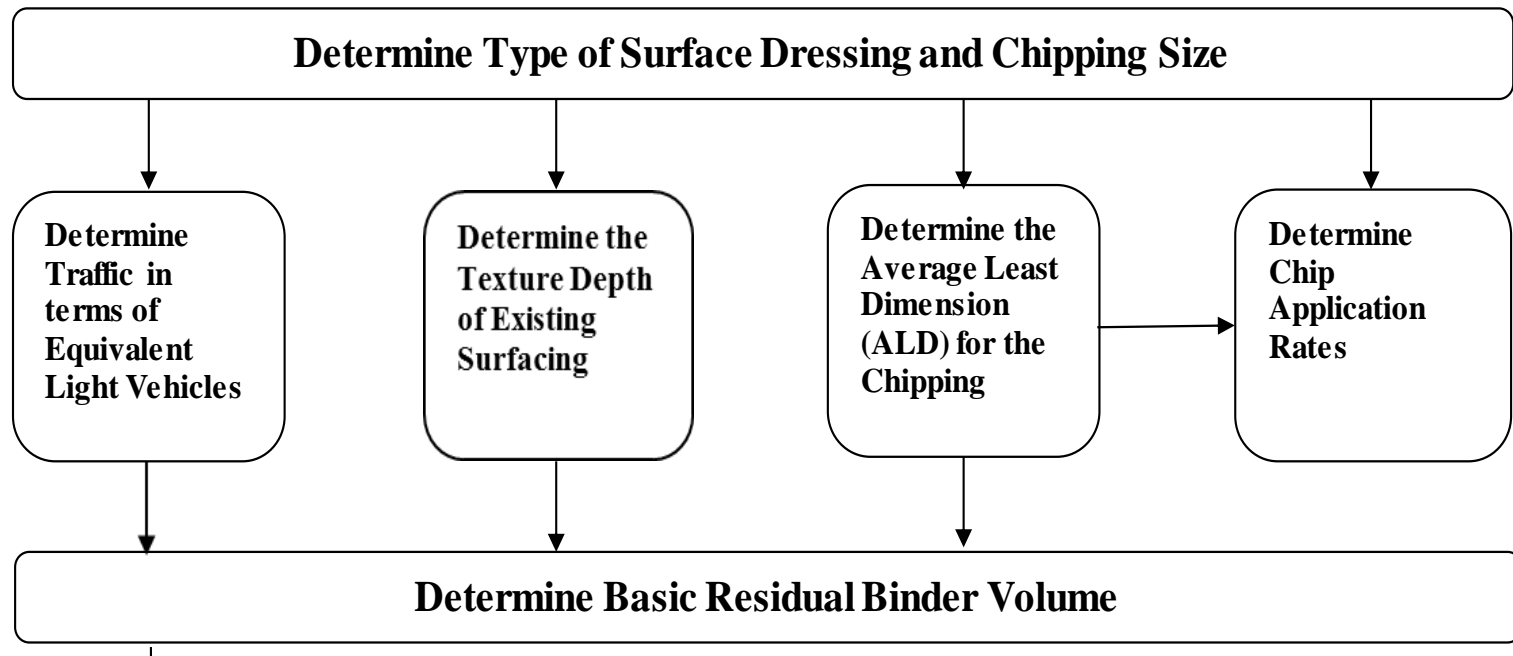
- In a loose single layer of chippings, the percentage of voids are initially about 50%, decreasing to around 30% after construction rolling, and to 20% under the action of traffic.
- The amount of binder required is related to the volume of voids between the aggregate. The quantity should be such that between 60 and 70% of the voids in the final compacted layer should be filled with binder.
- The average depth of the layer of chippings, after construction and trafficking compaction, is approx. equal to the ALD of the chippings used.
- Designed using mathematical formulae



States of Embedment of Surface Dressing Chippings (Hanson 1935)

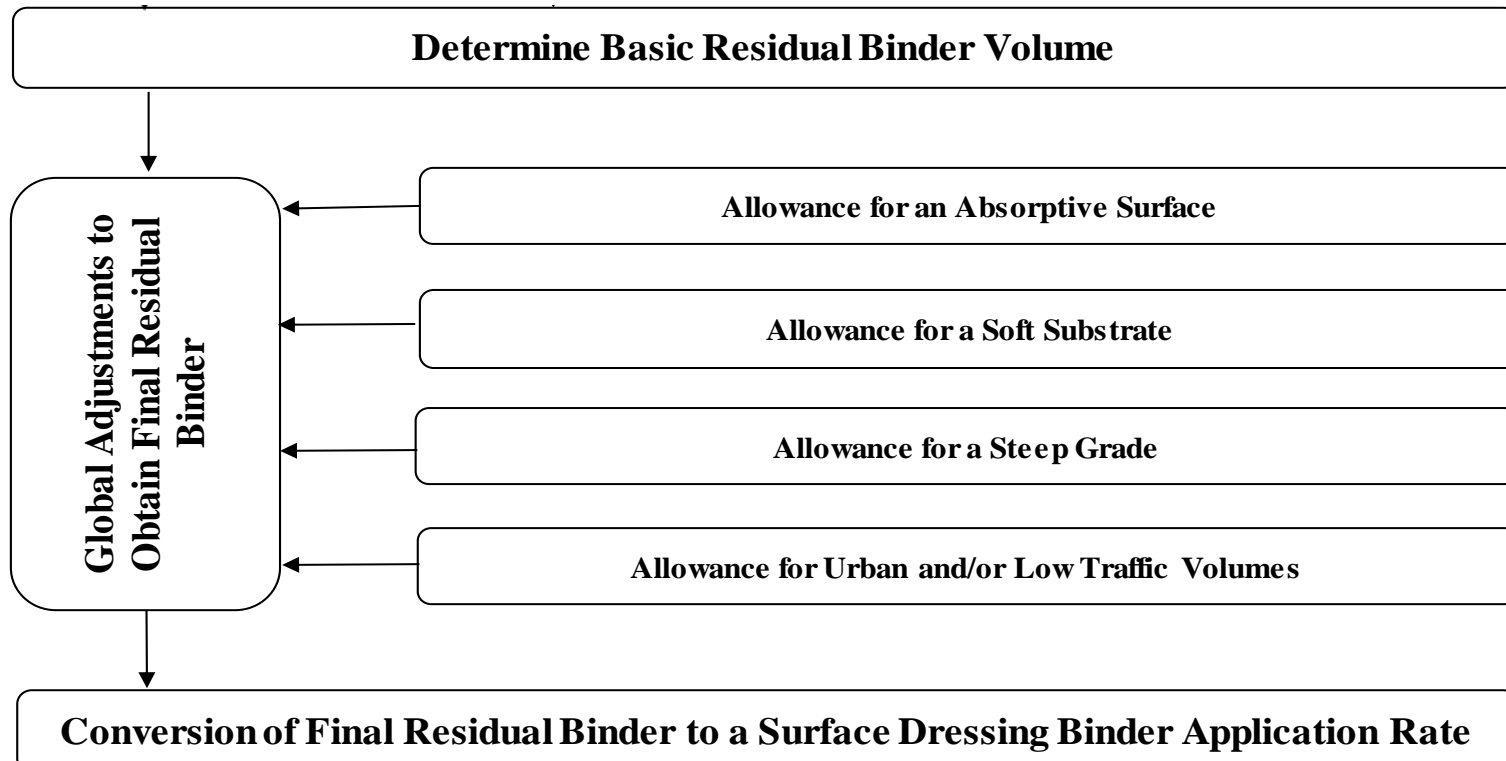
# Analytical Approach to Surface Dressing - Process

## Part 1



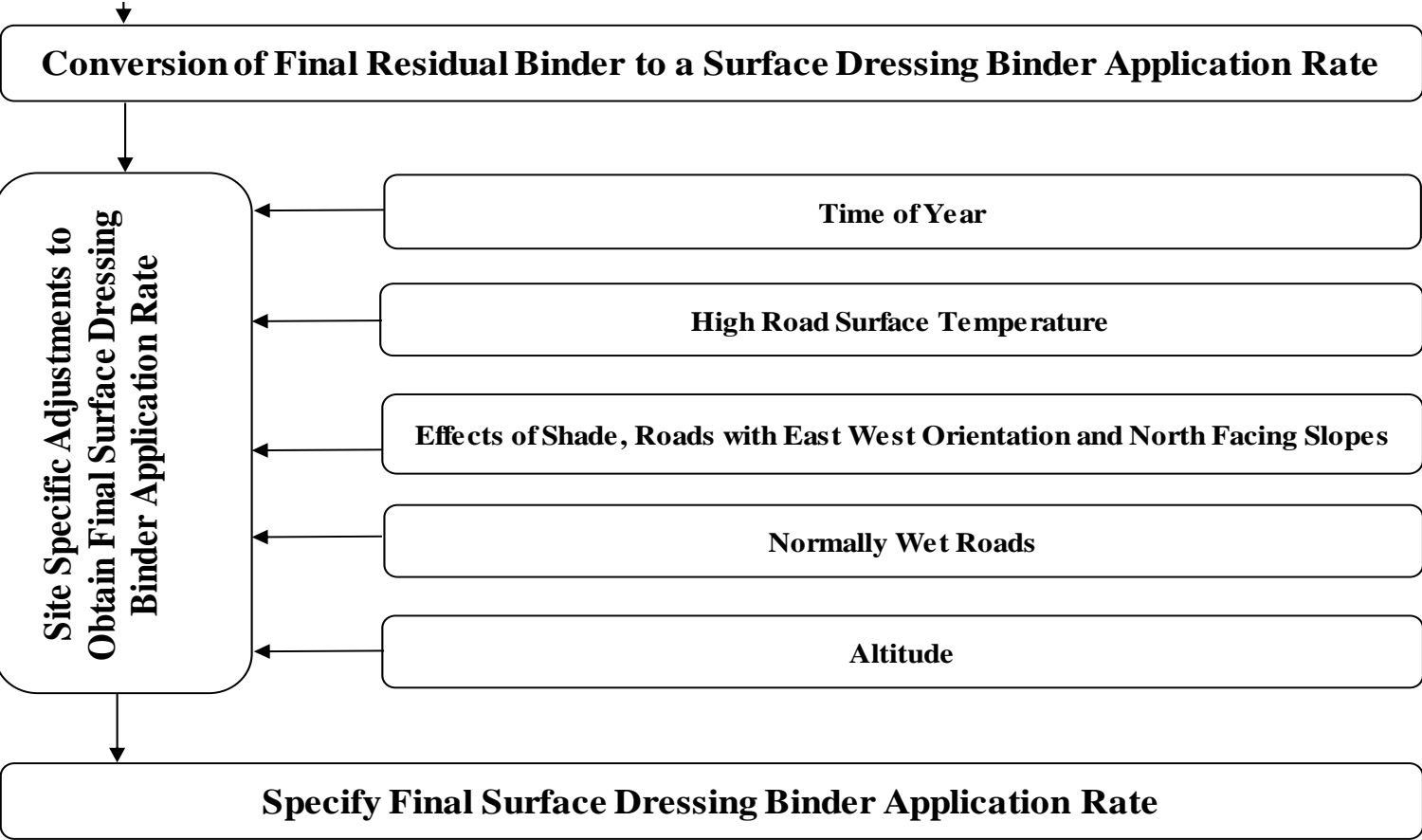
# Analytical Approach to Surface Dressing - Process

## Part 2



# Analytical Approach to Surface Dressing - Process

## Part 3



# Analytical Approach to Surface Dressing - Sensitivities

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- The binder application rate derived from the Analytical Design procedure is sensitive to changes in the following variables:
  - Traffic Volume
  - ALD of the chip
  - Texture Depth
  - Pavement Hardness
- Very important that the surface dressing design should be applied to homogeneous sections of road.
- Homogeneity in terms of Traffic, Texture, Hardness and Site conditions/stress.
- Where the surface conditions change (or constituent materials change), a new or modified surface dressing design for the different conditions needs to be considered



# Other Documents

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- GE-PAV-01006 Pavement Design and Maintenance General Information (HD 23)
  - PE-SMG-02002 Traffic Assessment (HD 24)
  - DN-PAV-03021 Pavement and Foundation Design (HD25 /26)
  - DN-PAV-03074 Design of Bituminous Mixtures, Surface Treatments, and Misc Products / Processes (HD 300)
  - AM-PAV-06045 Management of Skid Resistance (HD 28)
  - AM-PAV-06049 Pavement Asset Repair and Renewal – Scheme Approval (HD 30)
  - AM-PAV-06050 Pavement Asset Repair and Renewal Principles (HD 31)
  - DN-PAV-03023 Surface Materials for New and Maintenance Construction (HD 36)
  - DN-PAV-03024 Bituminous Mixtures, Surface Treatments Materials and Techniques (HD 37)
  - DN-PAV-03075 Approval of Specific Products Manual (HD 301 )
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# Questions & Answers

Thank You