



9th International Conference on MANAGING PAVEMENT ASSETS (ICMPA9)

A Performance Prediction Model to Manage Flushing of Sprayed Seal Pavements

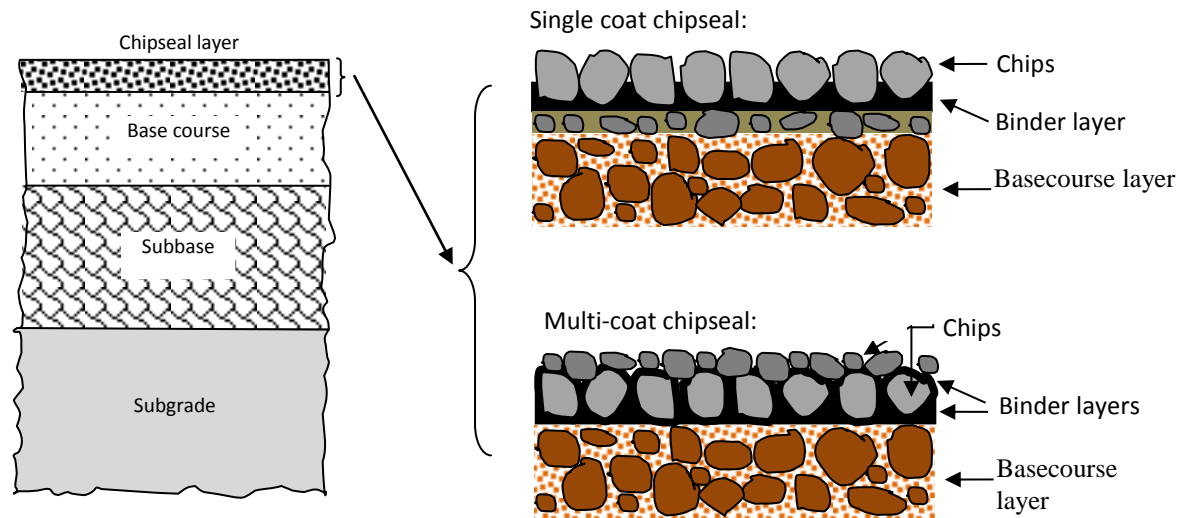
Dr Sachi Kodippily



Te Whare Wānanga o Tāmaki Makaurau

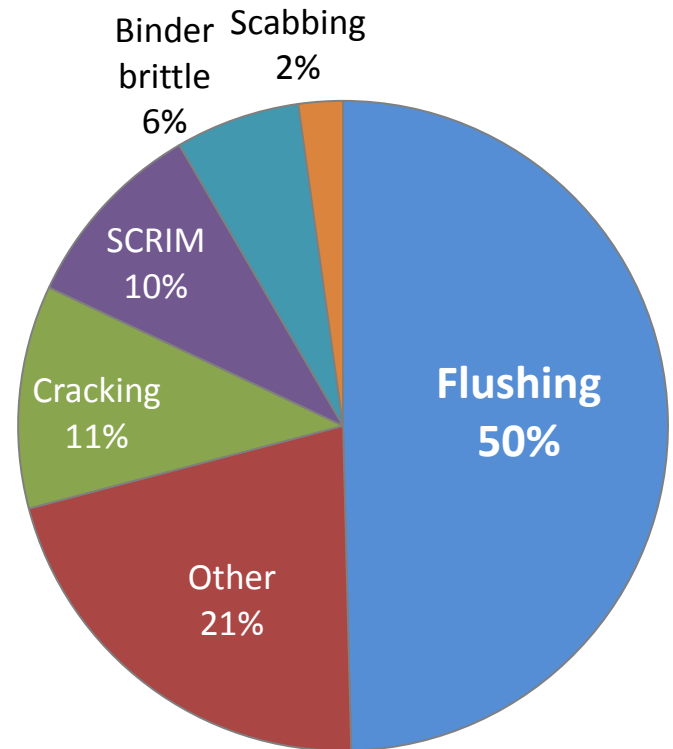
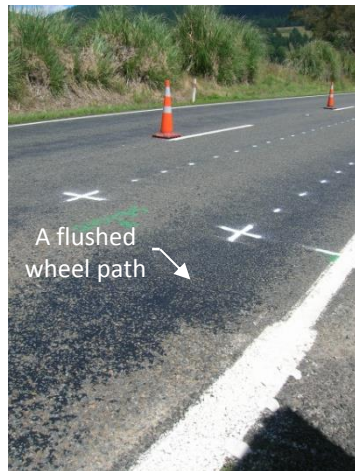
Introduction

- **Sprayed seal = Chipseal**
- **Economical → Ideal for low volume roads**



Flushing

- Full or partial covering of surface aggregates
- Predominant surfacing problem in New Zealand



Presentation Outline

- **Research objectives**
- **Data analysis and model development**
- **Experimentation:**
 - **Lab experiments; 3D analysis; Air voids analysis**
- **Flushing assessment framework**
- **Conclusions**

Objectives

- Develop an assessment technique to effectively predict flushing on chipseal pavements
- Develop a data-driven prediction model to identify the presence and quantity of flushing
- Establish chipseal performance characteristics that indicate flushing potential

FLUSHING PREDICTION MODEL

NZ LTTP Programme

- 14 years of survey data
- 58 State Highways sites and 83 local authority sites
- Data items in the LTTP database:
 - Pavement characteristics, eg, pavement and surface age, surface thickness and materials,
 - Traffic volumes
 - Structural condition as identified from visual recordings of distresses
 - Maintenance records

Flushing Assessment in LTPP

- Flushing measurements are based on visual inspections – light, moderate, severe



Light flushing



Moderate flushing

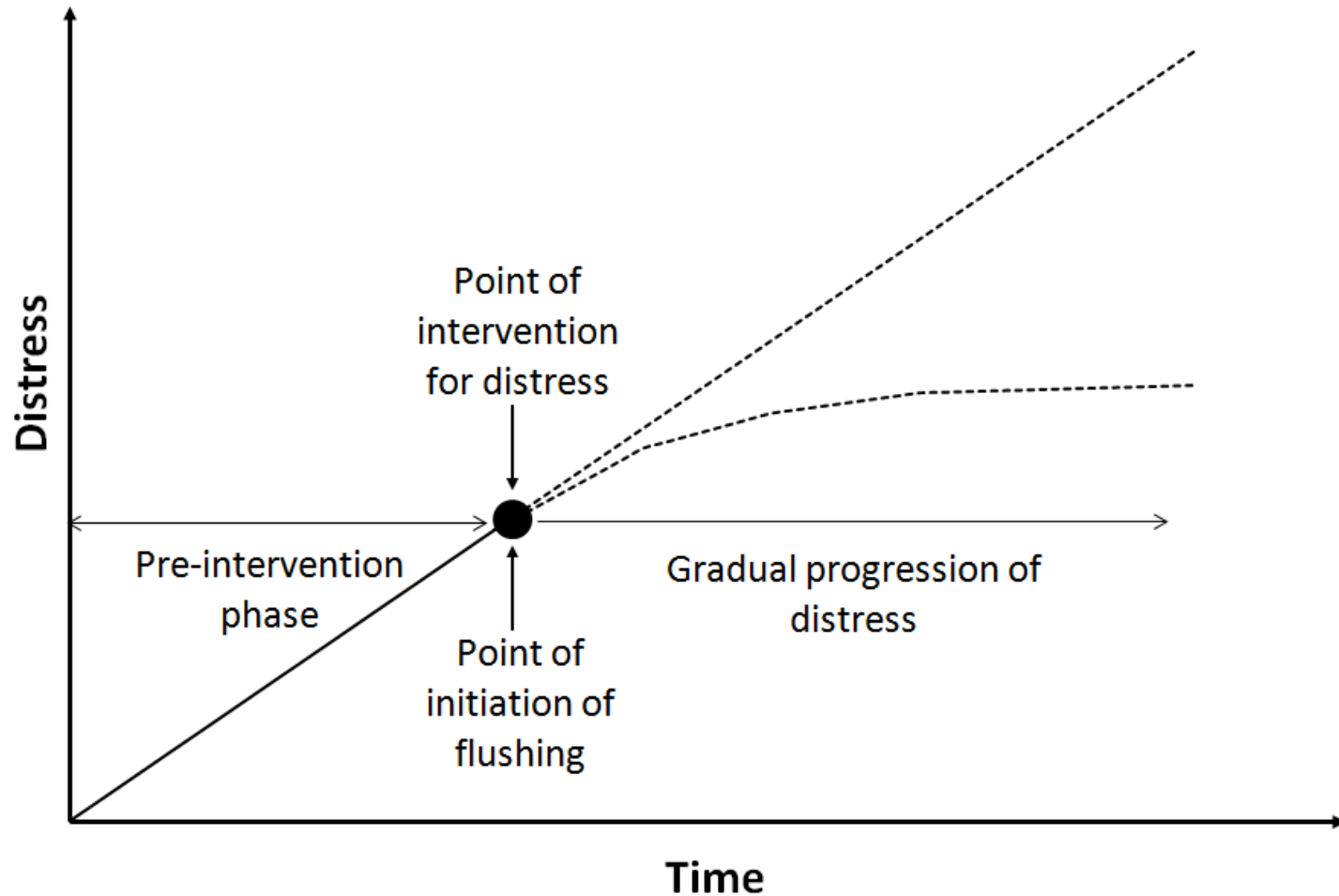


Severe flushing

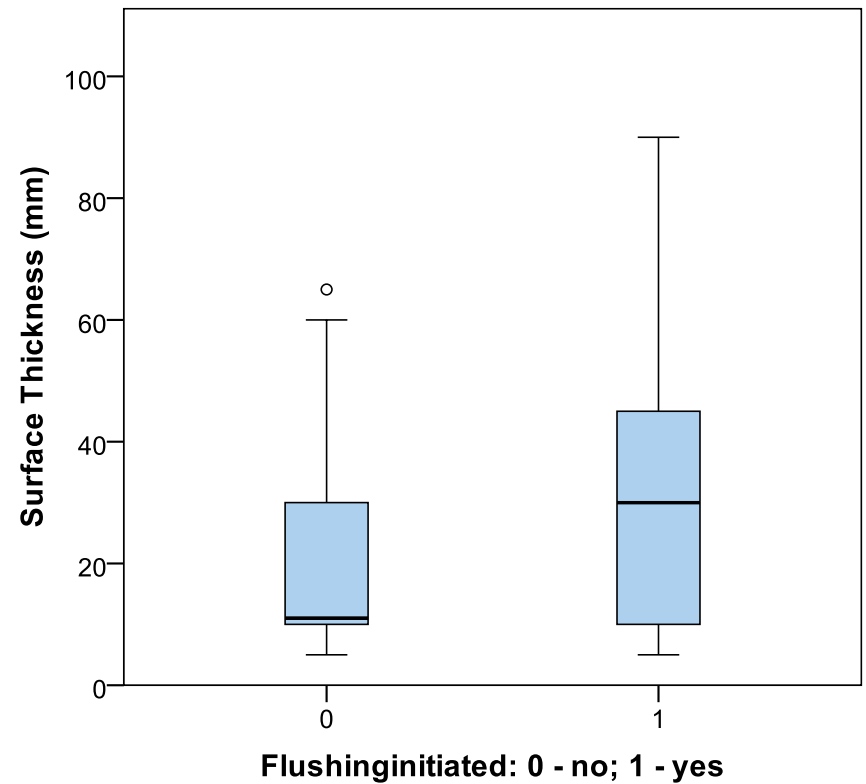
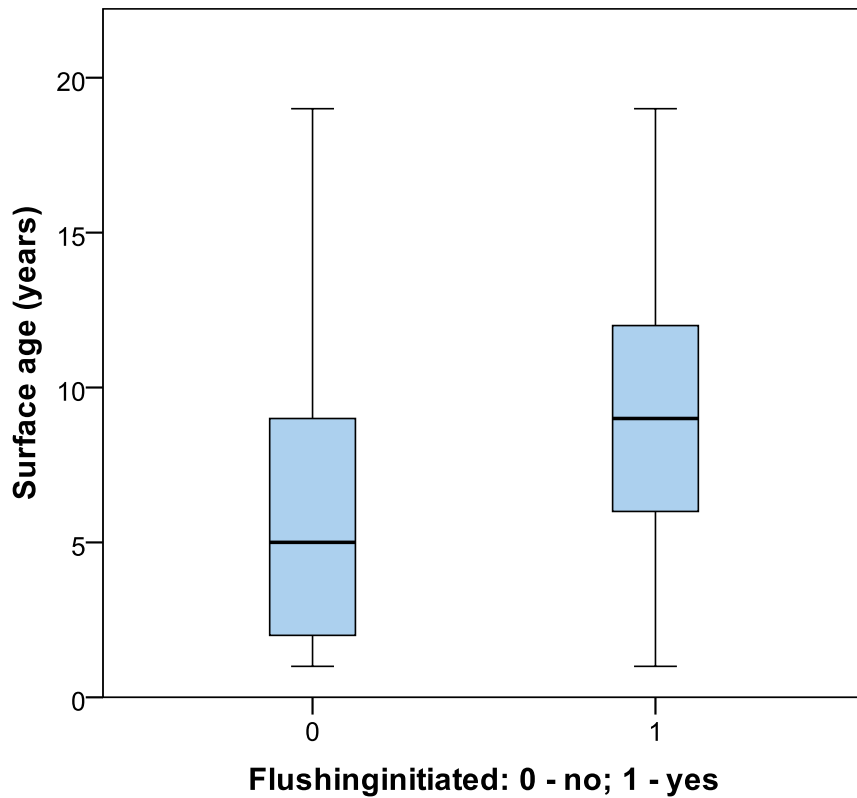
Shortfalls of Existing Flushing Assessments

- Need a systematic procedure to effectively identify flushing patterns
- Overcome limitations of visual and indirect management methods
- A pavement deterioration model is an efficient and accurate method of flushing management

Deterioration Phases for Flushing

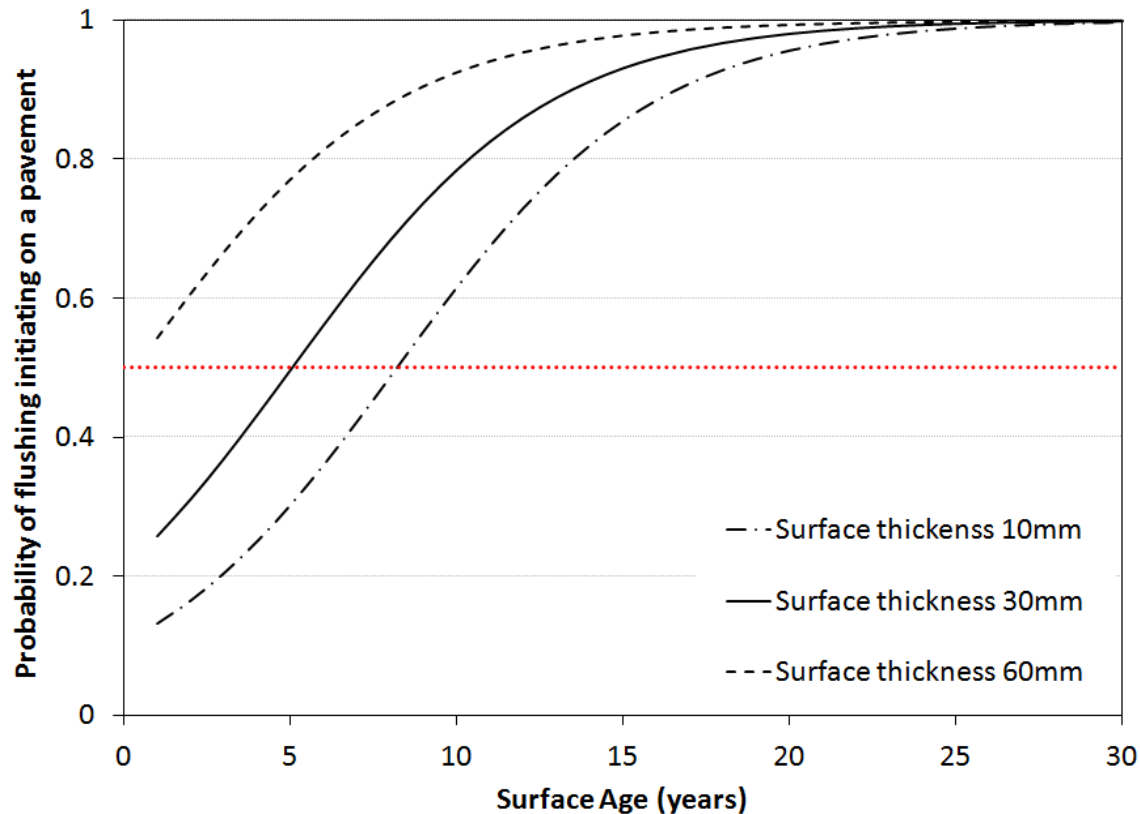


Flushing vs Surface Age/Surface Thickness



Flushing Initiation

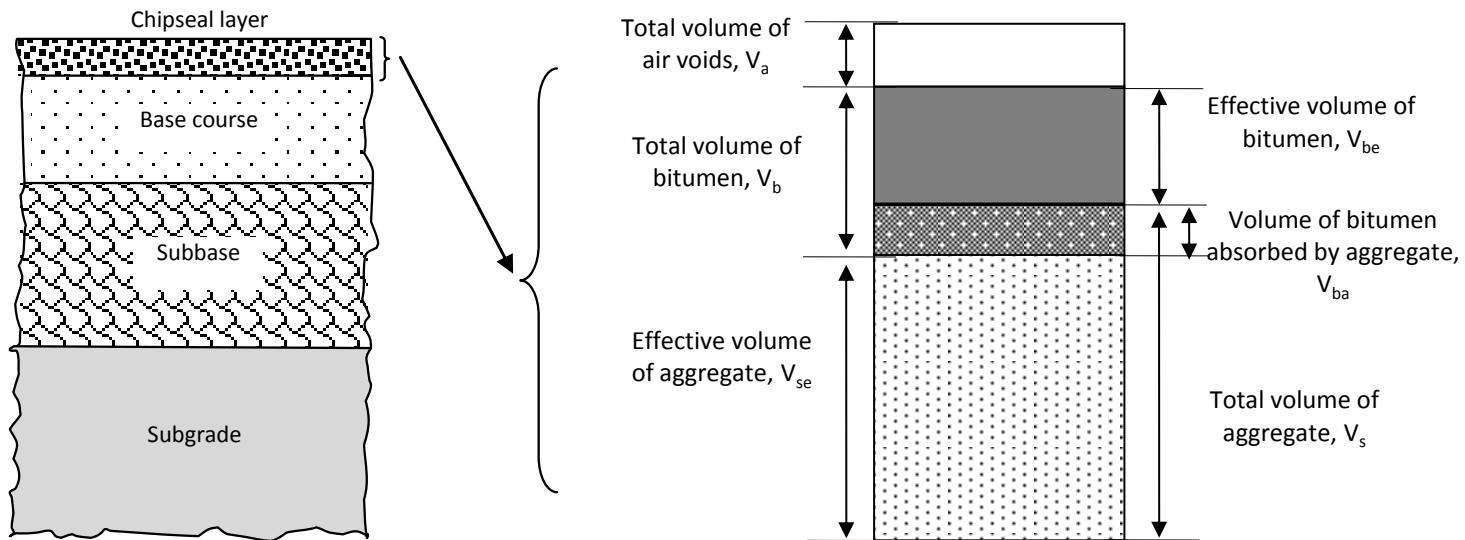
$$p(\text{FlushingInitiated}) = 1 / 1 + e^{-(0.293\text{surface} + 0.046\text{Surfthickness} - 2.913)}$$



IN-DEPTH MATERIALS ANALYSIS

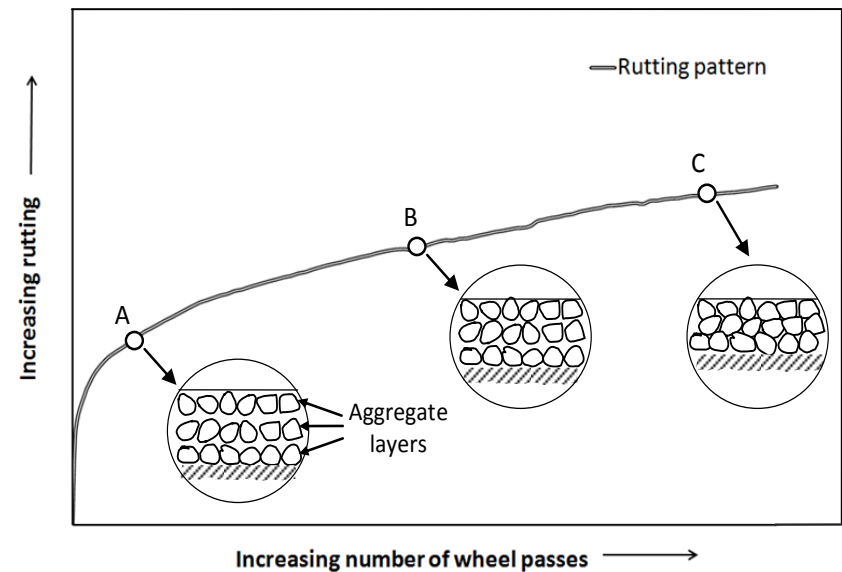
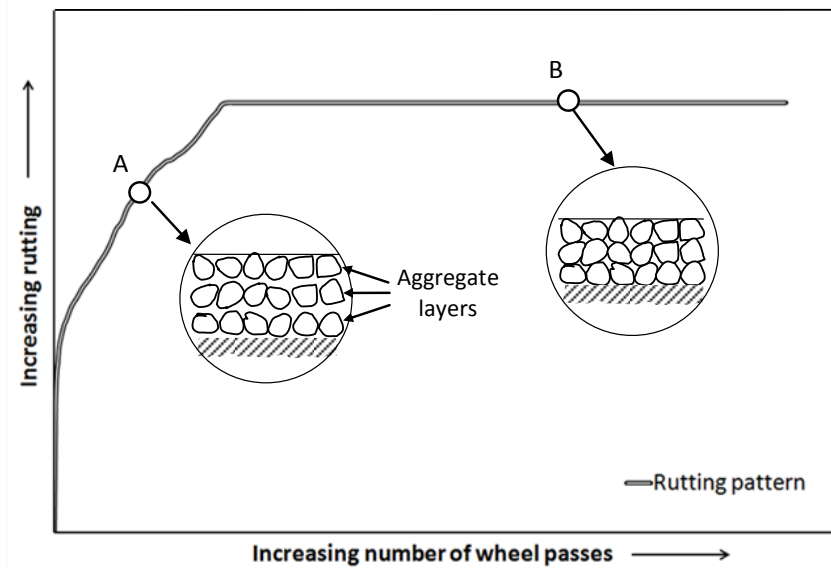
The Flushing Mechanism

- The volumetric balance between bitumen, aggregate and air voids is vital to flushing development

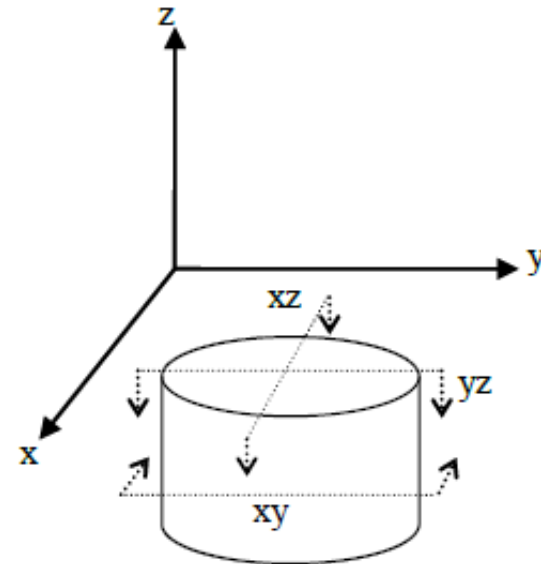
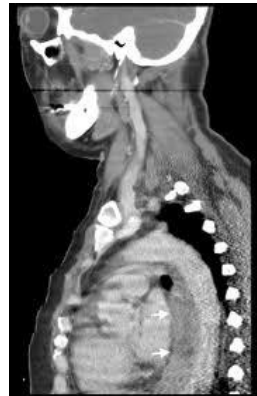


Chipseal Deformation

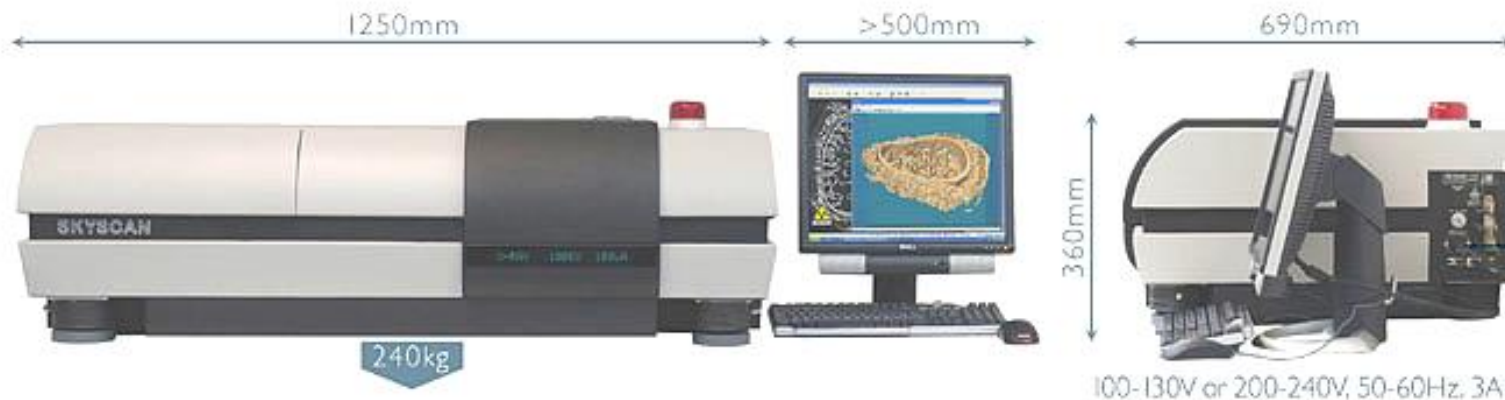
- Two distinct deformation patterns are present in multiple chipseal layers:



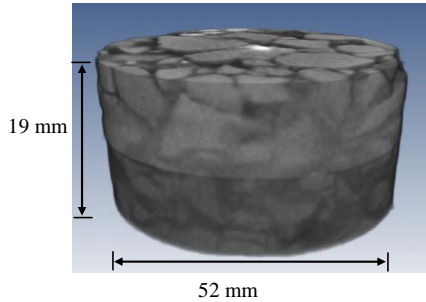
Computed-Tomography Scanning



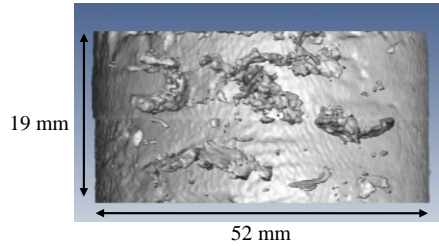
Source: <http://www.radiology-equipment.com/detail.CFM?LineItemID=762>



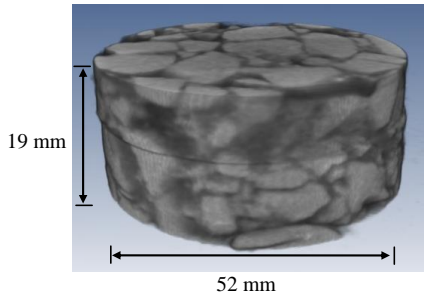
3D Model of Chipseal



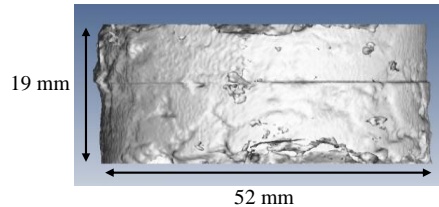
a) 3D reconstruction of untracked sample



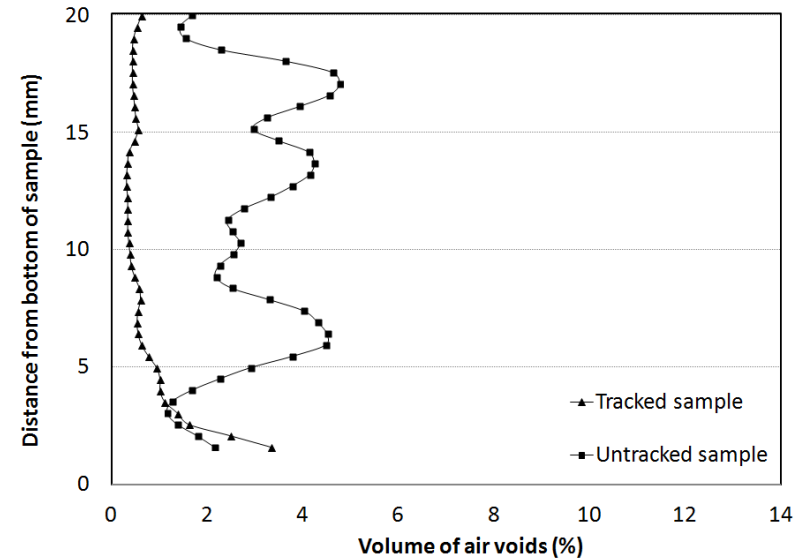
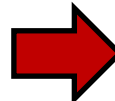
b) Air voids structure of untracked sample



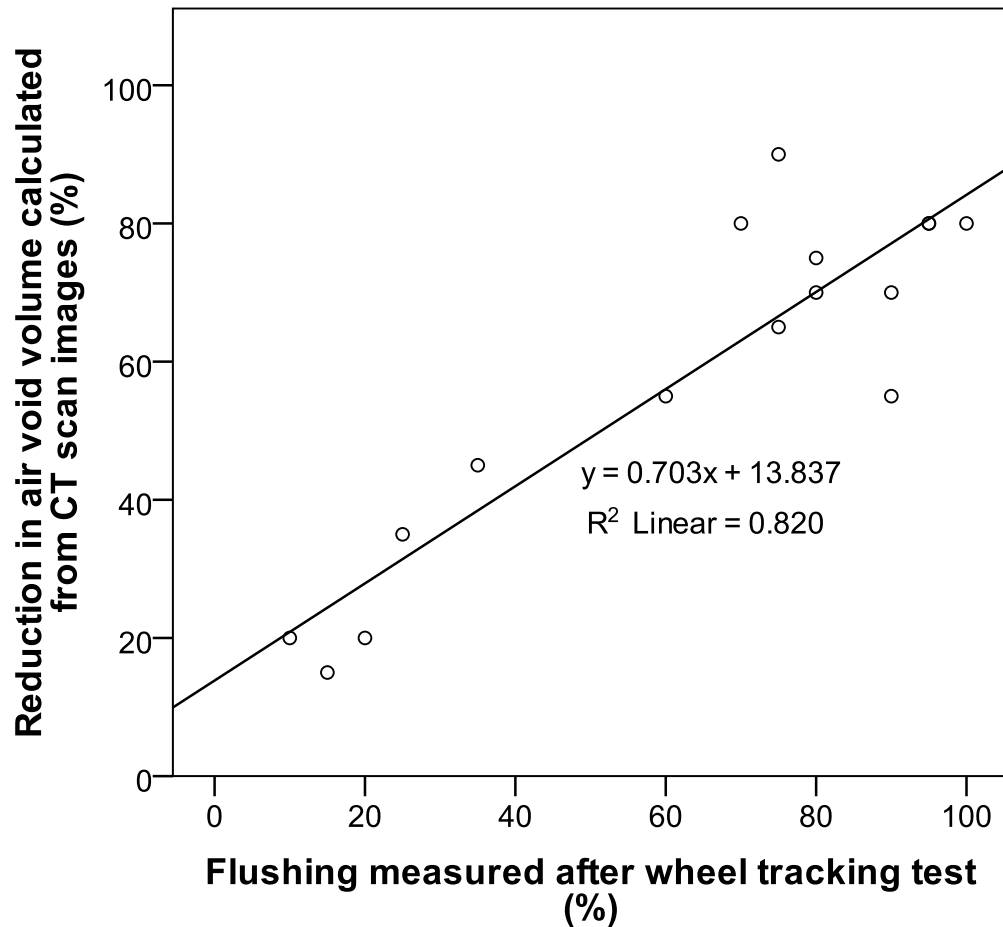
c) 3D reconstruction of tracked sample



d) Air voids structure of tracked sample

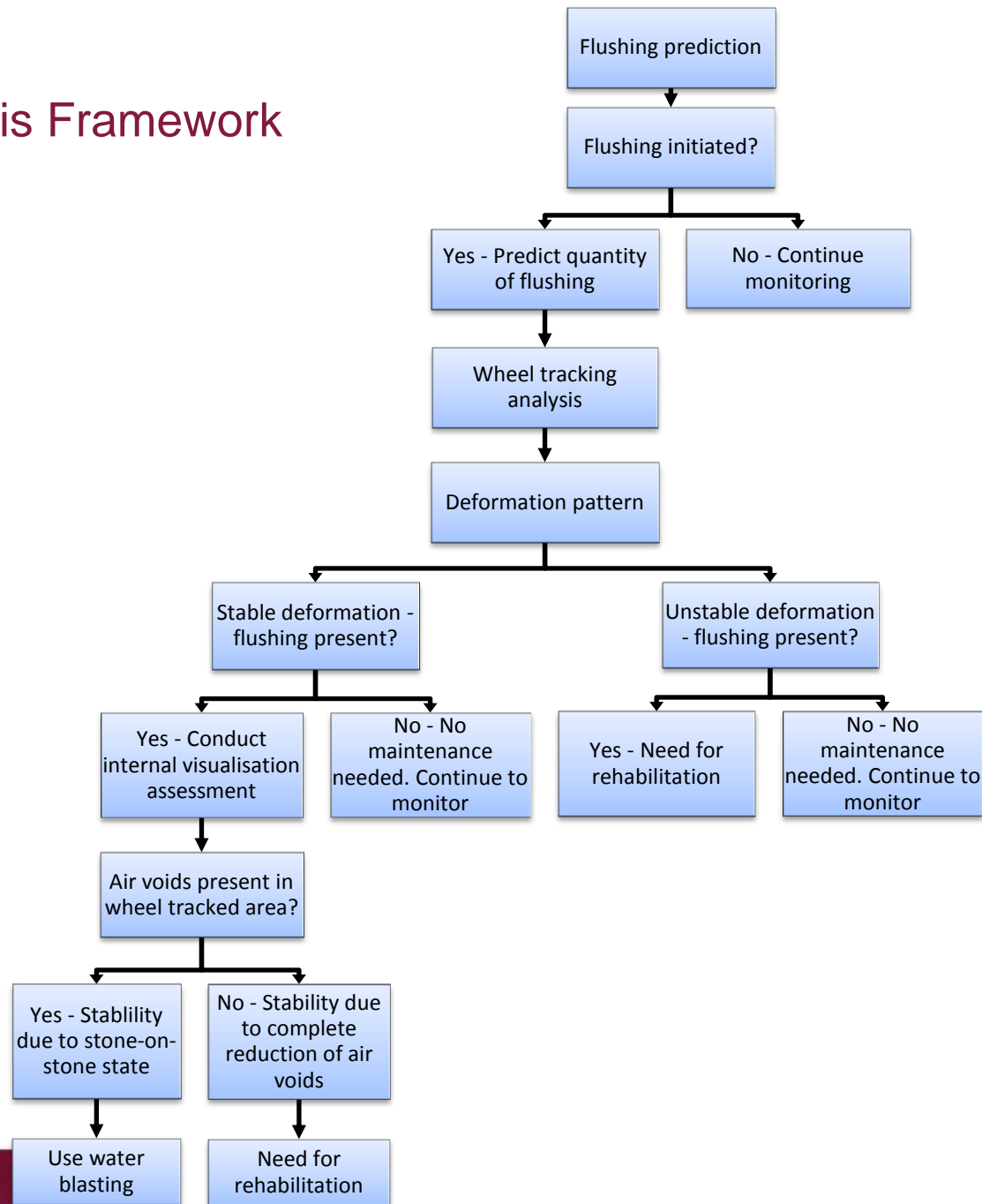


Air Voids & Flushing Trends



FLUSHING ANALYSIS FRAMEWORK

Flushing Analysis Framework



CONCLUSIONS

Conclusions

- Flushing prediction model based on LTPP data
- The flushing model predicts flushing initiation at an accuracy of 76%
- Laboratory testing, and internal analysis is vital to confirming model predictions
- Assessment framework to identify flushing from a network level down to volumetrics

Acknowledgements

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THANK YOU