Superpave5: Brief Overview

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Much Asphalt
Introduction

Superpave 4 vs Superpave 5

Origins?
Differences?
Similarities?
Performance?
Superpave4 Methodology

- Commenced - Mid 1990’s;
- Carried forward Marshall design thinking of designing to 4 % mix voids and targeting 92 %< compaction level;
- Ultimate density is achieved due to secondary (traffic induced) compaction from ± 8 % in-situ air voids to ± 4 % in-situ air voids.

\[ \text{Density at end of life} = \text{Design Density} \]
Superpave Methodology

\[ \therefore \text{Density at end of life} = \text{Design Density} \]

Secondary Compaction Effect
What on earth is Superpave5 ?????

Quite simply put…

Design to **5 %** air voids content

Compact to **5 %** air voids content (95 % compaction)

<table>
<thead>
<tr>
<th></th>
<th>Superpave4</th>
<th>Superpave5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gyration</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>Asphalt Content</td>
<td>5.1%</td>
<td>5.4%</td>
</tr>
<tr>
<td>Recycled Binder Ratio</td>
<td>0.206</td>
<td>0.193</td>
</tr>
<tr>
<td>Air Voids</td>
<td><strong>4.0</strong></td>
<td><strong>5.0</strong></td>
</tr>
<tr>
<td>VMA</td>
<td>15.5</td>
<td>17.0</td>
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Superpave5: Origins and Objectives

- Rooted in the French LCPC design methodology:
  - Primary principle: “A mixture should be designed and, during construction, compacted to its ultimate density” (Moutier, 1977).
- Main goal: “Finding a way of improving asphalt pavement performance without increasing cost”
  - Keep Binder content, mix stiffness and rutting performance the same.
  - Change the design gradation and compaction level to get there.
VMA is influenced amongst others by **TYPE** and **AMOUNT** of compactive effort

… therefore as compaction effort is reduced, gradation design needs to facilitate improved workability and reduced void content.

Δ 25 Gyrations

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Δ 1 % VMA
Superpave5: Field Performance Findings

- Similar levels of rutting observed (± 3.0mm after 5 years in LWP)
- Reduced layer permeability

Areas of continual low density where water and air penetrate, even with increased secondary compaction.
Superpave5: Field Performance Findings

- Binder ageing evaluated after 5 years in-situ:

80% PG 70-22 + 20% ± PG 130-0

PG 100-16

PG 94-21
Summary

- Asphalt layer permeability issues are significantly reduced with improved levels of in-situ compaction;
- Asphalt binder ageing in the field directly related to compaction of the layer;
- Reduced ageing reduces the risk of pavement cracking due to age hardening;

Resultant effect of designing and compacting to 5% air void content

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Improved durability of asphalt pavement and the subsequent protection it offers to base layers.
References and Acknowledgements

NCHRP Report 573 : Superpave Mix Design: Verifying Gyration Levels in the Ndesign Table, 2007
Huber, G., “Superpave5: Superpave Design at Five Percent Air Voids”, Idaho Asphalt Conference, Moscow, ID, 2018
Weilinski, Campbell, Beeson and Huber, “Superpave5: Effect of In-Place Air Voids on Asphalt Mixture Performance”, 2019

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