

9 ASPHALT DESIGN

ASPHALT CORE



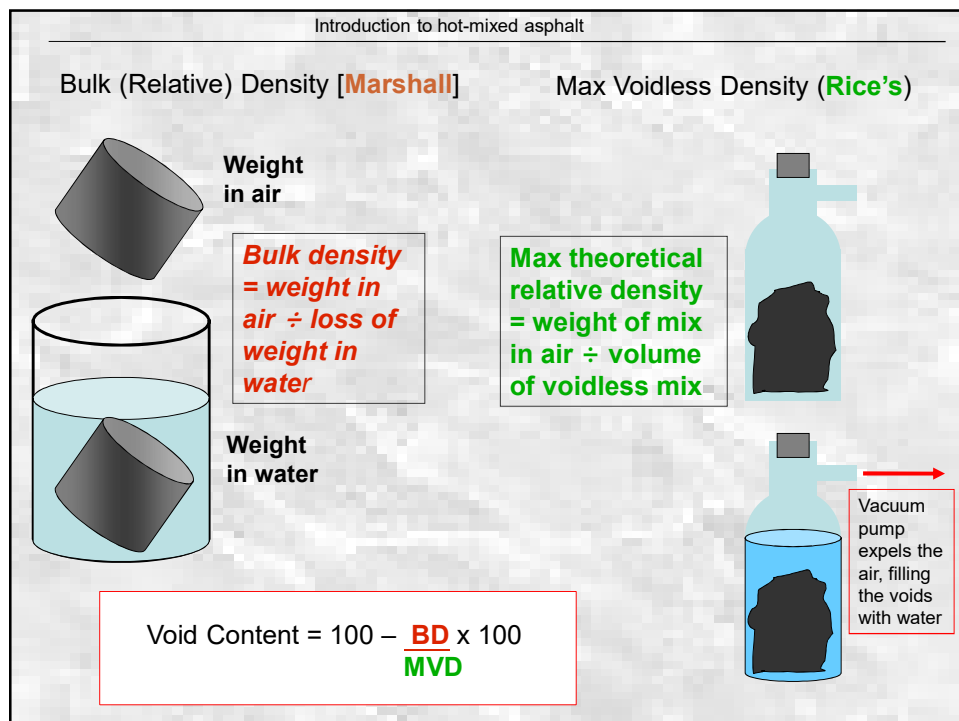
ASPHALT DESIGN

Simply:- STONE including Fines
+
BITUMEN (Glue)

HMA = Hot Mix Asphalt

Old:- design standard TMH8 (1987)

**New:- Interim Guidelines for the Design
of HMA in South Africa (2000 & 2013)**



The Marshall Mix Design Method

Marshall briquettes are prepared using the same aggregate mixture at 5 different bitumen contents

The results of the tests are then plotted

The optimum binder content is chosen, based on these results

RESULTS

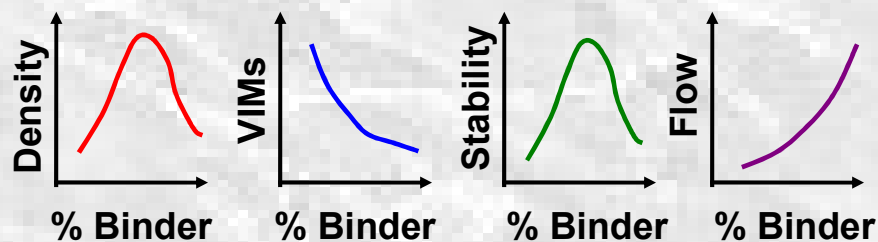
Binder Content, Marshall (Bulk) **Density**,
VIMs, **Stability** and **Flow**.

Marshall Tests

Voids In the Mix (VIMs)

$$\text{VIMs} = \frac{\text{Rice's MTD} - \text{Marsh D}}{\text{Rice's MTD}} \times 100$$

NB Rice's MTD = Max Void-less Density (MVD)



ASPHALT DESIGN

Currently Available - Urban Areas

A number of 'standard' mixes - mainly continuous - near Urban areas, also specials such as Open, B-R and SMAs

Recently also thin friction and prop mixes

New Mix Design is a Specialist Field

However, a general understanding of the Design considerations will improve your feel for the "Black Stuff".

ASPHALT DESIGN

MIX COMPONENTS

AGGREGATE - Structural Skeleton

Subdivided into:- "Stone" > 0,075mm

"Fines" < 0,075mm

Gradings: Continuous, Open, Gap

Shape: Cubical (FI→10) - Flaky (FI→30)

Surface Props: Roughness / Absorption

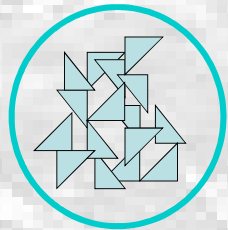
Hardness: Strength / Polishing

MIX COMPONENTS

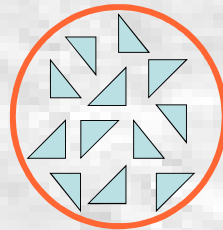
Grading

Continuous

Gap or Semi



VOIDs



Good
Density
Durability
Stiffness
Rut Resist

Poor
Fatigue
Perm
Skid R

Good
Low Perm
Fat Resist

Poor
Rut Resist
Stiffness

MIX COMPONENTS

BINDER (The Glue!)

Obtained by distillation from Crude Oil
made up of the heavier fractions including
asphaltenes, maltenes and aromatics

Generally straight pen bitumen in the range
40 to 100 pen

Quite Complicated specs for this material
Viscosity, softening point and penetration;
and now PG Binder specs

MIX COMPONENTS

FILLERS

Rock Flour, Flue / Baghouse 'dust' and active fillers: Lime, Cement & Flyash

Actions:-

- Extends the Binder
- Fills the Voids
- Stiffens the Mix
- Alters Workability
- Lime reduces **stripping**

Actions:-

- Extends the Binder
- Fills the Voids
- Stiffens the Mix
- Alters Workability
- Lime reduces stripping

MIX COMPONENTS

NB Considerable variation in bitumen composition depending on the source of the Crude

Modifiers:- Elastomers & Plastomers
The properties of the bitumen can be altered by adding: Rubber (B-R)

- SBS**
- EVA**
- Fibres**

Fibres

MIX PROPERTIES

DURABILITY: Resistance to Traffic, Sun, Water and Temperature Extremes

RESISTANCE TO CRACKING: Caused by the interaction of Traffic and the Pavement Structure

RESISTANCE TO DEFORMATION: Caused by Heavy Traffic and High Pavement Temperatures

MIX PROPERTIES Contd

FLEXIBILITY: To resist damage when the pavement deflects under Heavy Traffic loads

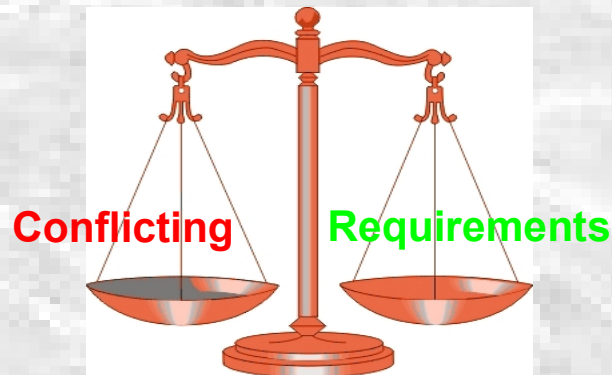
SKID RESISTANCE: Caused by bleeding and polishing of stone under Heavy Traffic

LOW PERMEABILITY: Resist water penetration

WORKABILITY: Ability to Shape and Compact the Mix

MIX PROPERTIES

OFTEN



Ultra thin friction course (UTFC)

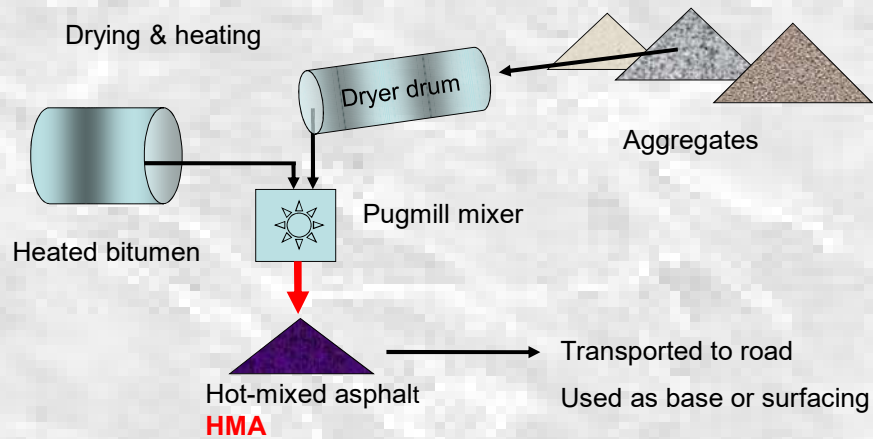


- The UTFC is a stone skeleton type mix using modified binder
- An essential part of UTFC is a thick tack coat of modified bitumen emulsion. This provides good adhesion of the thin friction course to the underlying asphalt layer and provides a waterproofing membrane
- A specialized Spray-paver is used to pave UTFC – the tack spray system is incorporated into the paver

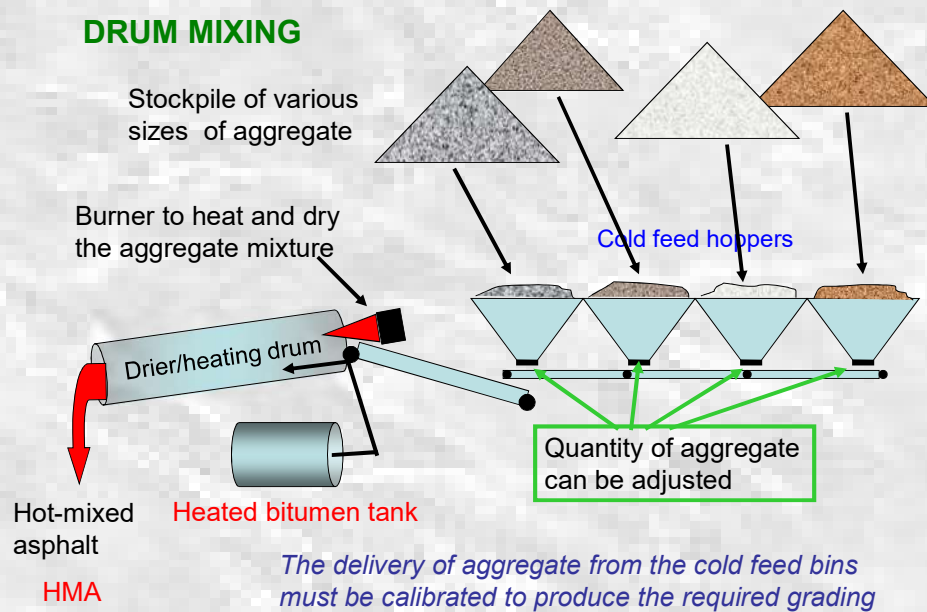
UTFC provides good skid resistance and riding quality, and has been found durable under heavy traffic

Basic HMA production concepts

BATCH MIXING



DRUM MIXING



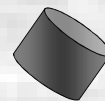


THERE ARE TWO WAYS OF SPECIFYING COMPACTION OF HOT MIX ASPHALT:

- 1. B(R)D of core sample as a percentage of Marshall density of the same mix



Field Core



**Marshall
Briquette**

v
s

Usually specified as "The compaction of the asphalt shall not be less than 95% of Marshall density"

- 2. B(R)D of core sample as a percentage of
Maximum Void-less Density (Rice's) of the same sample



v
s



Usually specified as:- “ The compaction of the asphalt shall not be less than 97% minus the design void content of Rice's density” - if design voids are 5% then min would be 92% Rice's.

Marshall BD should no longer be used for asphalt density control. Continuous HMA with less than 92% Rice's will be porous.



