Quality Assurance in Asphalt Surfaces

Presentation by Matt Burt

Asphalt Construction

- The most important factor in the construction of asphaltic surfaces is compaction
- A mix of average qualities can outperform one of exceptional qualities providing it is better compacted
- What we test for to determine this is the air void percentage present in the constructed surface

Air Void Percentage

- Target air void percentage is 3-5%
- If an asphalt surface has an air void percentage of 8%, its fatigue life is halved.

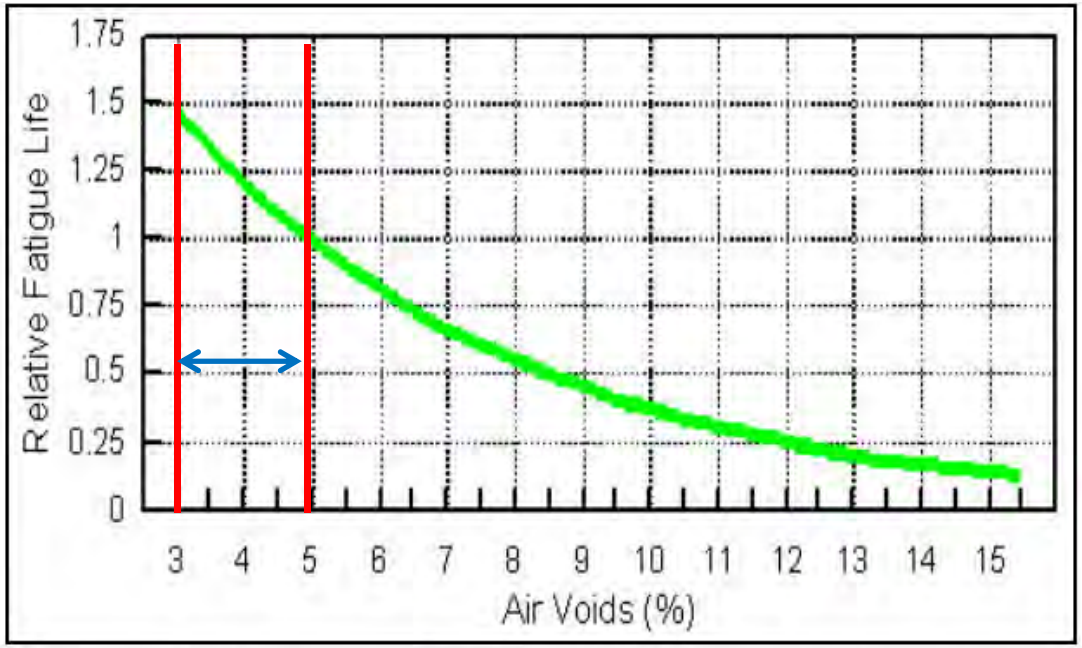


Figure 3: Relative Fatigue Life vs. Air Voids

*AAPA Working tip no 17: Air voids in asphalt

Too Low? – Lower than 3%

- Sheer strength decrease (becomes more brittle)
- Nowhere for the bitumen to go when it expands in hot weather. This can cause flushing and shoving.

Too High? – Higher than 5%

- Flexibility decreases
- As traffic is introduced, further compaction can occur in the wheel tracks causing rutting to occur

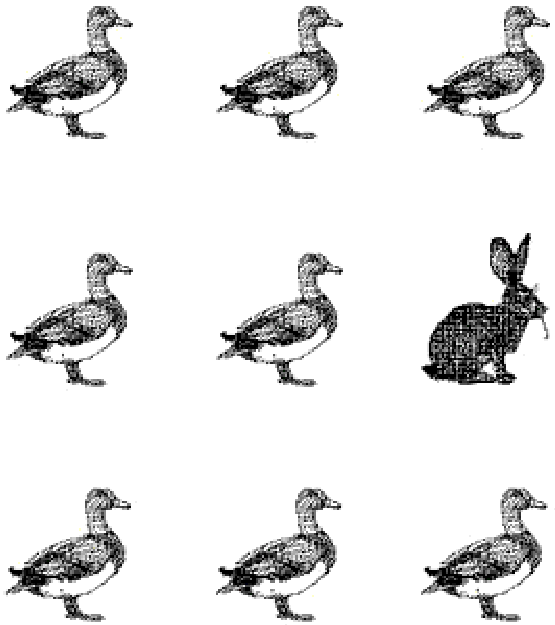
Random Verification Testing

- Random verification testing (RVT) is testing conducted parallel to Contractor's QA testing to ensure adequate compaction of the asphalt Has been achieved.

- Both RVT and QA test results should be consistent. However.....

Inconsistencies

- Inconsistencies have been occurring between the Contractors test results and our own...
- These have occurred when testing cores taken from constructed asphalt surfaces for air void percentages



Specifications

- TNZ P/9: 1975
- TNZ P/9 P: 1992
- AAPA National Asphalt Specification Second Edition, April 2004 New Zealand Supplement (NAS)

Example

	Core	Chainage	Air Void %
Contractor	1	10	4.2
	2	150	5.6
	3	237	6.0
	4	311	3.8
	5	495	4.2
	6	510	4.0
	7	540	5.6
	8	746	6.0
	9	821	3.9
	10	839	4.7
Consultant	1	480	9.2
	2	500	6.5
	3	995	6.6

TNZ P/9: 1975

"Nine out of every ten consecutive cores cut from the completed compacted pavement shall prove on test to have not less than 3 percent nor more than 6 percent total air voids.....Any sections of pavement that do not meet these requirements shall be removed and replaced with material supplied and compacted to specification requirements by the contractor at his own expense."

Western Research Institute

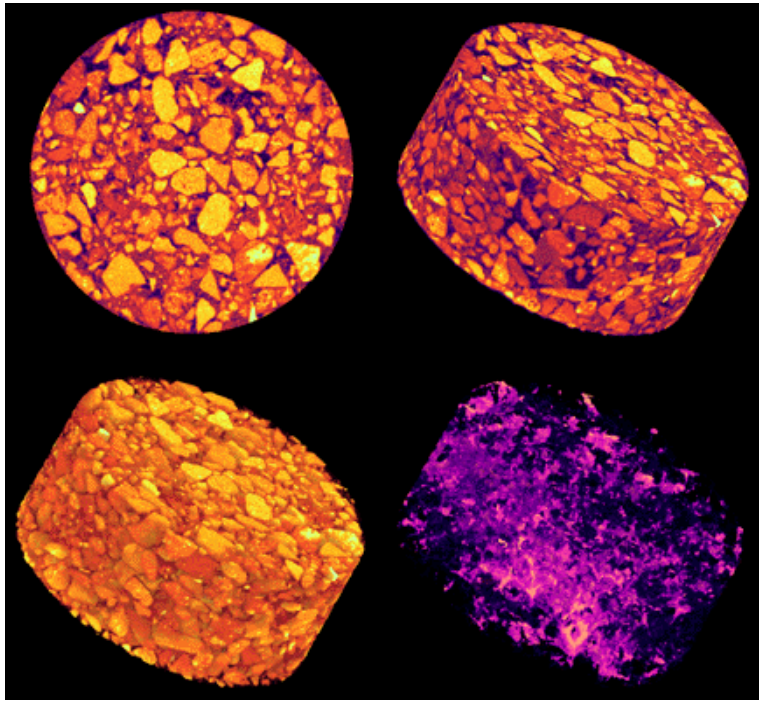
TNZ P/9: 1975

	Core	Chainage	Sub-lot	Air Void %
Consultant	1	480	5	9.2
	2	500	6	6.5
	3	995	9	6.6

- Requires 9 out of every 10 cores to be within range of 2-6%
- 3 out of 13 cores are outside this range.
- Sections may need to be removed at the cost of the Contractor.

TNZ P/9 P: 1992

"The relevant sub-lot shall be deemed acceptable in terms of density if the air voids for a surface mix are between 2.5% and 6.5%"..... " If an individual core has air voids outside the above range then four additional cores shall be taken randomly within the sub-lot"..... " If the mean value of these four cores lies between the limits given above, the relevant sub-lot shall be deemed acceptable in terms of density."



TNZ P/9: 1975

	Core	Chainage	Sub-lot	Air Void %	
Contractor	5	495	5	4.2	←
	6	510	6	4	←
	7	540	6	5.6	←
Consultant	1	480	5	9.2	←
	2	500	6	6.5	
	3	995	9	6.6	←

- Requires Air Void % between 2.5-6.5% for a surface mix
- Average of 4 = 5.75% (PASS)

AAPA NAS TNZ Supplement

Table 9.5.2 Characteristic Value of Insitu Air Voids for Wearing Course Asphalt

Asphalt Type and Thickness (mm)	Maximum Characteristic Value (%)
All heavy and very heavy traffic asphalt wearing courses	8
Medium traffic wearing course.	9
Light traffic wearing course	7

AAPA NAS TNZ Supplement

Vupper = Mean + (N x S) and Vlower = Mean - (N x S)

N = Constant (number of tests)
S = Standard deviation
V = Characteristic Value

V_{upper} = 5.41 + (0.877 x 1.52)
= 6.75%

V_{lower} = 5.41 – (0.877 x 1.52)
= 4.07%

PASS!!!

Summary

TNZ P/9: 1975: Due to 3 out of 13 results being non-compliant, part of asphalt surface may need to be removed and replaced at cost to contractor.

TNZ P/9 P" 1992: Each non-compliant result can be averaged with other results within the same sub-lot which, in this case, gives a pass.

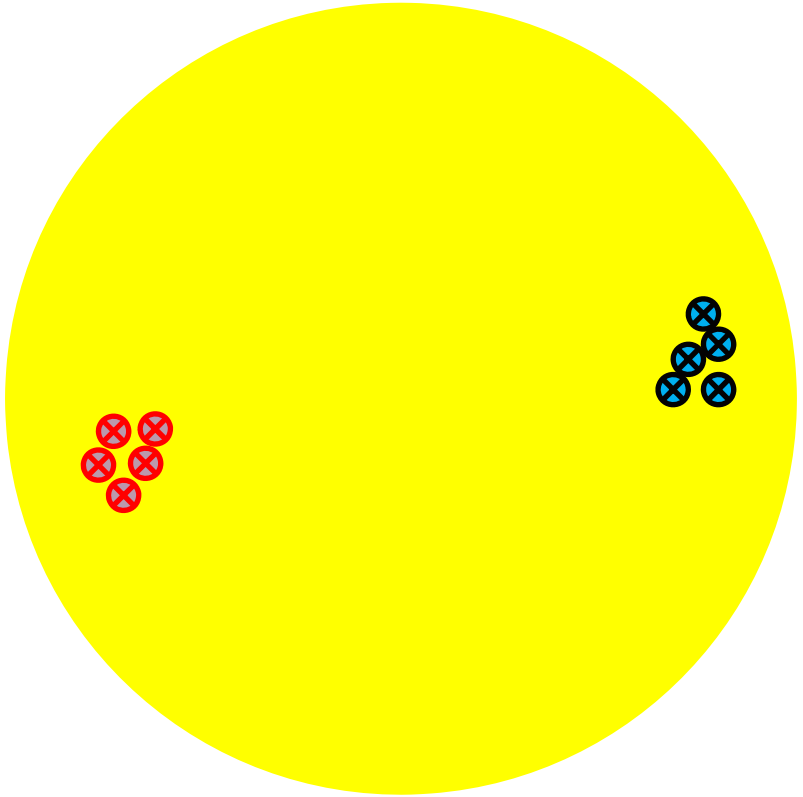
AAPA's NAS TNZ Supplement: Using the upper and lower characteristic limits in this specification, the surface passes.

Our Problem

- Differences are occurring too frequently to ignore
- This wouldn't be a problem if we had complete confidence in the results obtained but it creates quite a problem for Engineers to contracts involving asphalt surface construction
- Suggests there is a variable present in different labs that is affecting results

Reason

- LAB 1 results
- LAB 2 results



- Allowable Variation that falls under the IANZ testing specification

Consequences

- If contractors results are accurate then the average air voids percentage is 4.8%
- This gives a relative fatigue life shown by the red line of around 1. So a pavement designed for a life of 20 years will last 20 years

- If the consultants results are accurate then the average air voids percentage is 7.4%
- This gives a relative fatigue life shown by the blue line of around 0.6. So the same pavement design would last 12 years.

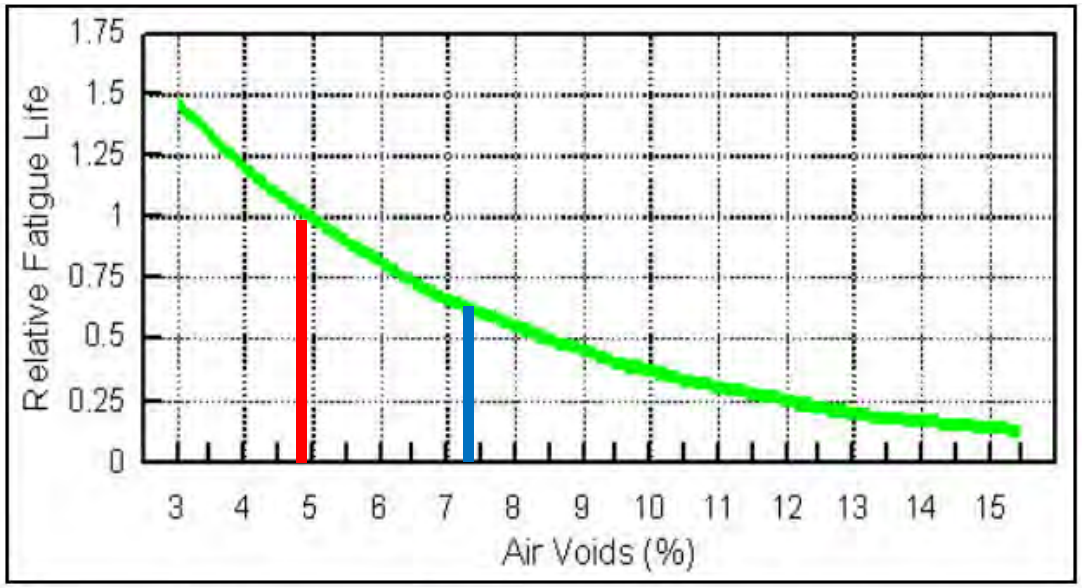


Figure 3: Relative Fatigue Life vs. Air Voids

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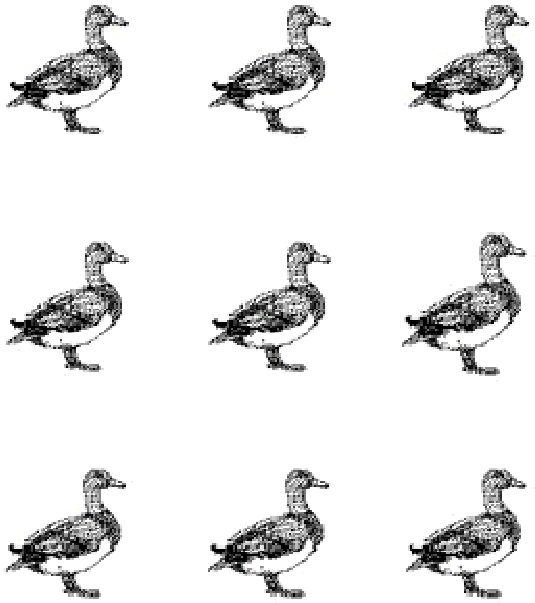
Draft M/10

- Draft M/10 uses a more statistic approach like that of the AAPA NAS TNZ Supplement
- But this still assumes that the results are accurate
- If confidence in the reproducibility of these tests is not improved then confidence in the results themselves will not be either.

Solution

- Industry wide initiative to improve confidence in both QA and RVT testing in New Zealand
- We need to get labs involved and together so they can observe each others testing method in order to identify possible sources of disparity



OPUS

Thank You!!!! Questions?