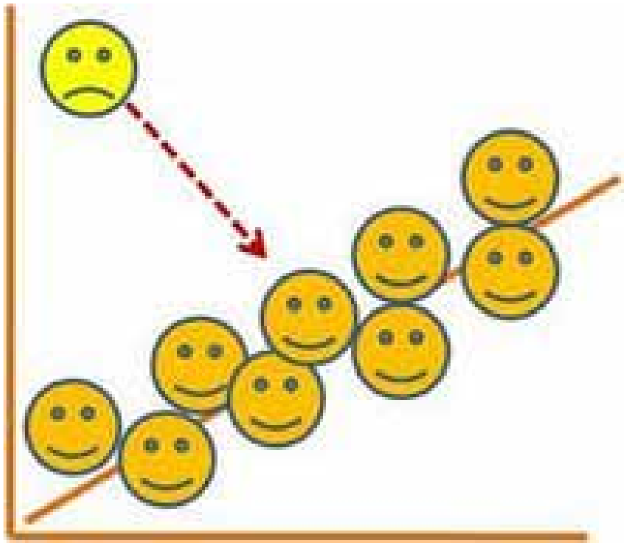
AAPA's 14th International Flexible Pavements Conference

Sydney
25–28 September 2011

Topic: Laboratory versus Field Assessment of Full Depth Asphalt Mixes in New Zealand.

PRESENTER: Glynn Holleran, Irina Holleran
Position: Technical Manger Auckland , TS Manager Auckland
Organisation: Fulton Hogan



If it is not Representative-
don't use it!

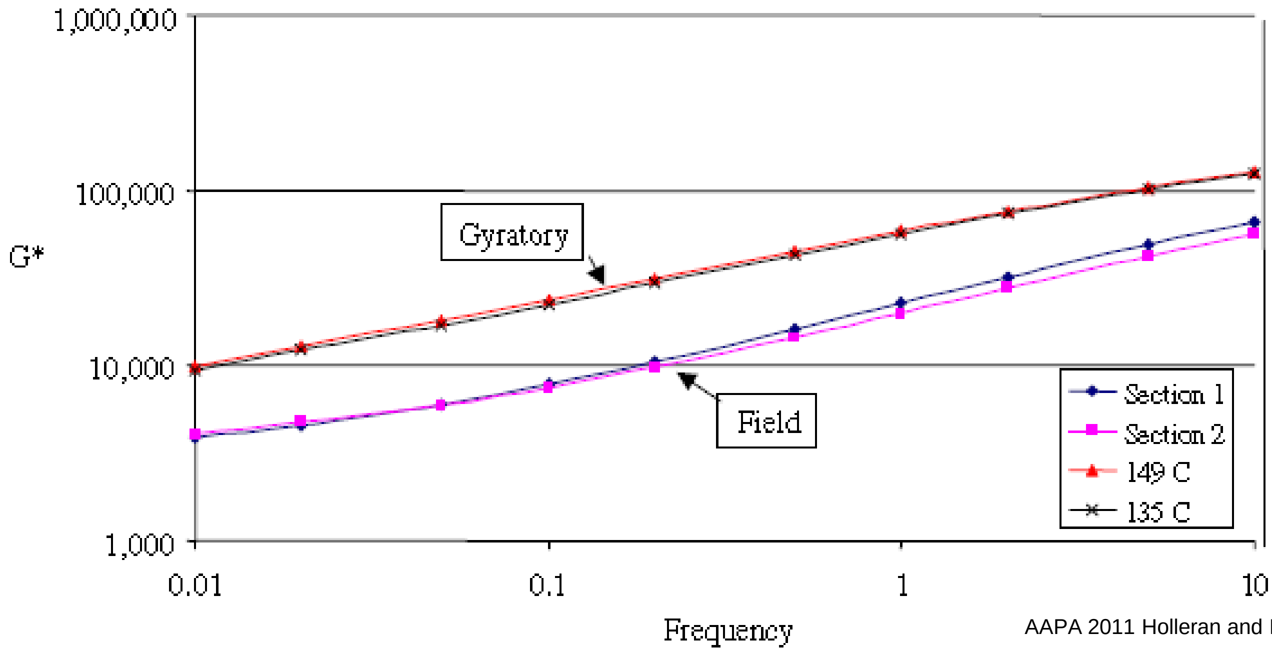
Outline

- Considerations in Performance of Asphalt Laboratory Design V Field
- RAP use and its issues
- Project Results Field v laboratory
- How do we get design to field reliably?

You cant afford to ignore basic principles

Differences due to compaction - Lit

- Void distribution
- Particle orientation
- Physical properties



AAPA 2011 Holleran and Holleran

Void distribution lab V Field – Image analysis

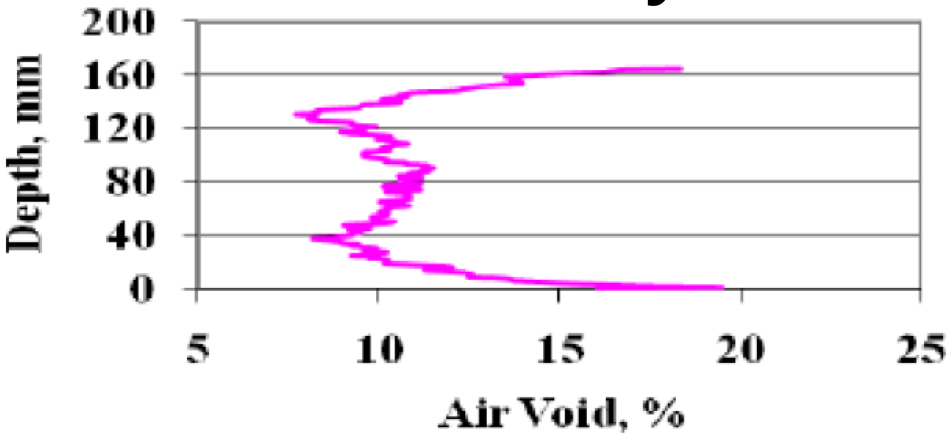
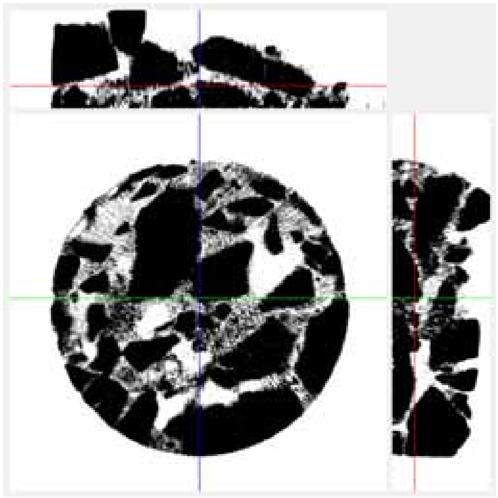
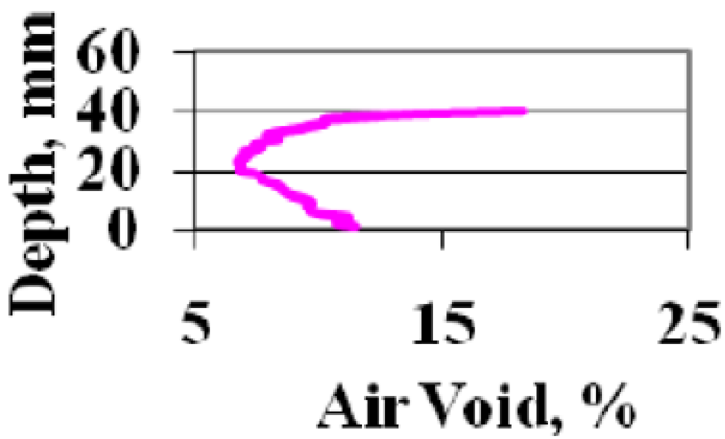


Figure Example of lab compacted sample





2011 Holleran and Holleran

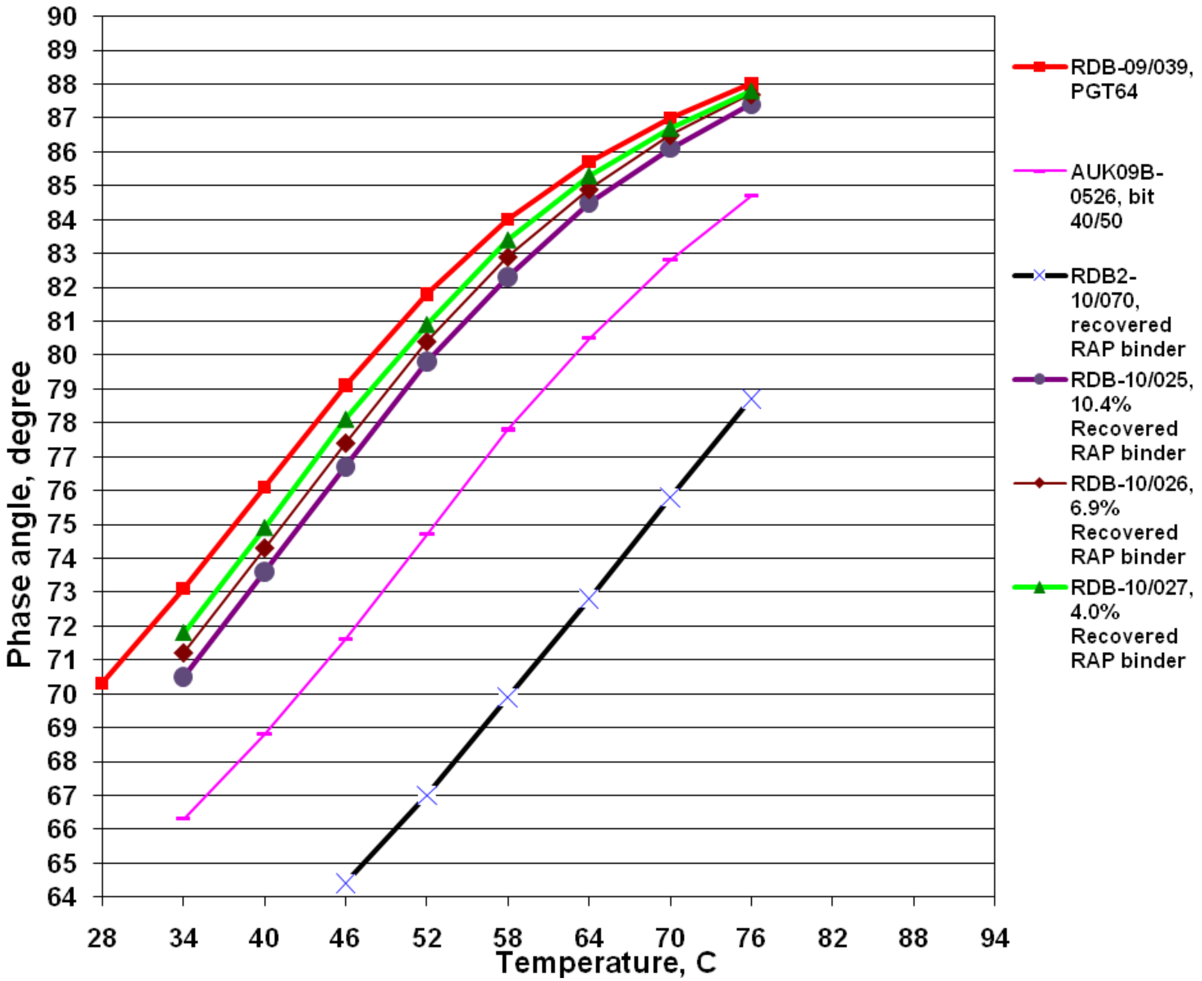
Figure Example of Field Compacted sample- same Mix

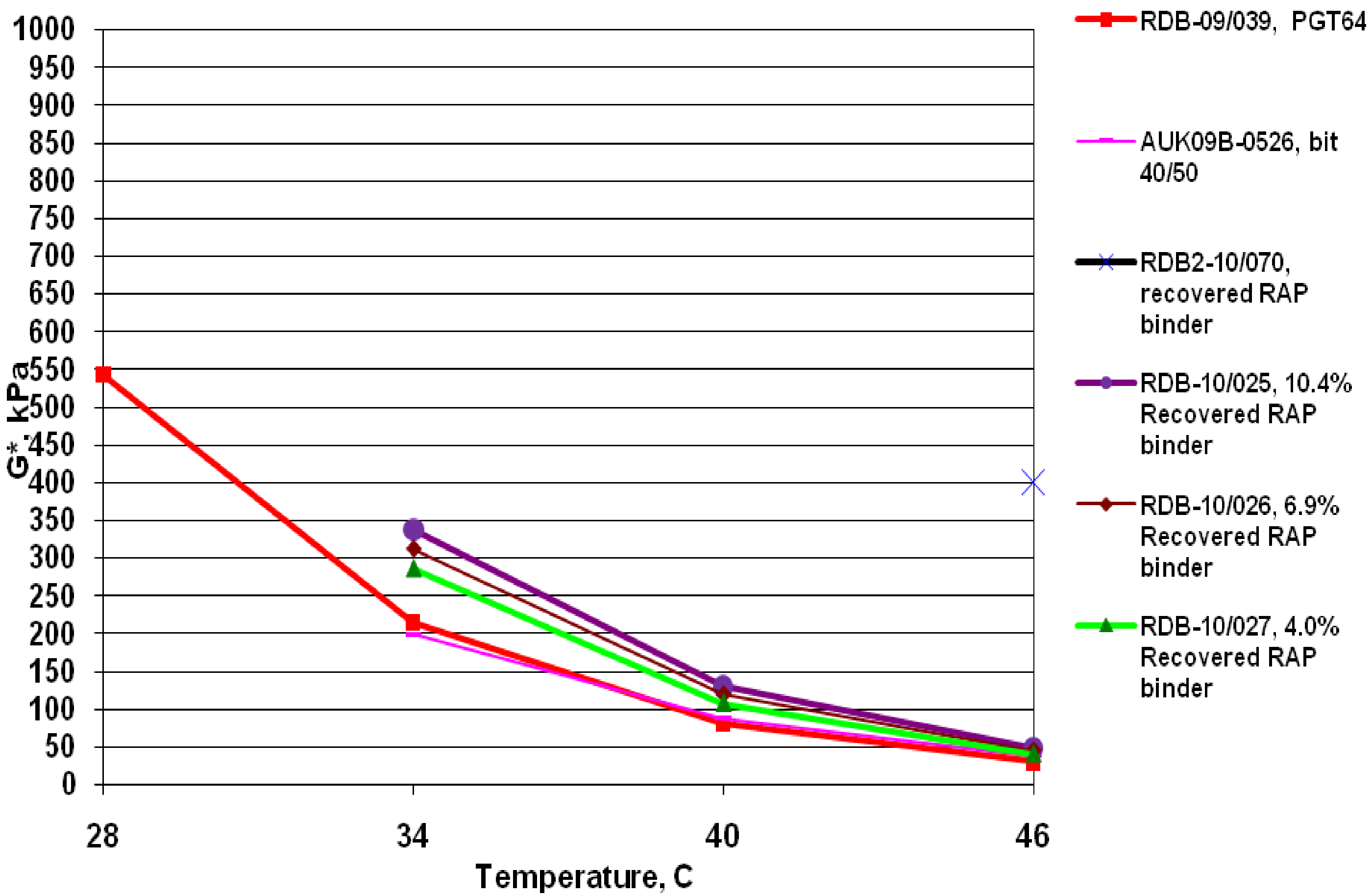
Design

- Binder allowance and mixing
- Grading- accessible fines
- Sg testing- Volumetrics are sensitive to Rap Sg . Calculate from fine and coarse extracted aggregates and allowance for binder
- Handling RAP not changing binder

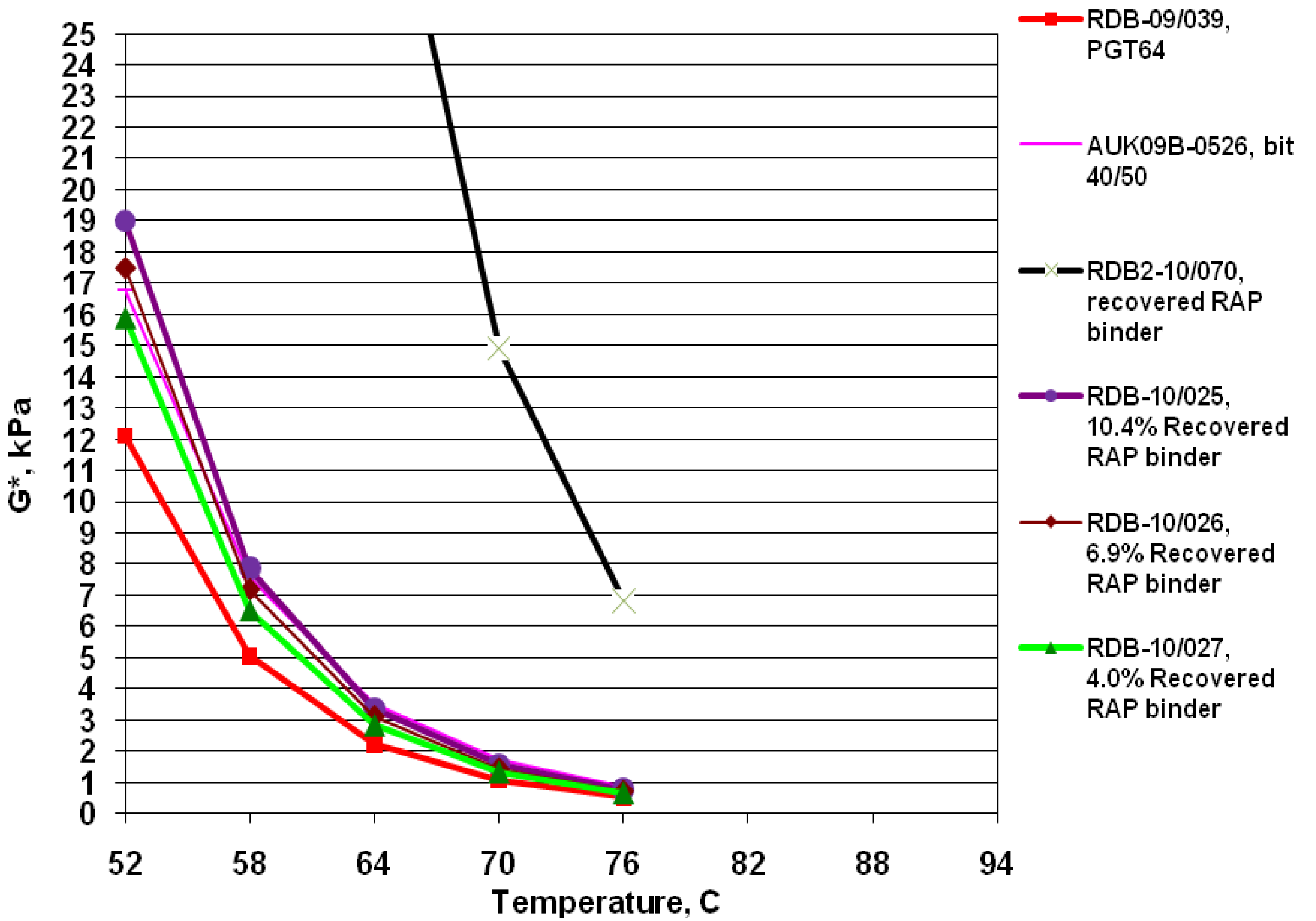
Contribution of RAP binder

- 100% mixing does not occur as physical properties are not consistent with this.
- Partial mixing occurs and may create an interfacial area between virgin and aged binder
- The interface will depend on
  - the virgin binder rheology and
  - Temperature
  - Mixing time
  - Heat soak time – silo storage
  - Degree of aging in the recovered binder


Phase angle, degree
90
89
88
87
86
85
84
83
82
81
80
79
78
77
76
75
74
73
72
71
70
69
68
67
66
65
64
28
34
40
46
52
58
64
70
76
82
88
94
Temperature, C
RDB-09/039, PGT64
AUK09B-0526, bit 40/50
RDB2-10/070, recovered RAP binder
RDB-10/025, 10.4% Recovered RAP binder
RDB-10/026, 6.9% Recovered RAP binder
RDB-10/027, 4.0% Recovered RAP binder

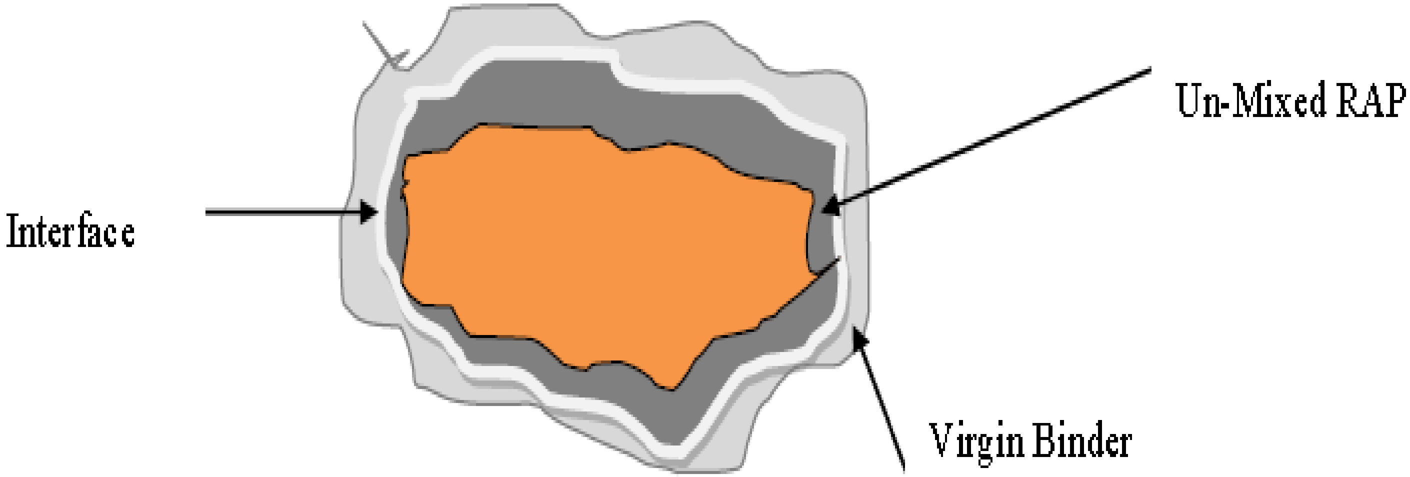


1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
G*, kPa
28
34
40
46
Temperature, C
RDB-09/039, PGT64
AUK09B-0526, bit 40/50
RDB2-10/070, recovered RAP binder
RDB-10/025, 10.4% Recovered RAP binder
RDB-10/026, 6.9% Recovered RAP binder
RDB-10/027, 4.0% Recovered RAP binder

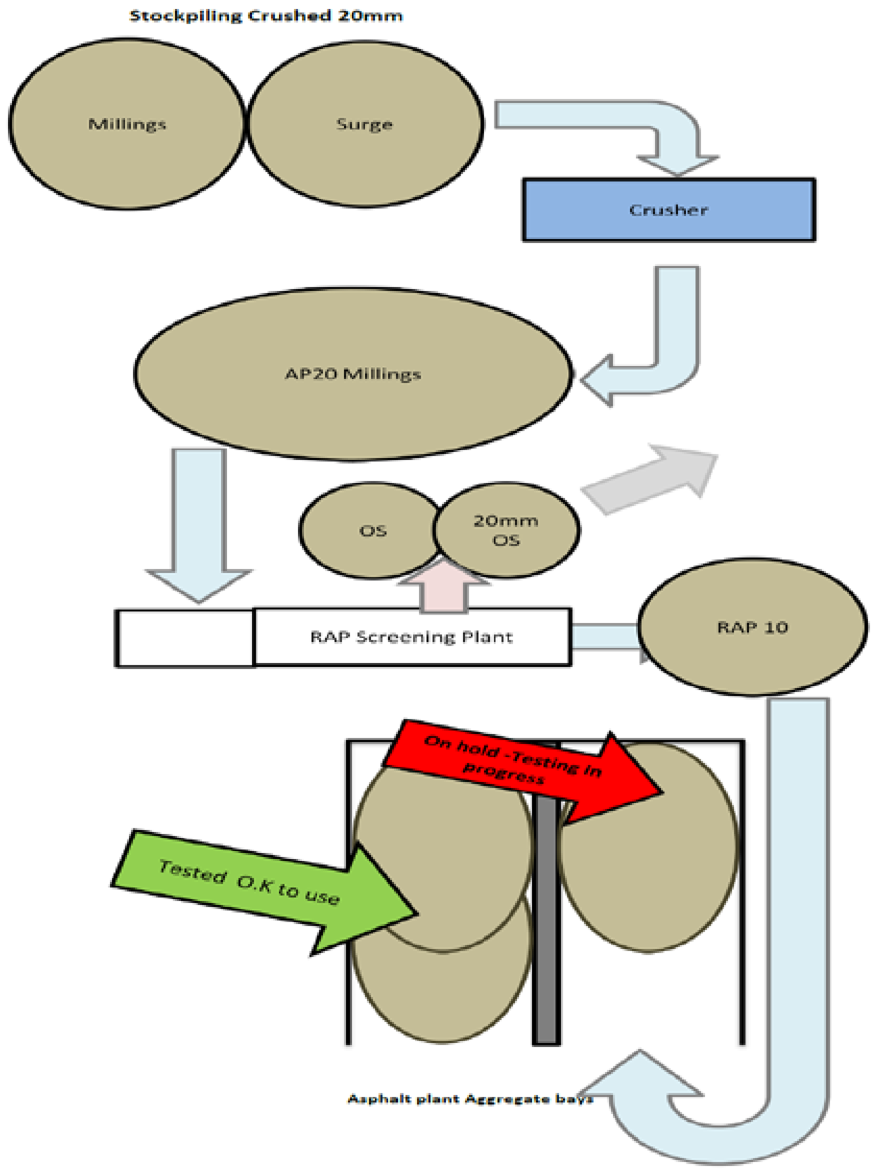


G*, kPa
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
52
58
64
70
76
82
88
94
Temperature, C
RDB-09/039, PGT64
AUK09B-0526, bit 40/50
RDB2-10/070, recovered RAP binder
RDB-10/025, 10.4% Recovered RAP binder
RDB-10/026, 6.9% Recovered RAP binder
RDB-10/027, 4.0% Recovered RAP binder

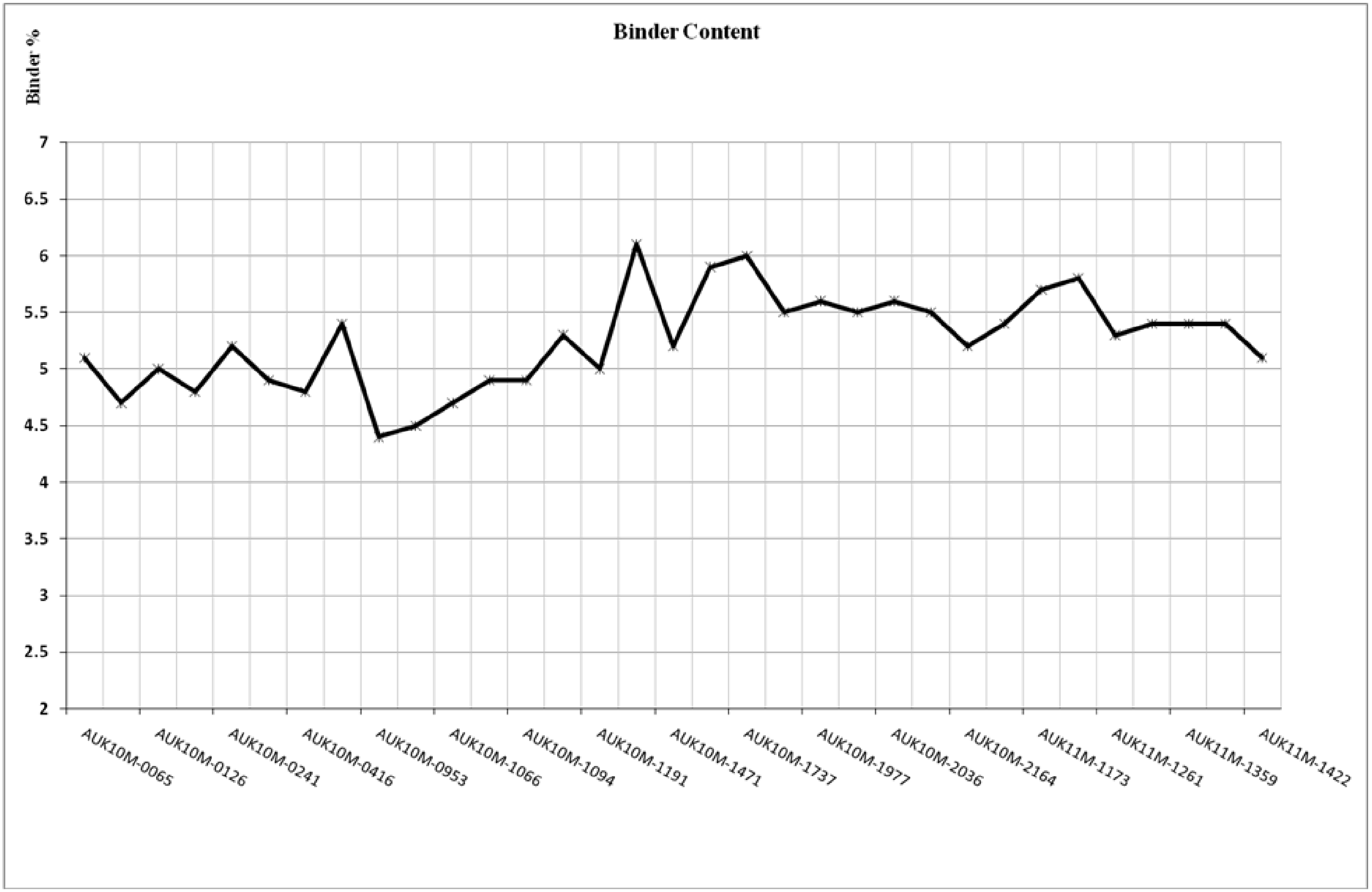
Conceptual Effect of Rap Binder



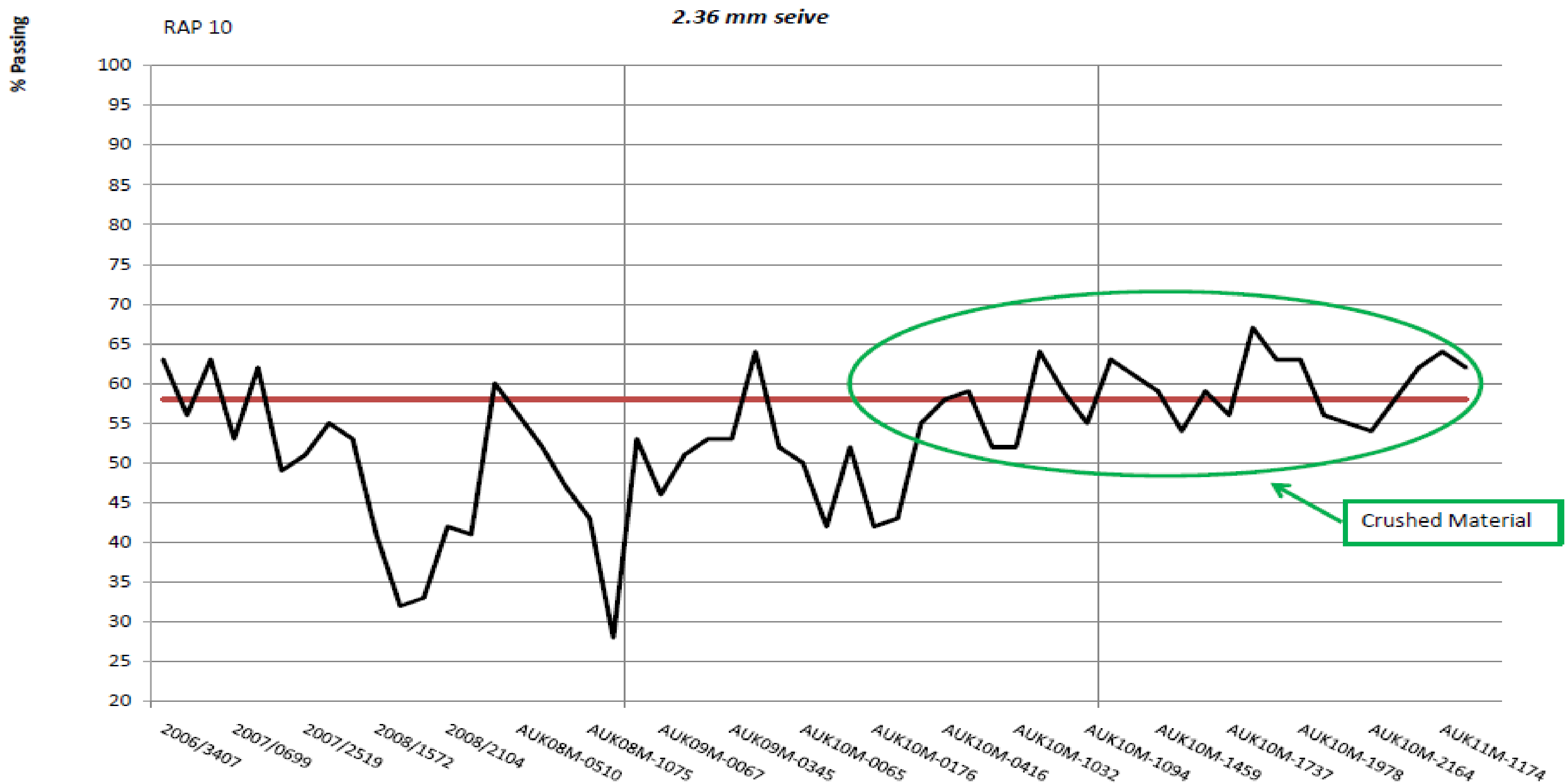
Effect of Non accessible Fines


Stockpiling Crushed 20mm
Millings
Surge
Crusher
AP20 Millings
OS
20mm OS
RAP Screening Plant
RAP 10
On hold -Testing in progress
Tested O.K to use
Asphalt plant Aggregate bays


elf



Binder Content
Binder %
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
AUK10M-0065
AUK10M-0126
AUK10M-0241
AUK10M-0416
AUK10M-0953
AUK10M-1066
AUK10M-1094
AUK10M-1191
AUK10M-1471
AUK10M-1737
AUK10M-1977
AUK10M-2036
AUK10M-2164
AUK11M-1173
AUK11M-1261
AUK11M-1359
AUK11M-1422

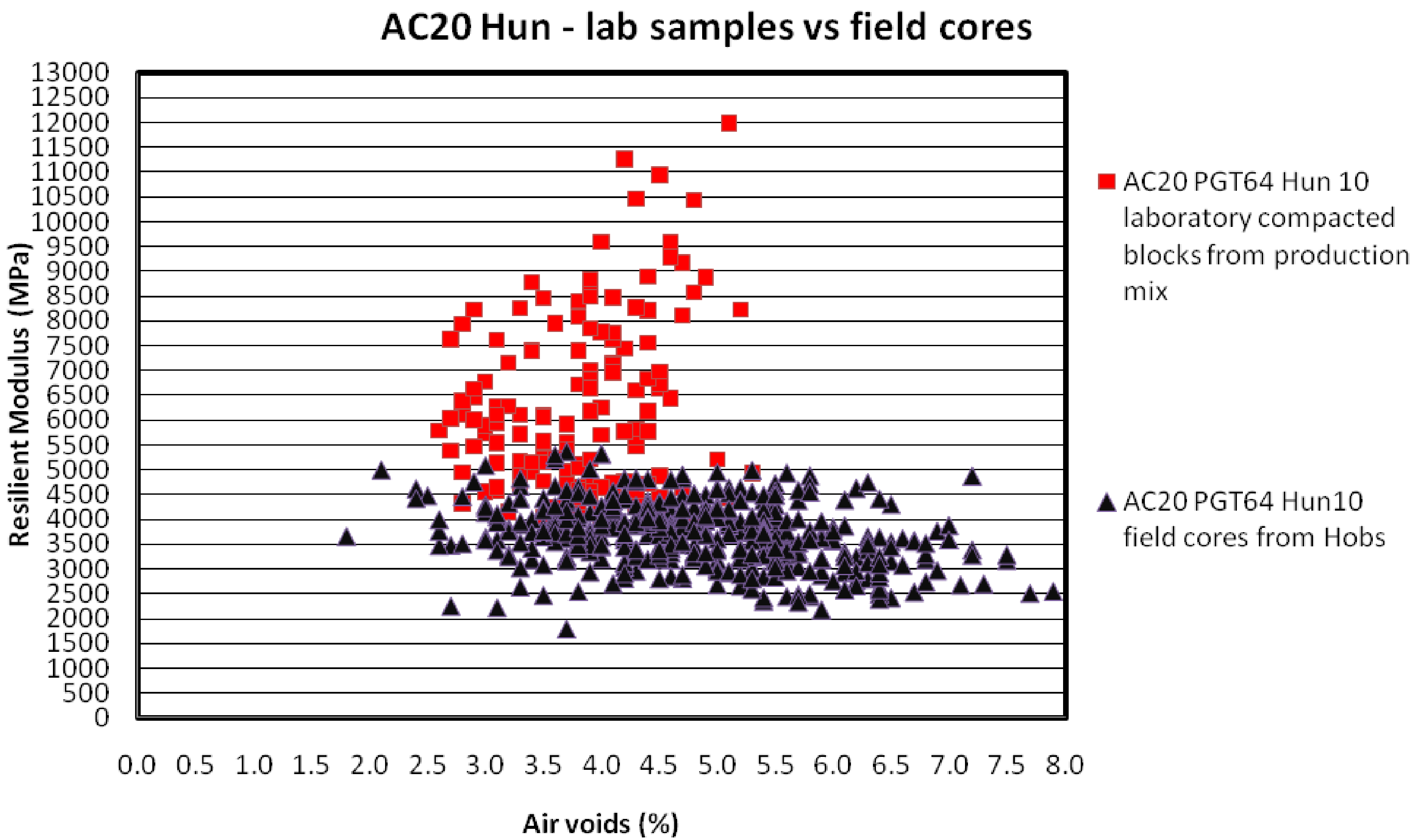


% Passing
RAP 10
2.36 mm seive
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
2006/3407
2007/0699
2007/2519
2008/1572
2008/2104
AUK08M-0510
AUK08M-1075
AUK09M-0067
AUK09M-0345
AUK10M-0065
AUK10M-0176
AUK10M-0416
AUK10M-1032
AUK10M-1094
AUK10M-1459
AUK10M-1737
AUK10M-1978
AUK10M-2164
AUK11M-1174
Crushed Material

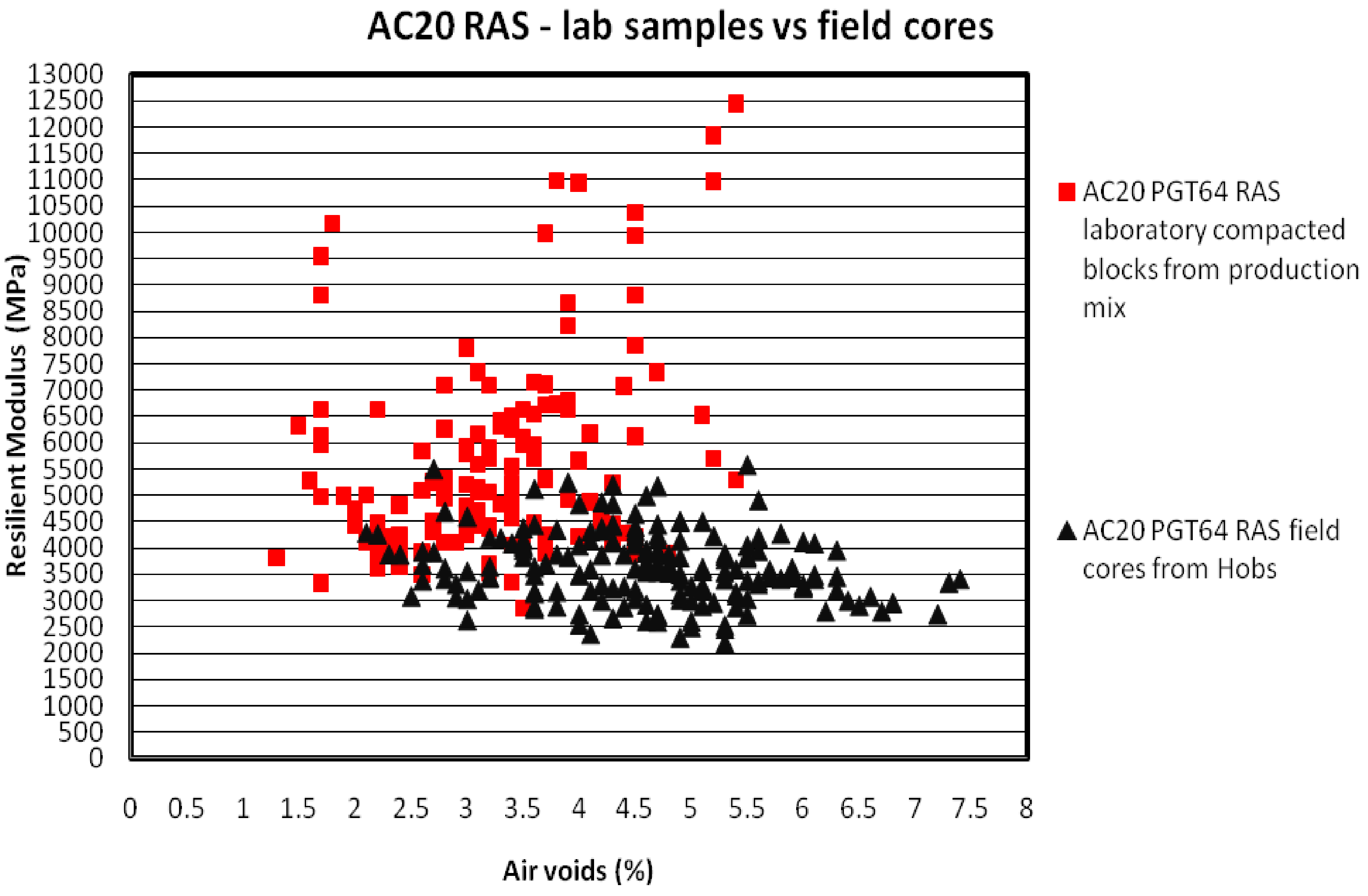
Region	Silverdale		Auckland		Auckland	
RAP Type	RAP 7		RAP10		RAP10	
Process	Screened		Screened		Crushed	
	Binder	Cont Sieve (2.36mm)	Binder	Cont Sieve (2.36mm)	Binder	Cont Sieve (2.36mm)
Number of Tests	32.0	32.0	46.0	46.0	14.0	14.0
Average	5.3	65.9	5.4	51.9	5.5	59.1
Max	6.2	78.0	6.4	64.0	5.8	67.0
Min	4.4	39.0	4.4	28.0	5.1	53.0
Std Dev	0.5	8.0	0.5	8.6	0.2	4.6
2x Std Dev	1.0	16.0	1.1	17.2	0.4	9.2

AAPA 2011 Holleran and Holleran

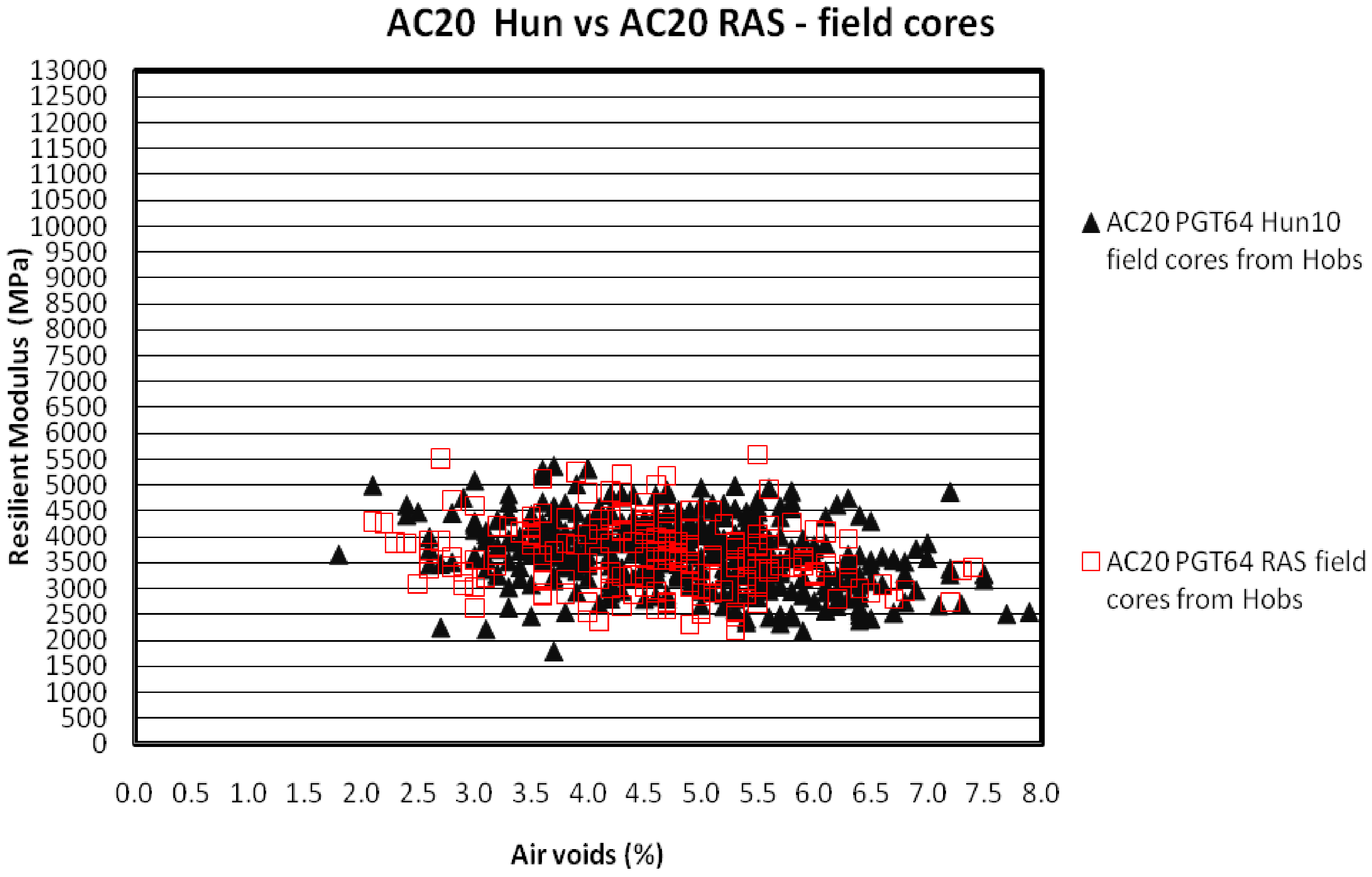
Laboratory Compaction V Field



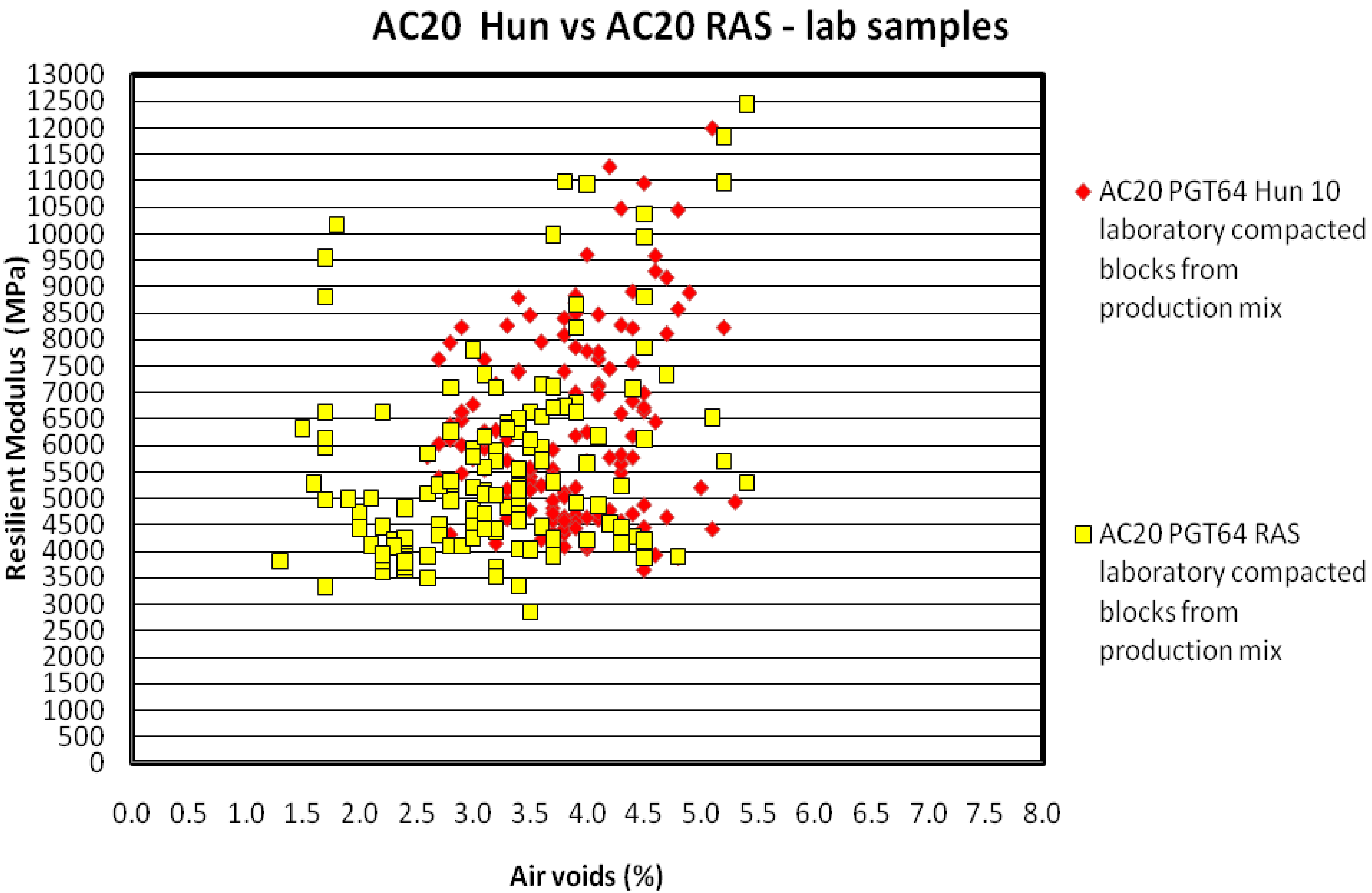
AAPA 2011 Holleran and Holleran



AAPA 2011 Holleran and Holleran



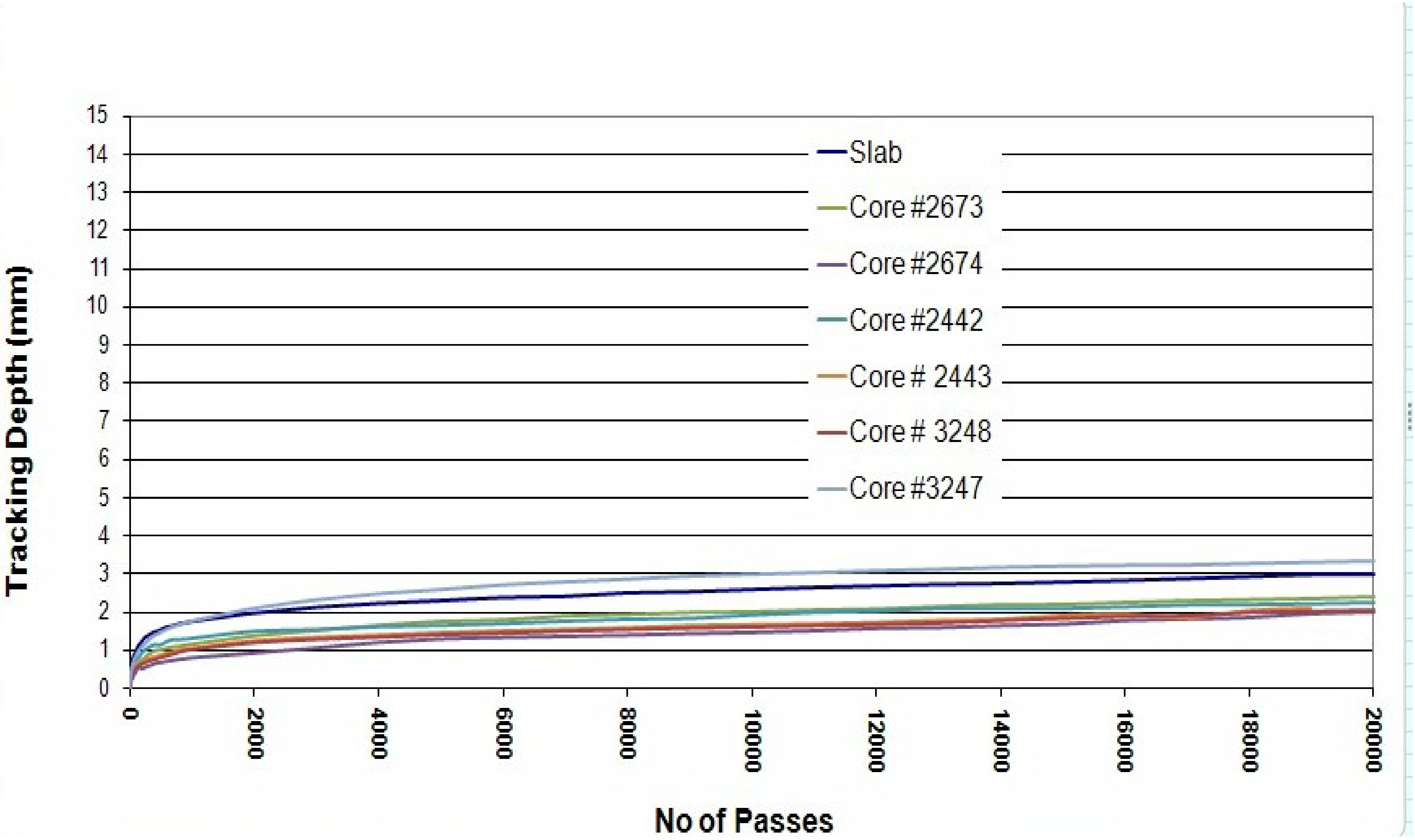
AC20 Hun vs AC20 RAS - field cores
Resilient Modulus (MPa)
13000
12500
12000
11500
11000
10500
10000
9500
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0
Air voids (%)
AC20 PGT64 Hun10 field cores from Hobs
AC20 PGT64 RAS field cores from Hobs



AC20 Hun vs AC20 RAS - lab samples
Resilient Modulus (MPa)
13000
12500
12000
11500
11000
10500
10000
9500
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0
Air voids (%)
AC20 PGT64 Hun 10 laboratory compacted blocks from production mix
AC20 PGT64 RAS laboratory compacted blocks from production mix

Matta results

- Field Matta consistently lower for field samples
- Less scatter
- Void ranges similar but wider for field samples
- Density levels of compaction within same ranges as laboratory
- Difference maybe due to void distribution and particle orientation
- Pavement design with Matta should not be done with laboratory design if Servo used



Tracking Depth (mm)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Slab
Core #2673
Core #2674
Core #2442
Core # 2443
Core # 3248
Core #3247
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
No of Passes

Wheel tracking

- Compacted with a wheel system
- Slabs very similar though not identical to field samples
- Differences may be due to different void distribution and orientation

Mix	15% RAP Mix Cycles to Fail	15% RAP Mix Flexural Strength (MPa)	Typical Virgin Mix AC20 Cycles to Fail	Virgin Mix Flexural Strength (MPa)
AC20Hun	250,000	6560	315,000	6760
AC20RAS	319,480	4500	315,000	6760

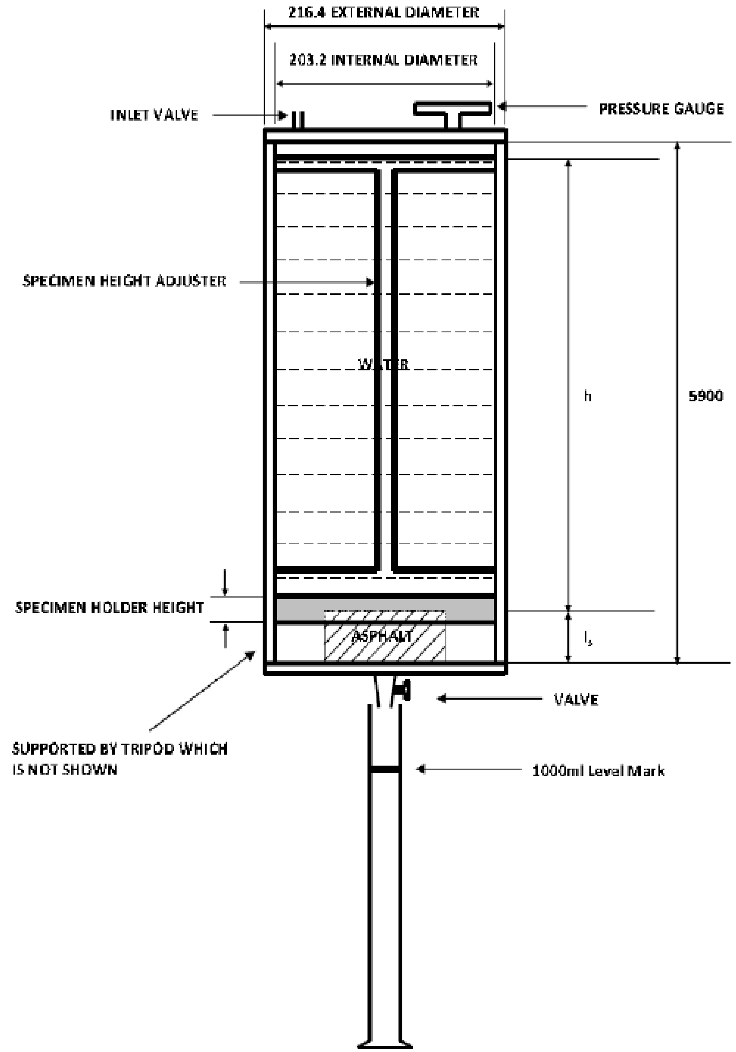
*Fatigue Life of Compacted Bituminous Mixes Subject to Repeated AG:PT/T233 – 06 Flexural Bending 20^{0}C 400 ms.

Fatigue Life

- 4 pt beam testing
- Comparable fatigue life to virgin mixes
- Mix and aggregate dependant
- Fatigue beams made using rolling wheel so may be more reflective of in field performance

LABORATORY PERMEAMETER

DIMENSIONS IN MILLIMETERS



Permeability

- Greater for field compacted mixes
- AC20 compacted to optimum is not impermeable
- Gyratory compacted samples in lab have lower permeability than field cores of similar void levels

Conclusions

- RAP can be successfully controlled but requires special handling in design and in processing
- Lab Matta results do not reflect field results and should not be used for design
- Gyratory compaction does not simulate field compaction
- Wheel compaction should be considered as it gives better reproduction of field core results
- QC is better done on field cores than on production samples in the lab – Filed takes all variables into account