Case Study Using Performance Related Tests

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QES Quality Engineering Solutions
Engineering • Inspection • Construction

Express Appreciation To

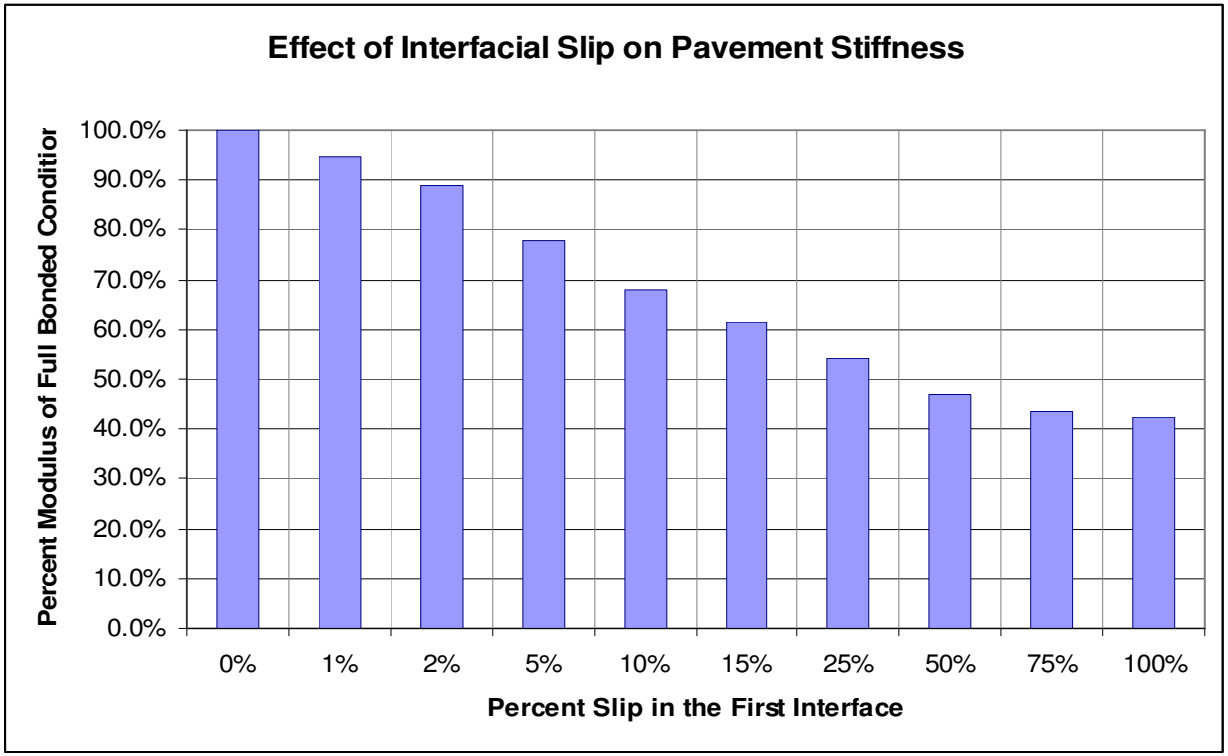
- Roger Dames- LA County Metro
- Pascal Mascarenhas-Vulcan Materials
- Western Region Superpave Center-UNR
- Asphalt Institute


STATION
Metro


NO
URNS
Busway
Chandler Bl
BIKE PATH


Coldwater Cyn
35

Bonding Effect



Resilient Modulus								
		Conventional Wearing Course		Replacement Material	Rubber Wearing Course		Base Course	
		NWP	WP	NWP	NWP	WP	NWP	WP
Air voids (%)	Average	6.7	NA	6.6	6.1	NA	NA	4.8
	Minimum	5.9	NA	5.5	5.7	NA	NA	4.1
	Maximum	7.2	NA	7.5	7.1	NA	NA	5.8
Mr at 77°F (ksi)	Average	1,635	NA	1,280	1,160	NA	NA	1,285
	Minimum	1,470	NA	1,100	780	NA	NA	1,000
	Maximum	1,900	NA	1,420	1,460	NA	NA	1,615
Mr at 104°F (ksi)	Average	1,050	NA	870	800	NA	NA	780
	Minimum	790	NA	730	595	NA	NA	550
	Maximum	1,355	NA	1,125	1,010	NA	NA	1,120

RSCH Testing

- 0.1 sec loading time ~ highway speed loading
- 0.25 sec ~ slow/stop condition loading

Repeated Shear Constant Height Test Results at 60°C

Core ID	Layer	Mix type	Location	Bulk specific gravity, Gmb	Max. theoretical specific gravity, Gmm	Air Voids (%)	Loading/rest period (seconds)	Number of repetitions for 5% permanent shear strain	Permanent shear strain after 10,000 repetitions (%)
10-1	Top	Conventional	NWP	2.385	2.511	5.0	0.10/0.60	18,300	4.4
10-2	Top	Conventional	WP	2.375		5.4	0.10/0.60	50,700	2.8
10-3	Top	Conventional	NWP	2.378		5.3	0.10/0.60	6,418,500	1.1
10-4	Top	Conventional	WP	2.389		4.9	0.25/0.45	7,900	6.6
10-48	Top	Conventional	NWP	2.370		5.6	0.10/0.60	17,500	4.9
10-49	Top	Conventional	WP	2.355		6.2	0.25/0.45	1,775	6.9 (2,500)*
10-40	Top	Replacement	NWP	2.345	2.521	7.0	0.10/0.60	31,500	3.1
10-41	Top	Replacement	NWP	2.412		4.3	NA[+$]	NA[+$]	NA[+$]
10-42	Top	Replacement	NWP	2.409		4.4	NA[+$]	NA[+$]	NA[+$]
10-29	Top	Rubber	NWP	2.352	2.466	4.6	0.25/0.45	1,755	7.6 (3,200)
10-30	Top	Rubber	WP	2.408		2.4	0.10/0.60	5,972,200	1.6
10-31	Top	Rubber	NWP	2.352		4.6	0.10/0.60	3,670	7.2 (6,000)
10-32	Top	Rubber	WP	2.401		2.6	NA[+]	NA[+]	NA[+]
10-36	Top	Rubber	NWP	2.327		5.6	0.10/0.60	4,200	7.4 (9,000)
10-37	Top	Rubber	WP	2.418		1.9	0.25/0.45	3,650	7.1 (7,000)

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[+] NA denotes "test data Not Available.", [$] Unable to test core samples because of the thin top layer.

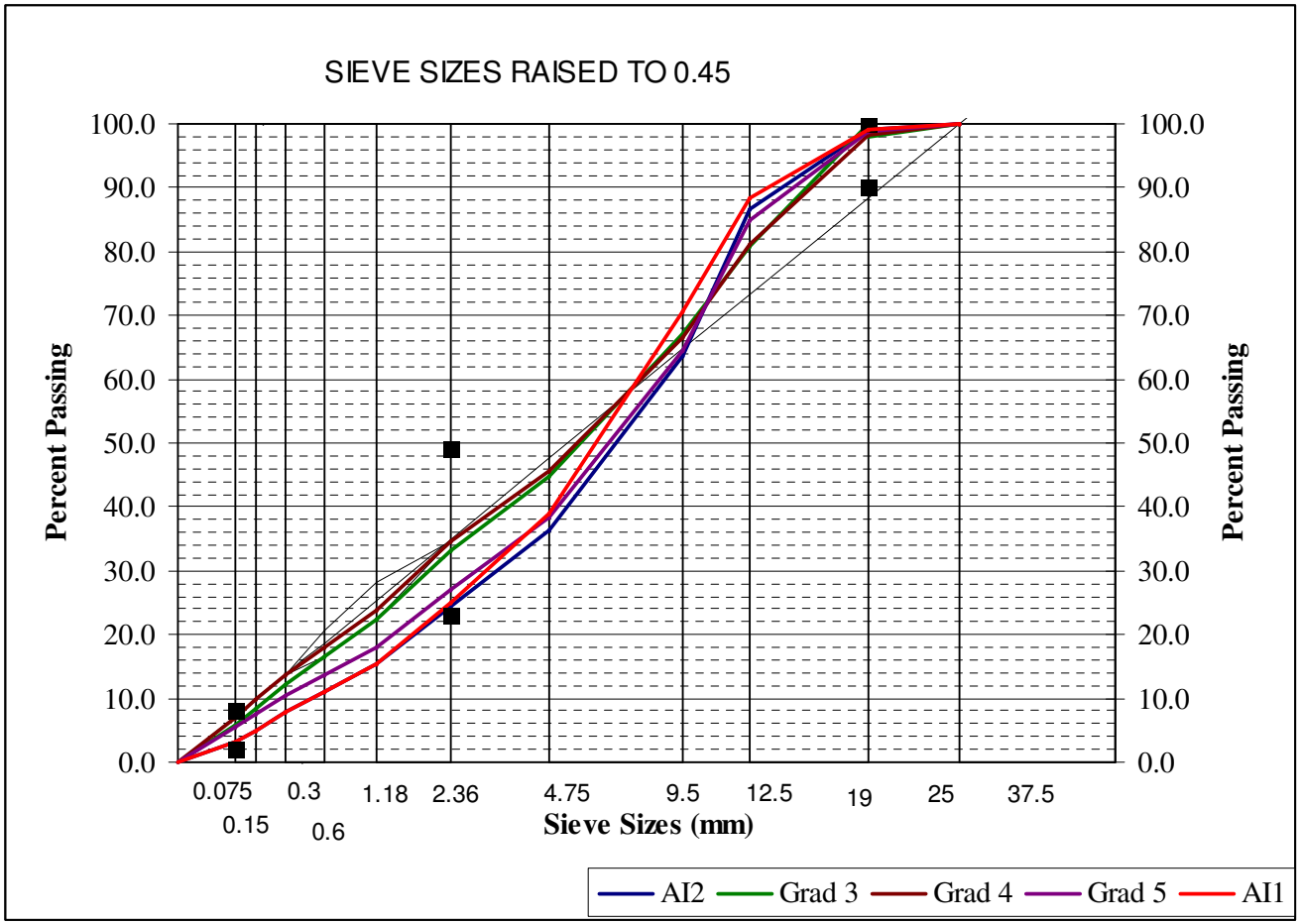
Rehabilitation Strategy

- Replace structurally deficient section
- Replace surface where stop conditions
- Replace rubber modified surface

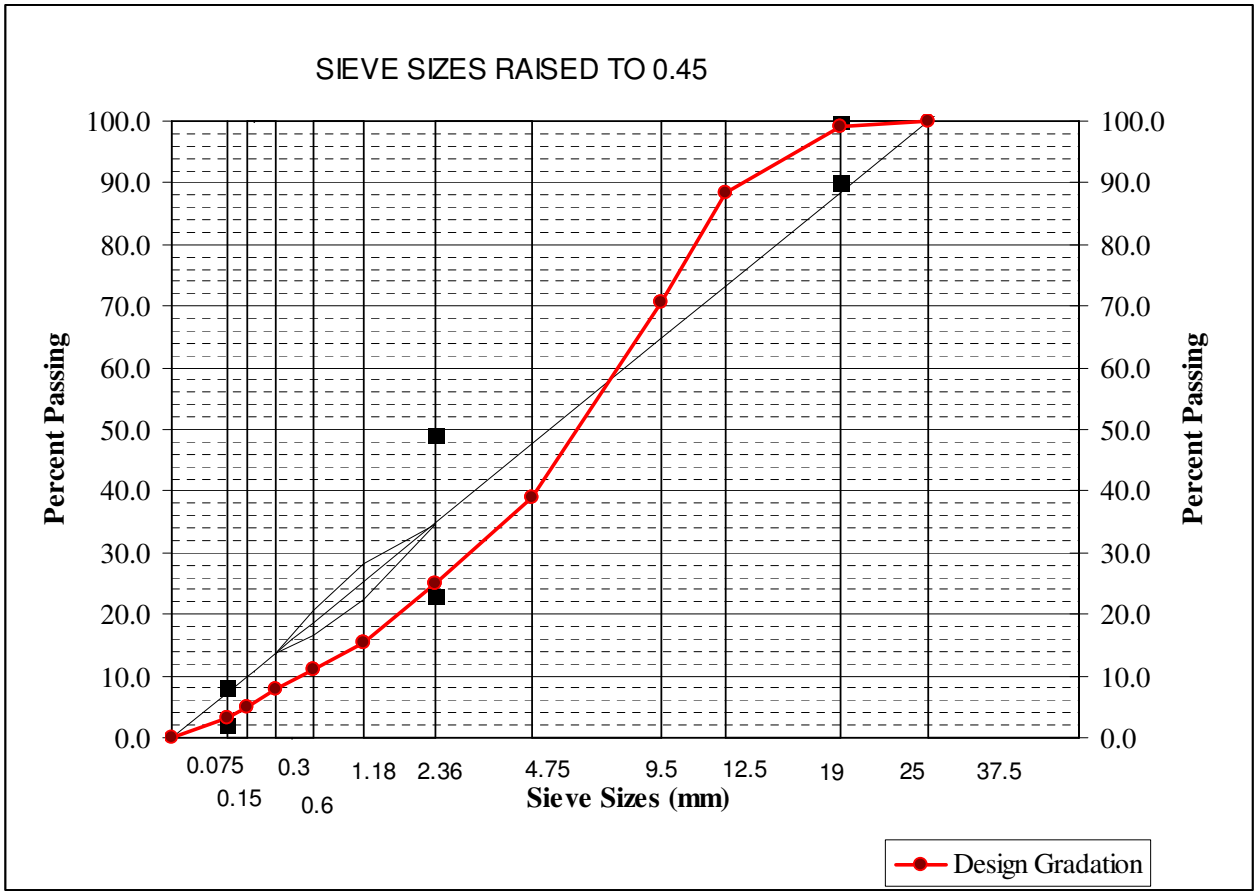
More Rut Resistant HMA Needed

- Superpave mix
- With PG 76-22 asphalt binder

Several Trial Mix Gradations



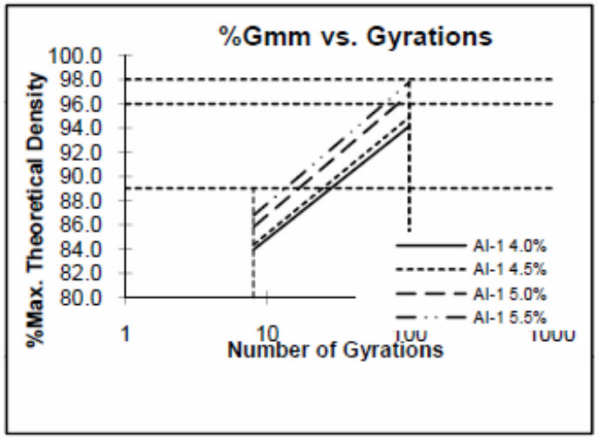
Final Mix Gradation

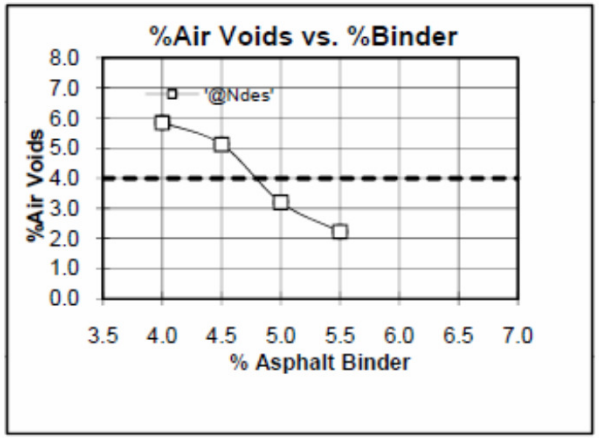


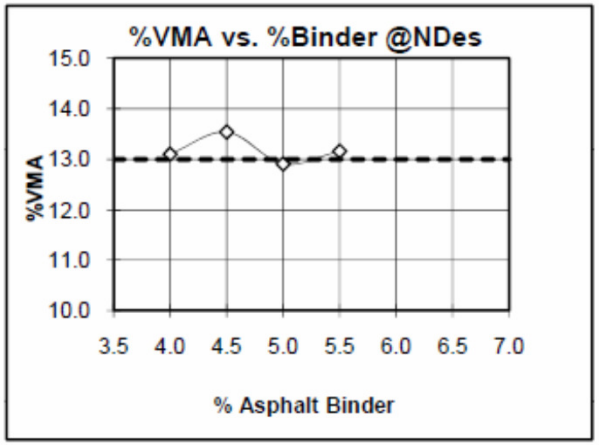
Asphalt Binder

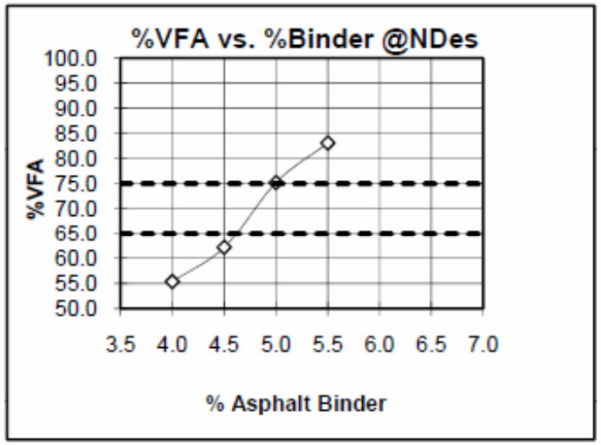
- Performance Graded Binder
  - AASHTO M320

Project Name:	San Fernando Busway, CA	**N Initial:**	8
Workbook Name:	Trial AC-Blend AI-1 Vulcan-San Fernan	**N Design:**	100
Technician:	Blankenship & Emmons	**N Max:**	100
Date:	7/23/08	**Nom. Sieve Size:**	19mm
Asphalt Grade:	PG 76-22	**Design Temperature:**	°C
Compaction Temp:	149°C	**Design ESAL's (millions):**	30.







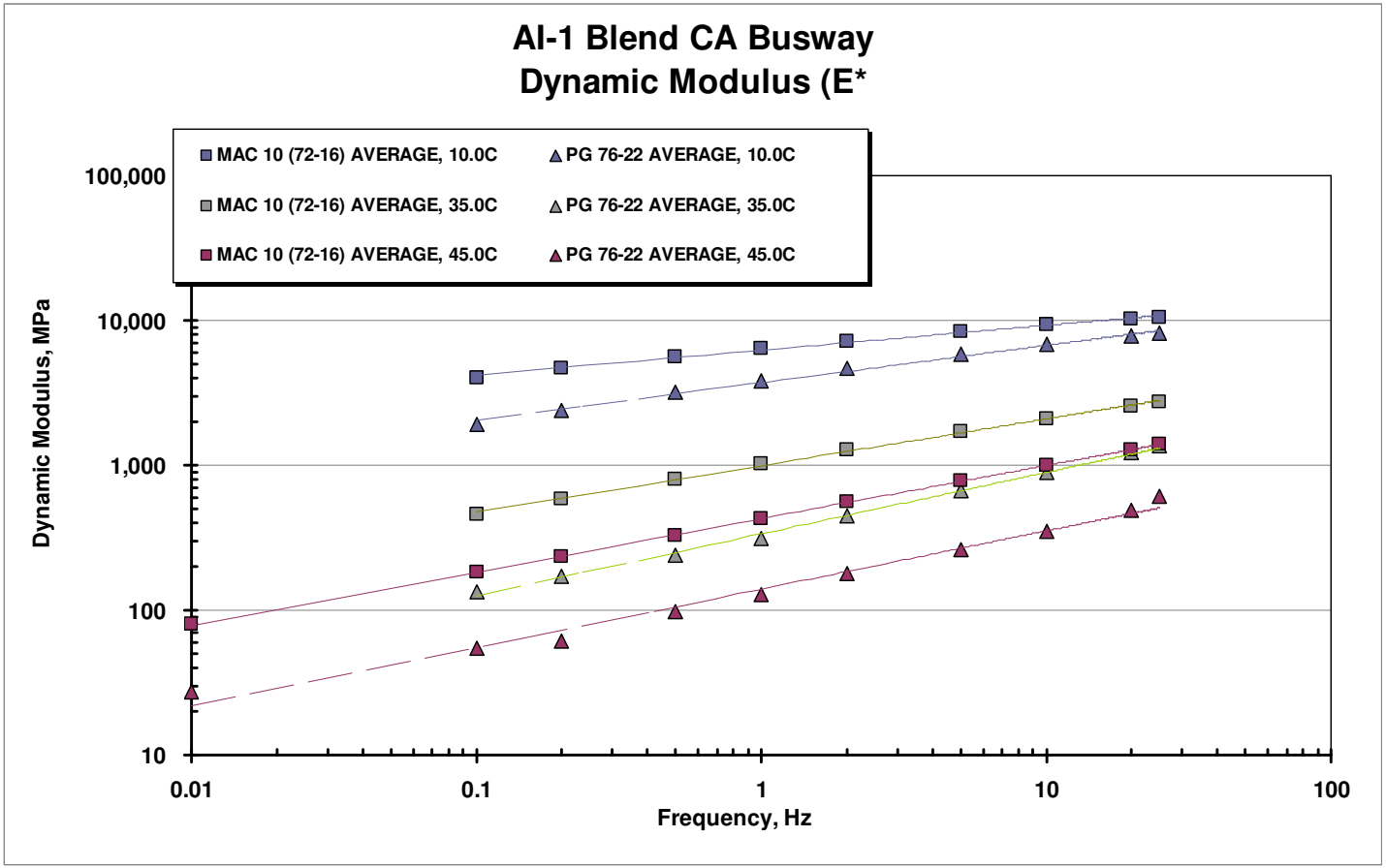


	Y	X			
Blend	%AC	Air Voids @ NMax	Air Voids @ NDesign	%VMA NDesign	%VFA @ NDesign
AI-1 4.0%	4.0	5.8	5.8	13.1	55.4
AI-1 4.5%	4.5	5.1	5.1	13.5	62.2
AI-1 5.0%	5.0	3.2	3.2	12.9	75.2
AI-1 5.5%	5.5	2.2	2.2	13.2	83.1

Ready to Pave?

- Shortage of SBS Material
  - Supplier Suggested MAC10-TR binder
  - Locally available
- Additional Performance Testing, DSR
- Available performance data;
  - Accelerated Test @ CA Pavement Test Center, MAC15-TR

Binder Test Results



Superpave Test Strip


W 1200 F


DYNAPAC
533
BLAW-KNOX


25


PF-3200


BUS
SPEED
LIMIT
35
DYNAPAC


DANGER
DO NOT DRINK
THIS WATER
PELIGRO

Case Study Summary

- Early failures
- Performance testing for replacement
- Test Strips
- Detailed QA during construction

Case Study Using Performance Related Tests

Thank You