Use of the Overlay Tester for Designing Crack Resistant Asphalt Mixes

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Background

- Reflective cracking is arguably the most common distress associated with flexible pavements in Texas.
- The Overlay Tester appears to be a good predictor of reflective cracking.
- Currently only Crack Attenuating Mixes (CAM) have an Overlay Test requirement specified (750 minimum)
- There is a lot of potential for using the Overlay Tester to improve the way we design our mixes.
- Testing variability is one of the primary obstacles to further implementing the Overlay Test.

Designing mixes resistant to thermal reflection cracking

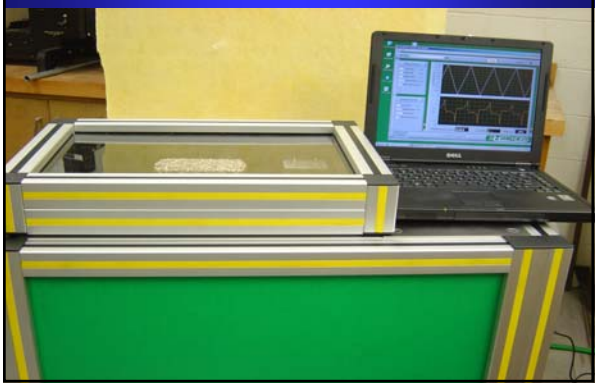
Background to the overlay tester

- Concept over 40 years old
- Early work at Texas A&M and in Europe
- Used extensively in 1980's to study inter-layers and fabrics
- Currently being used in NCHRP model evaluation study
- TxDOT study (2001) evaluation as mix design tool

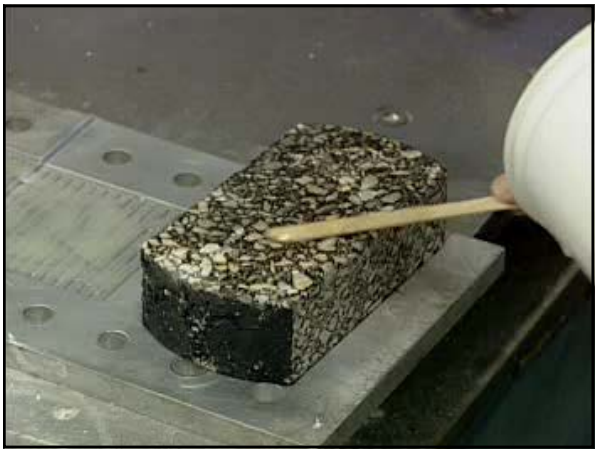
Equipment Upgrades

1. **Upgrade Hardware and software**
2. **Fully computer-controlled test**

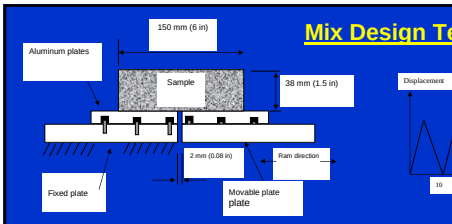
TxDOT's New Overlay Tester



Sample Preparation



Mix Design Test Protocol



- Sample size: 6'' long by 3'' wide by 1.5'' high
- Loading: Continuously triangular displacement 5 sec loading and 5 sec unloading
- Standard Test Conditions
  - Opening displacement: 0.025 in.
  - Room temperature: 77 F
- Definition of failure
  - Discontinuity in Load vs Displacement curve
  - Visible crack on surface

Statewide Evaluation of Good/Bad reflection cracking projects

US 84 Abilene (6 mo old)

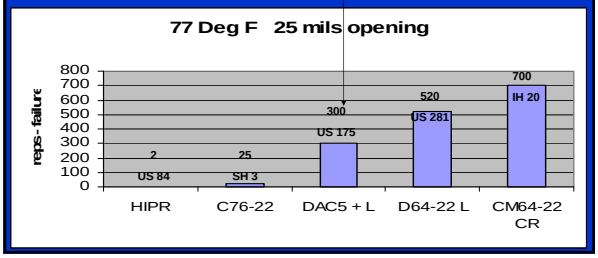
Inplace Recycling

US 175 Dallas

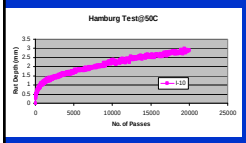
10 year old section

Field Validation Studies

1) does the test rank materials correctly ?
2) What are acceptable criteria ?



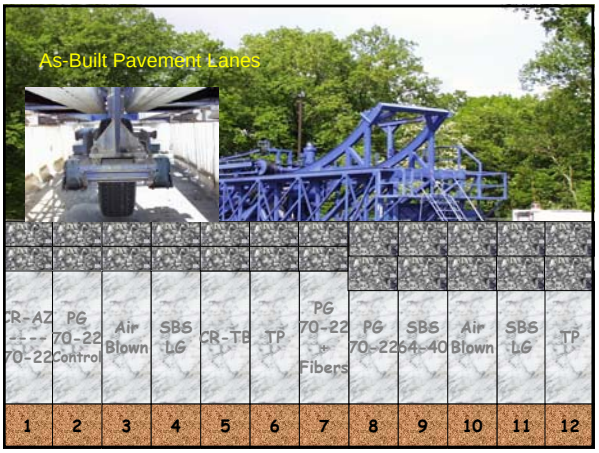
IH-10 Type C (PG76-22L), 4.4%AC

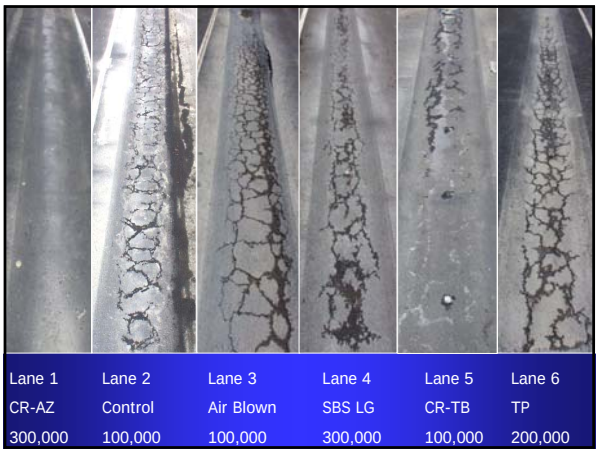


Properties	Result	Target
Cracking (overlay tester cycles to failure)	2	>200
Rutting (APA rutting after 8000 cycles)	2.6 mm	<6mm
Rutting Hamburg (Hamburg cycles to 0.5 inch rut)	>20K	>20K

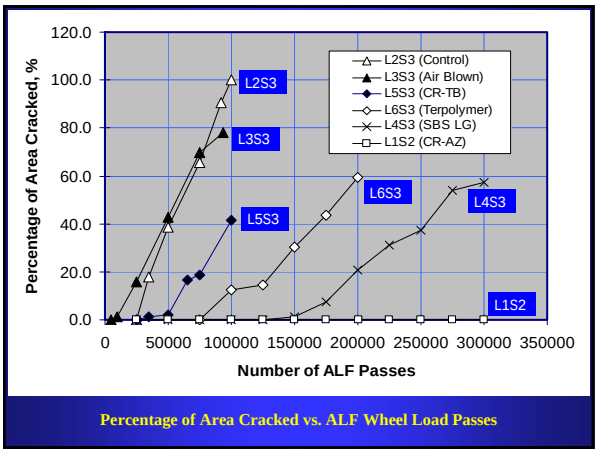
Rut resistance mix (4 in thick) placed on IH 10 in 2002 heavy traffic

Reflection cracking in 2004

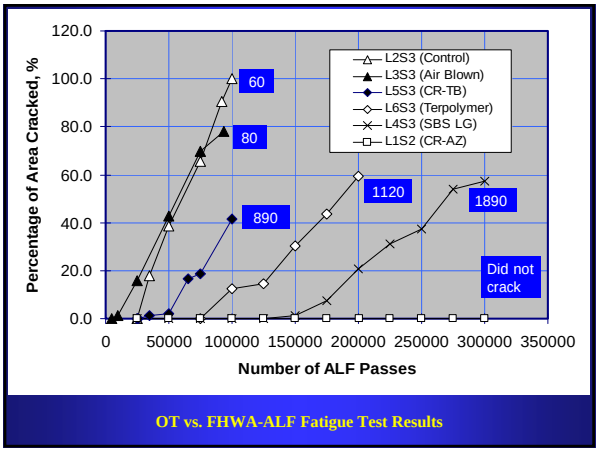




Lane 1	Lane 2	Lane 3	Lane 4	Lane 5	Lane 6
CR-AZ	Control	Air Blown	SBS LG	CR-TB	TP
300,000	100,000	100,000	300,000	100,000	200,000



Percentage of Area Cracked vs. ALF Wheel Load Passes



OT vs. FHWA-ALF Fatigue Test Results

Last update: September, 2007

Summary of Overlay Test Results

CST

Flexible Pavements

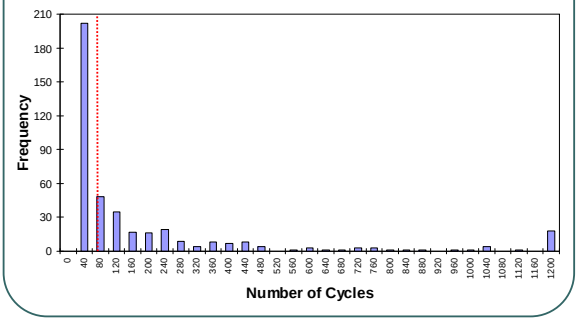
Overlay Test Results

- Approximately **630** tests have been performed.
- The data includes duplication. After the mix is tested 3 times, the 3 test results are entered in the database.
- The summary only includes data where there were more than **10** occurrences of a similar variable (mix type, aggregate type, PG binder)
- Test is performed until a 93% reduction or more of the maximum load measured from the first opening cycle. If 93% is not reached, the test is run to 1200 cycles.

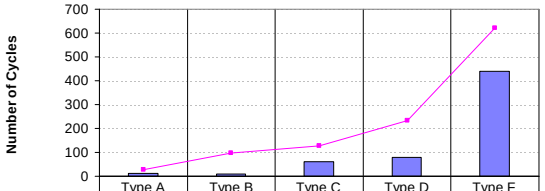
Influence of Mix Type

	Dense Graded	Performance Designed	Stone-Matrix Asphalt	RBL/CAM
Median	47	317	374	1200
Count	417	76	39	58
Minimum	1	3	24	83
Maximum	1200	1200	1200	1200
Average	172	507	548	978

Frequency Distribution
Dense-Graded Hot Mix Asphalt

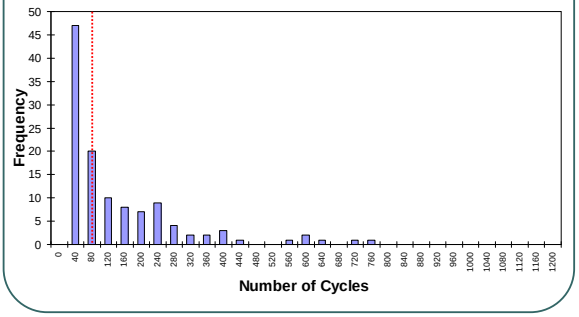


Influence of Mix Type
Dense-Graded Hot Mix Asphalt

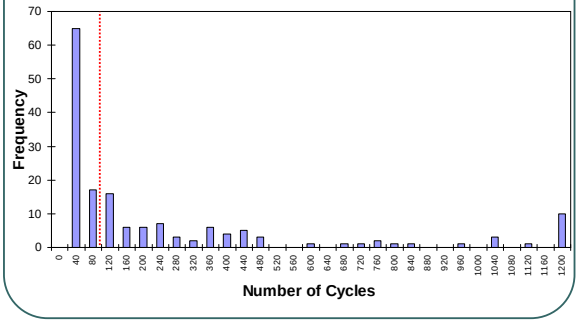


	Type A	Type B	Type C	Type D	Type F
Median	13	10	61	78	438
Count	15	108	119	162	13
Minimum	2	1	2	2	43
Maximum	98	1200	752	1200	1200
Average	28	97	127	232	621

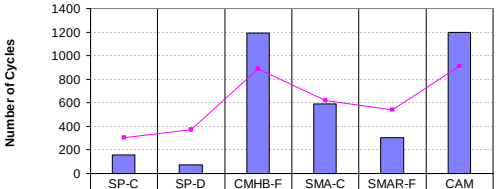
Frequency Distribution
Dense-Graded Type C



Frequency Distribution
Dense-Graded Type D

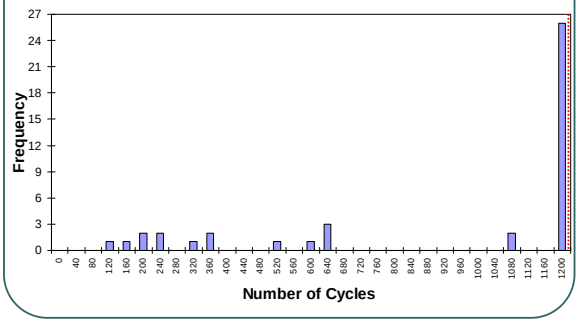


Influence of Mix Type
Performance-Designed Mixtures
Crack Attenuating Mixture (CAM)
Stone-Matrix Asphalt



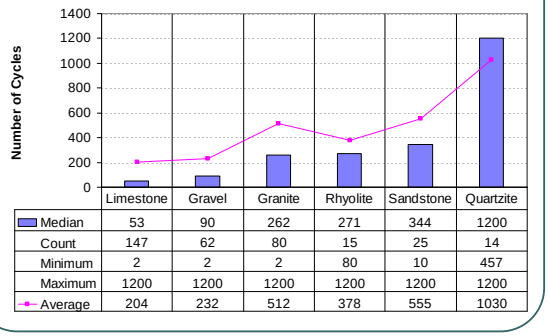
	SP-C	SP-D	CMHB-F	SMA-C	SMAR-F	CAM
Median	157	72	1191	591	306	1200
Count	20	14	30	22	14	42
Minimum	34	7	14	30	53	83
Maximum	1200	1200	1200	1200	1200	1200
Average	303	370	887	618	539	911

Frequency Distribution
CAM



Influence of Aggregate Type

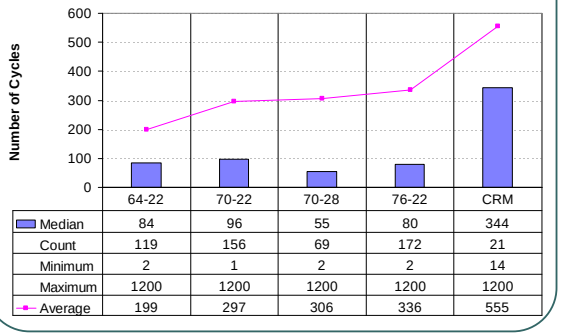
All mixtures



	Limestone	Gravel	Granite	Rhyolite	Sandstone	Quartzite
Median	53	90	262	271	344	1200
Count	147	62	80	15	25	14
Minimum	2	2	2	80	10	457
Maximum	1200	1200	1200	1200	1200	1200
Average	204	232	512	378	555	1030

Influence of Asphalt

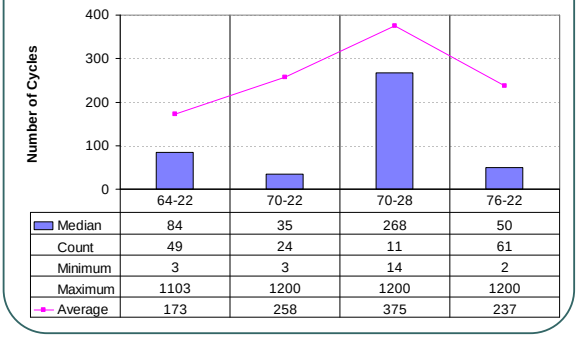
All mixtures



	64-22	70-22	70-28	76-22	CRM
Median	84	96	55	80	344
Count	119	156	69	172	21
Minimum	2	1	2	2	14
Maximum	1200	1200	1200	1200	1200
Average	199	297	306	336	555

Influence of Asphalt

Dense Graded Type D Mixtures Only



	64-22	70-22	70-28	76-22
Median	84	35	268	50
Count	49	24	11	61
Minimum	3	3	14	2
Maximum	1103	1200	1200	1200
Average	173	258	375	237

Overlay Tester Conclusions

- The Overlay tester is practical and appears to be an effective predictor of HMA cracking.
- The overlay tester has revealed that most TxDOT mixes are relatively susceptible to cracking.
- "Crack Attenuating Mixes" (CAM) are gaining popularity in Texas. CAM mixes are both rut resistant and crack resistant.
- Testing variability is an ongoing issue. Eventually we should have an overlay requirement for all mixtures…..not yet ready.