

AMPT Performance Testing of High RAP Mixes

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RAP – RECLAIMED ASPHALT PAVEMENT



Conventional Wisdom

Recommended Virgin Asphalt Binder Grade	RAP %
No change in binder section	< 15
Select virgin binder one grade softer than normal (e.g., select a PG 58-28 if a PG 64-22 would normally be used)	15 to 25
Follow recommendations from blending charts	> 25

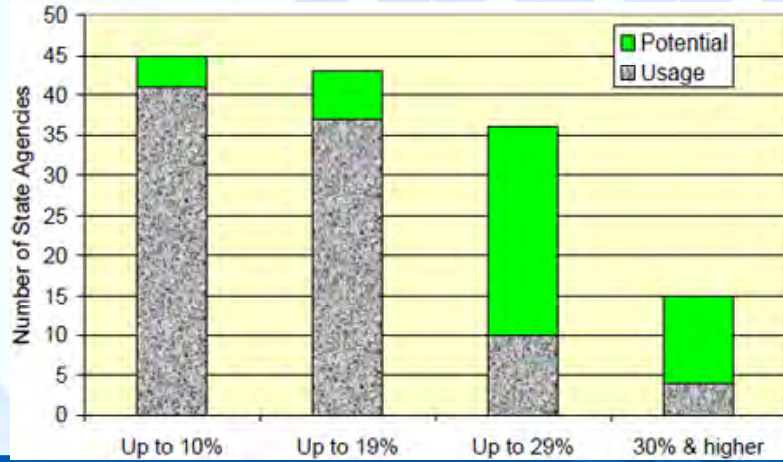


FHWA 2011 Survey

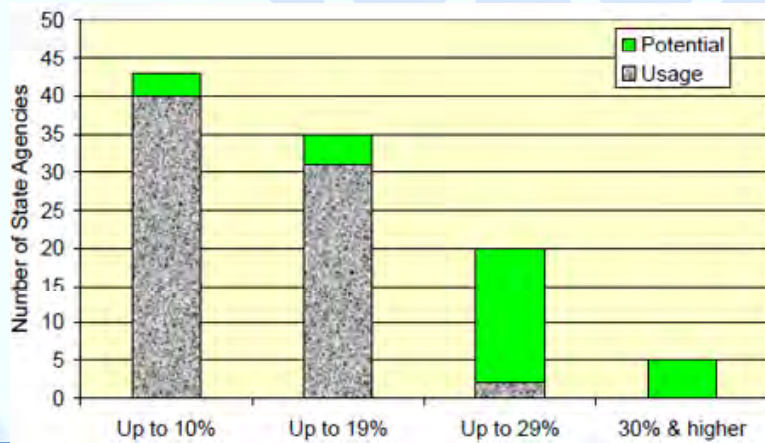
- **Reclaimed Asphalt Pavement in Asphalt Mixtures: State of The Practice**
- How much RAP is permitted in mixtures?
- How much RAP is actually used?
- What are the main roadblocks to greater usage of RAP?



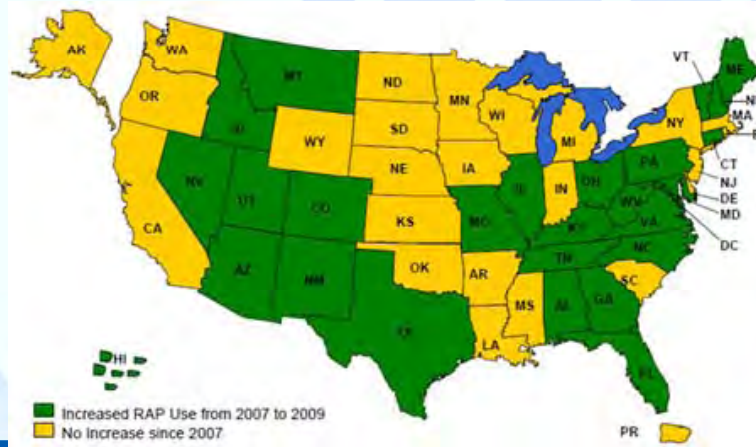
Usage and potential of various RAP percentages in the intermediate layer



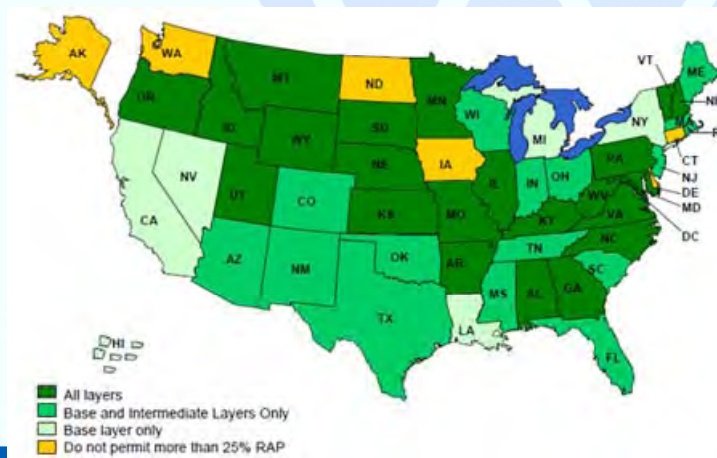
Usage and potential of various RAP percentages in the surface layer



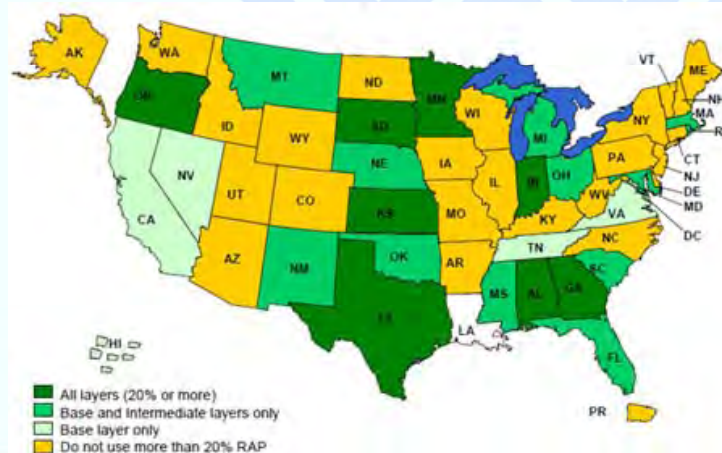
States with increased RAP use since 2007



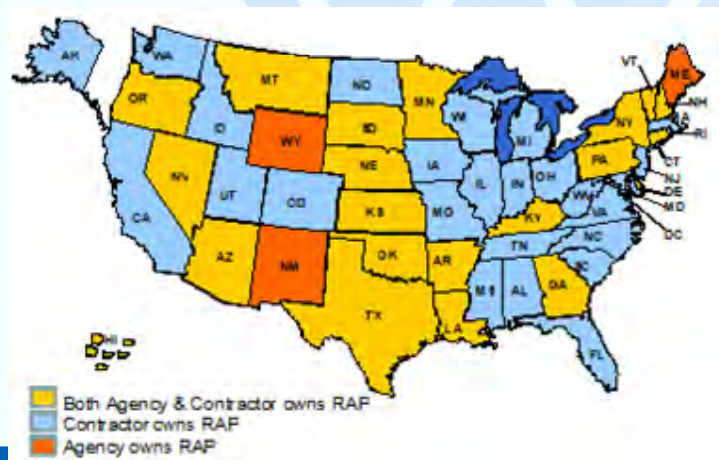
States that permit more than 25 % RAP in HMA layers



States that use more than 20 % RAP in HMA layers




Ownership of RAP by State highway agency



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20% Surface – case
25% Base - statewide



Higher RAP mixes are permitted

- How does high RAP affect expected performance?
- Superpave

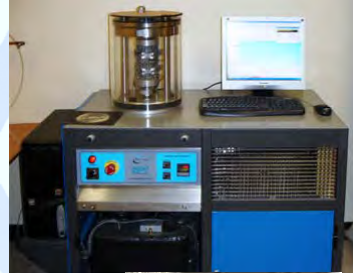


Did we get the cart
before the horse?



Asphalt Mixture Performance Tester

- Testing Methodology for evaluating asphalt mixtures
- Superpave does not have a strength test
- Precision control of
 - Load
 - Temperature
- Precision measurement of
 - Load
 - Deformation



AMPT tricks

- Dynamic Modulus of pavement life
- Flow number – in
- Fatigue life - how material to fail.



What we did



Experimental Design

- 2 Binder Grades
 - PG 70-22 and PG 64-22
- 3 RAP Contents
 - 0%, 15%, and 25%
- 3 Tests
 - Dynamic Modulus, Flow Number, Uniaxial Fatigue

Material Preparation

- Limestone stockpiles of 67's, 8's, F-Sand, and W-Sand and RAP was obtained from West Virginia Paving's asphalt plant in Beaver, WV



Verification Samples

- 4.0% air void was not achievable with job mix formulas, so asphalt contents were modified

Binder Grade	% RAP	P _b
DM and FT		
PG 64-22	25	4.9%
PG 70-22	0	4.9%
	15	4.6%
	25	4.9%
DM and FN		
PG 70-22	0	4.9%
	15	5.1%
	25	4.7%



METHODOLOGY

Dynamic Modulus Testing

- PP 60-14, PP 61-13, and TP 79-13

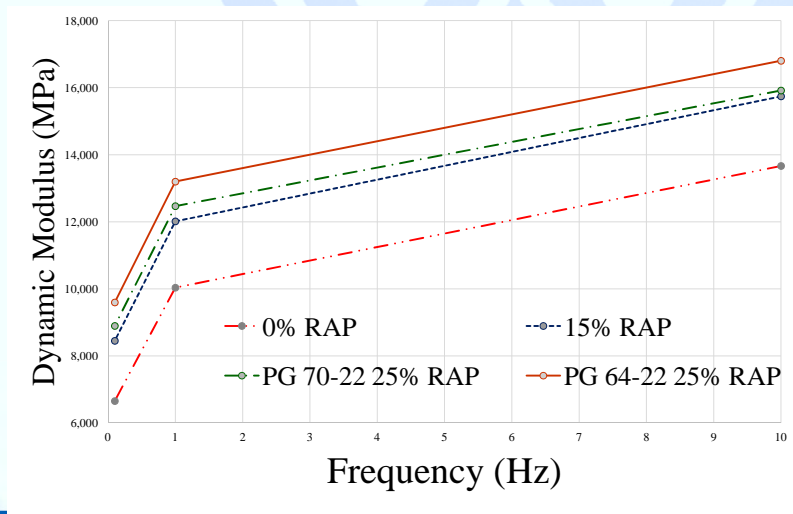


Flow Number Testing

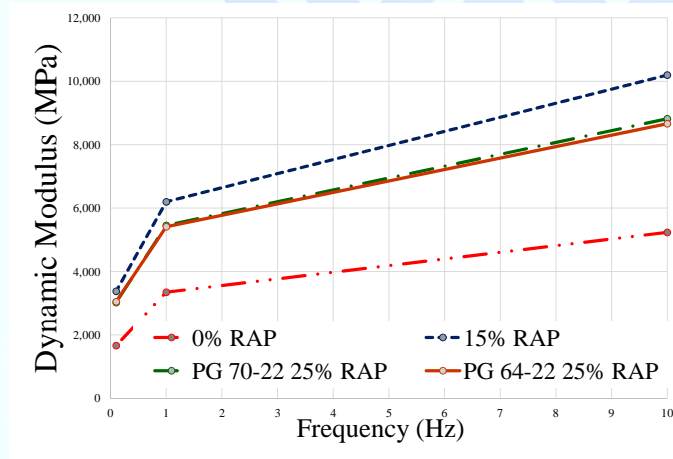
- PP 60-14 and TP 79-13



Dynamic Modulus 4C



Dynamic Modulus 20C



Overall Modulus Ranking

Temperature	4	20	40
PG 70-22 RAP 0%	1	1	1
PG 70-22 RAP 15%	3	2/3	2
PG 70-22 RAP 25%	2	4	4
PG 70-22 RAP 25%	4	3/2	3

1 = lowest modulus

Low modulus good – flexible, less fatigue

High modulus good – rutting resistance





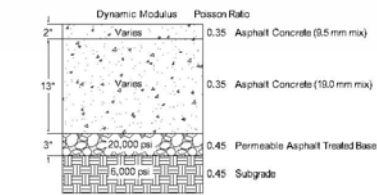
Flow Number Rutting Parameter

Binder Grade	% RAP	Replicate	Flow Number
PG 70-22	0	1	178
		2	167
	15	1	342
		2	555
	25	1	591
		2	611

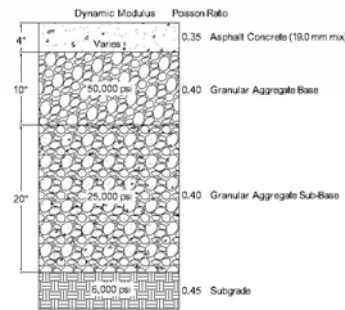
High number good!



Analysis Using Dynamic Modulus



Full Depth Pavement Structure



Conventional Pavement Structure



CONCLUSIONS

- Rutting - higher number of cycles to failure than the virgin mix
- Fatigue –
 - RAP mixes showed a higher number of cycles to failure in the full-depth structure while
 - virgin mix showed a higher number of cycles to failure in the conventional structure



RECOMMENDATIONS

More research

30% RAP?

