

Hamburg Wheel Tracking (HWT) Test

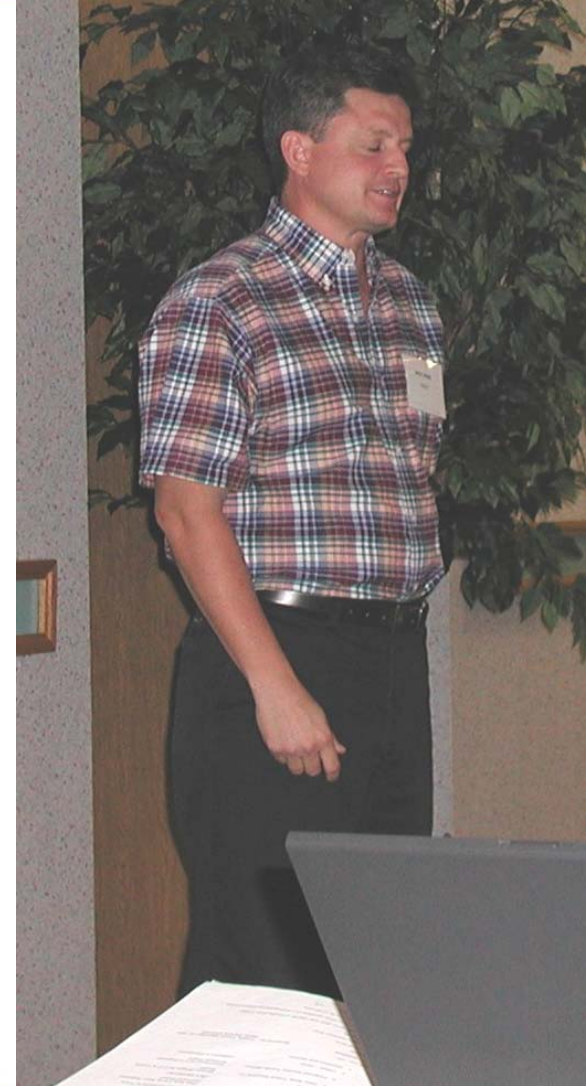
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Topics

- Background of HWT
- Data trends (Texas)
- Specifications

- Special thanks to Dale Rand and TxDOT



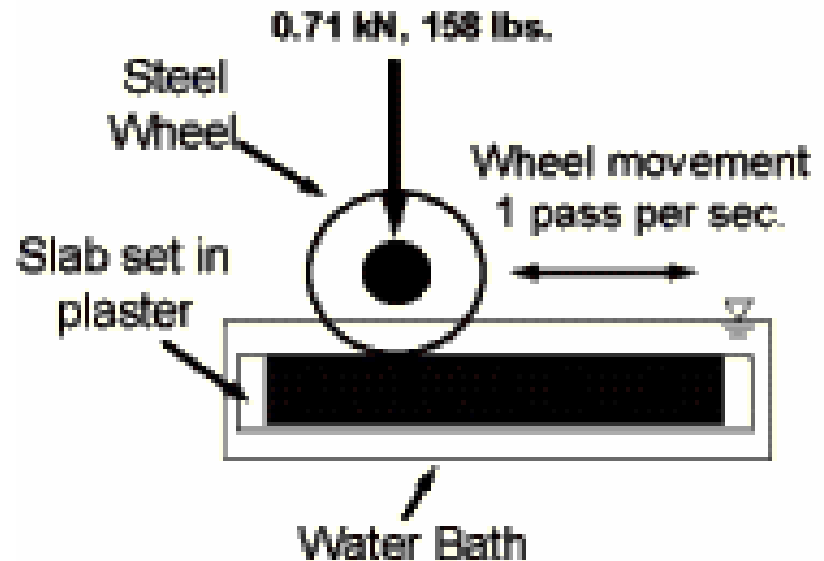
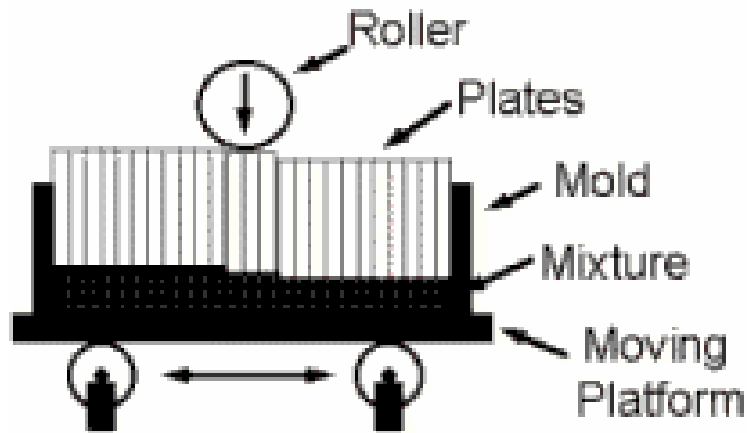
Background

- Developed in Germany, used since the mid-1970's
 - *Spurbildungsgerat, auf Deutsch*
- A loaded steel wheel tracks over the samples in a heated water bath, the deformation is observed vs. the number of loading passes
- Has mostly been used in North America as an mixture evaluation tool



Hamburg Wheel Tracking Test

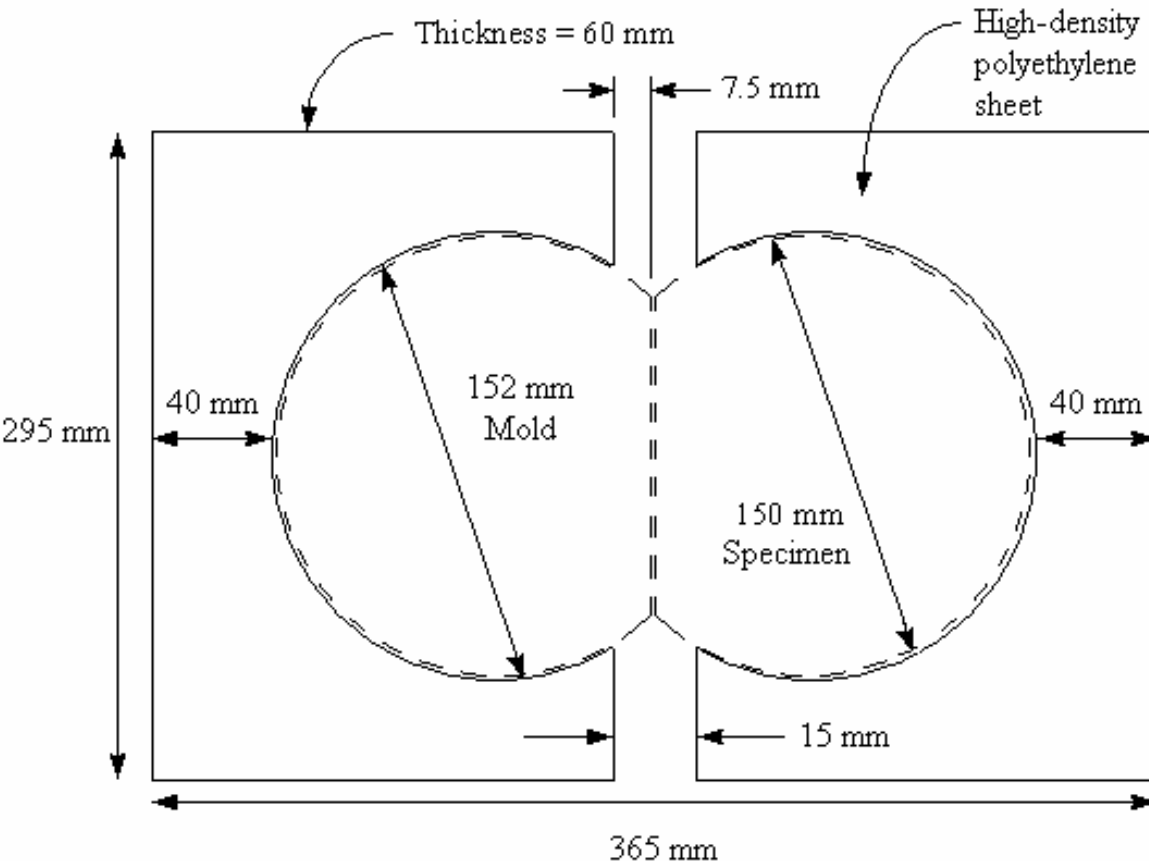
Linear Kneading Compactor



- TxDOT uses specimens molded in the SGC or 6" cores cut from the pavement
 - 10" cores can also be used
- ~50 cycles per minute, < 7 hrs for 20,000 passes

Courtesy, Koch Pavement Solutions

Specimen Configuration, TEX-242-F



** Not drawn to scale

Top View of Test Specimen Configuration for the Hamburg Wheel-tracking Device.

- Lab-compacted specimens molded to 93% $G_{mm} \pm 1\%$
- Circular specimens sawed as shown in the figure



HWT

Hamburg Wheel-Tracking Device



Precision Machine & Welding

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PMW Wheel-Tracking Device



HWT Specimens, After Testing

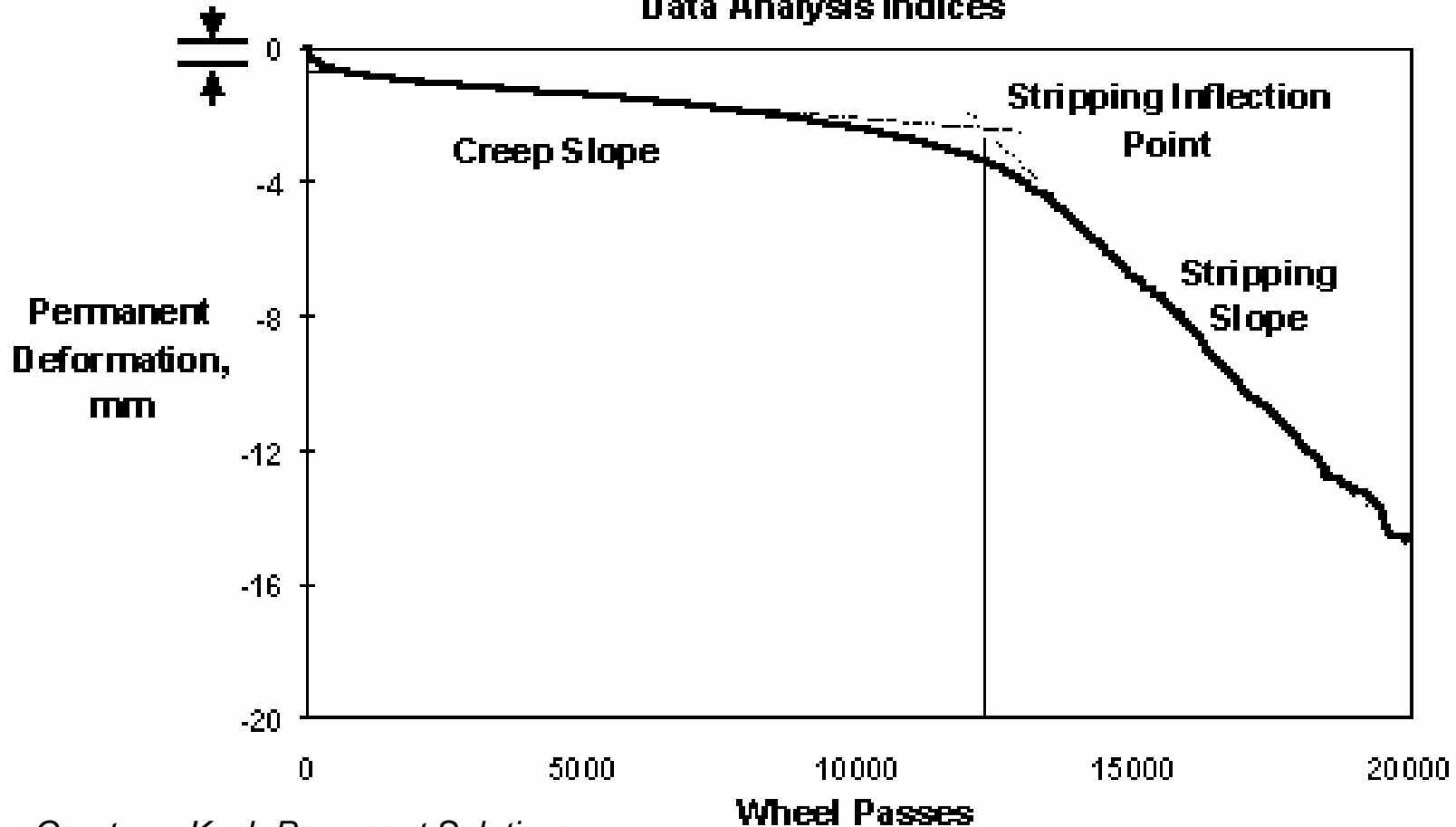
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HWT Indices

Post compaction

Wheel Tracking Test Data Analysis Indices



Courtesy, Koch Pavement Solutions



Colorado DOT Test Criteria: CPL 5112

- Test temperature based on PG high temperature grade
 - PG 52...**40C**
 - PG 58...**45C**
 - PG 64...**50C**
 - PG 70...**55C**
- Data reported include:
 - Number of passes
 - Maximum impression
 - Test temperature
 - Sample(s) air voids
 - Creep slope
 - Stripping slope
 - Stripping inflection point



TxDOT 2004 Specifications

- No longer use the Modified Lottman (TEX-531-C, AASHTO T283)
 - TxDOT still uses the boil test (TEX-520-C)
- All HMA items, except Items 292 (Plant mix, asphalt-treated base) and 342 (Permeable Friction Course) include HWT criteria
- Only the maximum rut depth (0.5 inches) is specified, the number of passes depends on the PG grade
 - Not using the other Hamburg parameters for mix design acceptance



HWT-TxDOT Materials & Tests Laboratory, Cedar Park



- TxDOT has seven HWT's
- Four in their central laboratory (Cedar Park)
 - Three in MAT labs around the state
 - Three approved commercial labs
- Testing performed at 50C, for prescribed number of passes or until failure (1/2 inch deformation)



TxDOT HWT Requirements Mixture Design & Production

Hamburg Wheel Test Requirements		
High-Temperature Binder Grade	Test Method	Minimum # of Passes @ 0.5" Rut Depth, Tested @122°F ⁴
PG 64 or lower	Tex-242-F	10,000
PG 70		15,000
PG 76 or higher		20,000

4. May be decreased or waived when shown on the plans. Test not required for RBL.

Note: TxDOT also includes a maximum indirect tensile strength requirement to avoid brittle mixtures



HWT Testing Requirements

- Mixture design (for approval)
- Trial batch (Lot 1)
- Minimum on 1 HWT during the project
- Engineer may test as desired
 - Usually not done unless there are other indications of potential problems
- During production, failing test results result in suspension of operations and may require removal and replacement of material



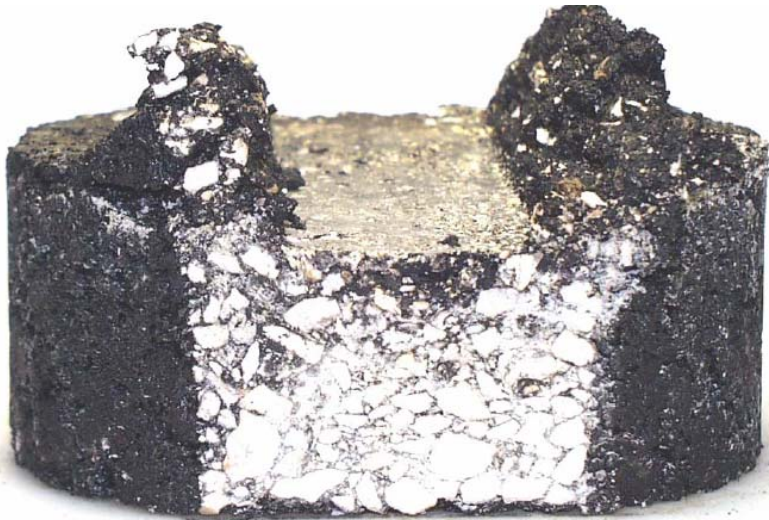
Passing Result



- Dense-graded mixture
- PG 76-22
- 14% RAP



Contrasting results



- Failed @ 10,200 passes
- PG 76-22, Limestone



- Passed, 2.8 mm @ 20,000 passes
- Same aggregate, different binder source

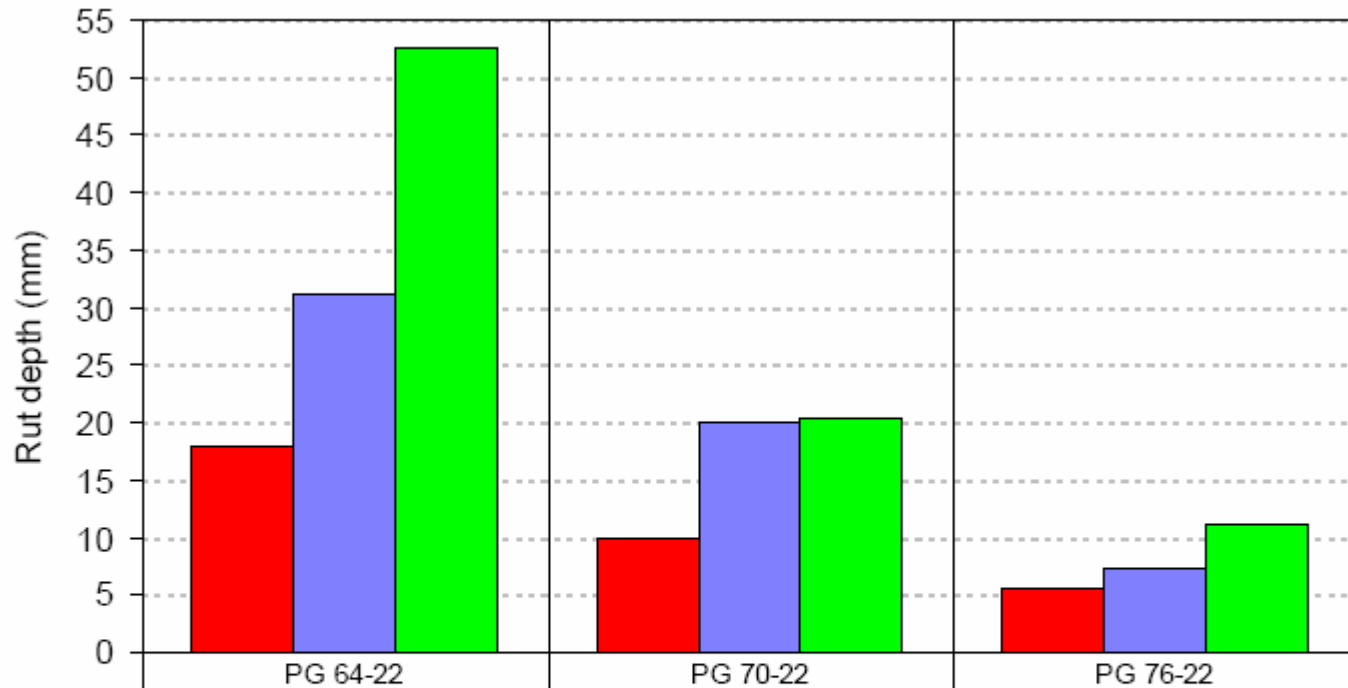


General Trends

- HWT does a better job of identifying mixtures that are susceptible to premature failure than other laboratory tests (Lottman, Hveem stabilometer, Creep, etc)
- Stiffer asphalt binders (higher high temperature grades) do better
- Adding liquid antistrip or lime usually improves the HWT results. Improvement with lime is usually more dramatic than with liquid.
- Harder aggregates do better (igneous -vs- limestone)
- Stone on stone mixes do better than dense mixes
- There are no absolutes!...Do not assume!... Measure!
(D. Rand)



Trends in the data



■ Lime	18.0	10.0	5.7
■ Liquid	31.2	20.1	7.2
■ None	52.6	20.3	11.2
Count (Lime)	41	94	153
Count (Liquid)	38	35	51
Count (None)	29	34	63

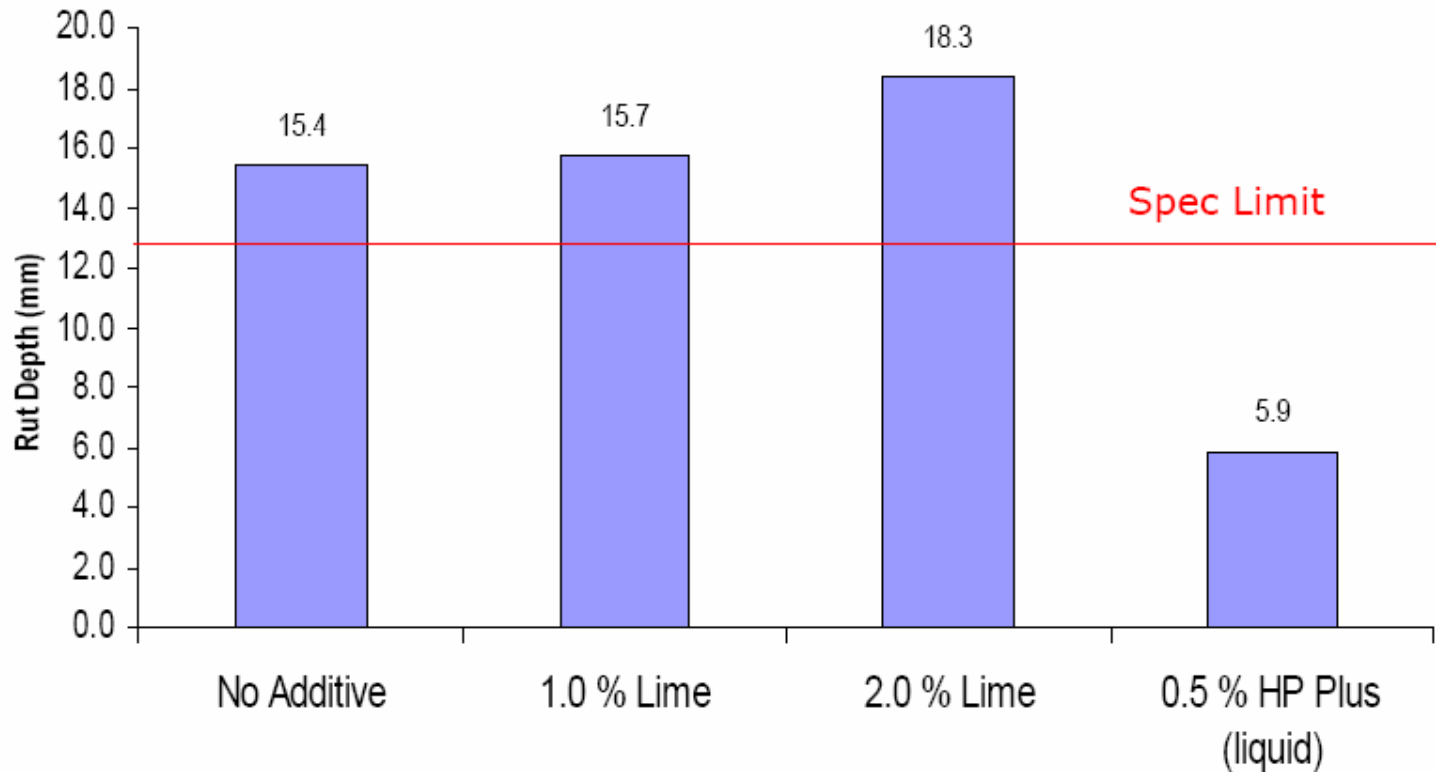


There are exceptions!!!

Hamburg Wheel Test Results (20,000 Passes)

Wichita Falls (12.5mm SFHMACP)

Limestone Aggregate with Koch PG 76-22



Caution!!!

- HWT favors stiff asphalt binders and mixtures
 - Good for thick pavements, bad for thin, deflecting pavement structures
- HWT does not identify mixtures that are susceptible to cracking



Other uses

- Forensic tool
 - In combination with distress survey, other sampling and testing, NDT
 - Not enough data (yet) to identify a test result limit that suggests failure
- Pavement evaluation tool
 - Test samples from existing pavement before deciding on rehabilitation or resurfacing strategy
 - Particularly where there is evidence of moisture trapped within the pavement, raveling, or a history of moisture damage with existing materials



Moisture Damage

- Note lateral deformation
- Ruts > 1 in. deep
- Moisture damage in underlying material
- **This can be avoided!!!**



In summary...

- HWT is used by TxDOT in lieu of stability and Lottman tests for design and project control
- Other agencies use HWT as a forensic tool
- HWT or other loaded wheel tests can and should be used for verifying designs and for evaluating existing materials



Thanks!

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