EXPANDING THE REALM OF POSSIBILITY

Detection of Stripping in HMA

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Outline

- Objective
- Project Hypotheses and Testing Methods
- Pilot Project Findings
- Conclusions
- Recommended Survey Strategy

Project Objectives

- To develop an asphalt pavement survey protocol using nondestructive techniques to detect stripping in HMA

Goal:

The protocol developed to quantify the affected area, depth, and severity of stripping in pavements that are mill and overlay candidates

Project Hypotheses

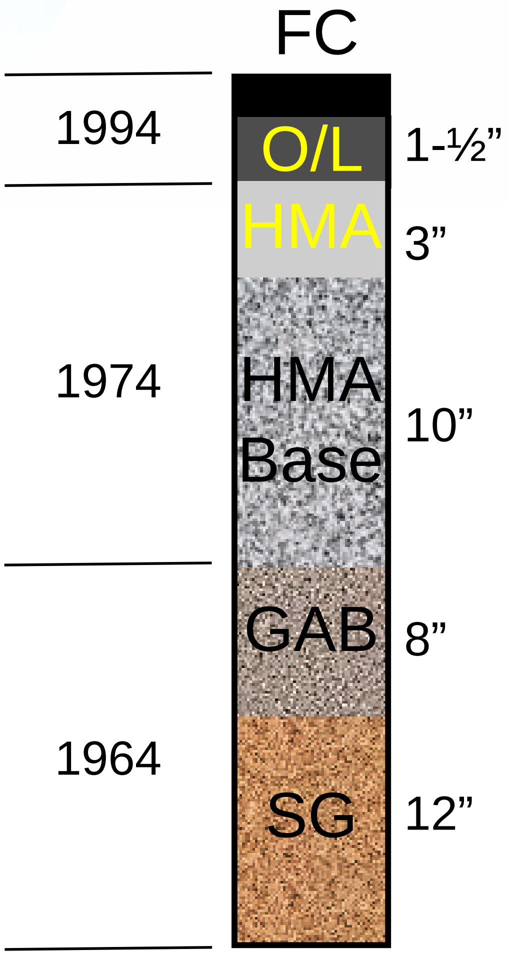
- The modulus, tensile strength and tensile strain of an HMA mixture are significantly affected by the level of moisture damage.
- GPR technology can be used to identify areas with non-uniform properties associated with moisture damage.
- Seismic test results can provide a measure of the modulus of the HMA.
- Seismic testing provides comparable results to laboratory measured modulus values.

Equipment/Methods Employed

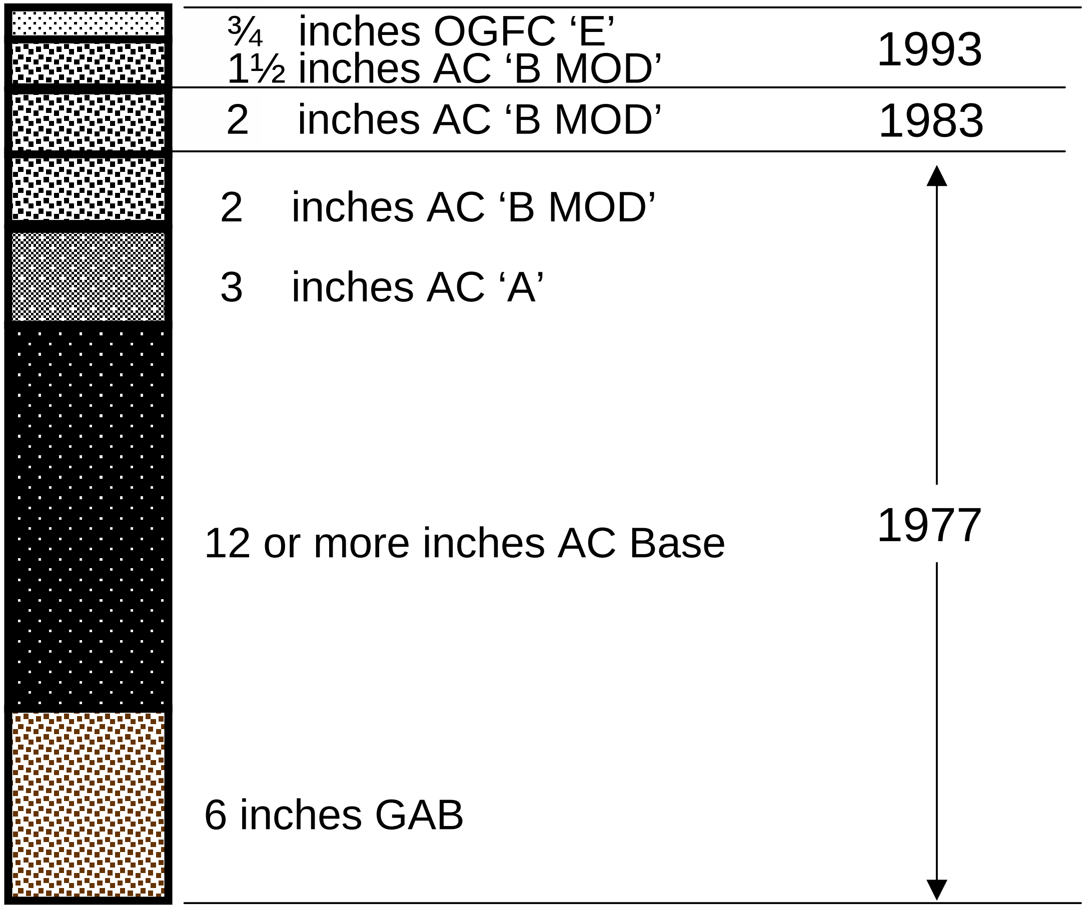
Testing Overview

- Two Pilot Projects
  - Phase I project involved full suite of candidate technologies
  - Phase II project involved a reduced set of the most effective technologies

Pavement Structures



Phase I



Phase II

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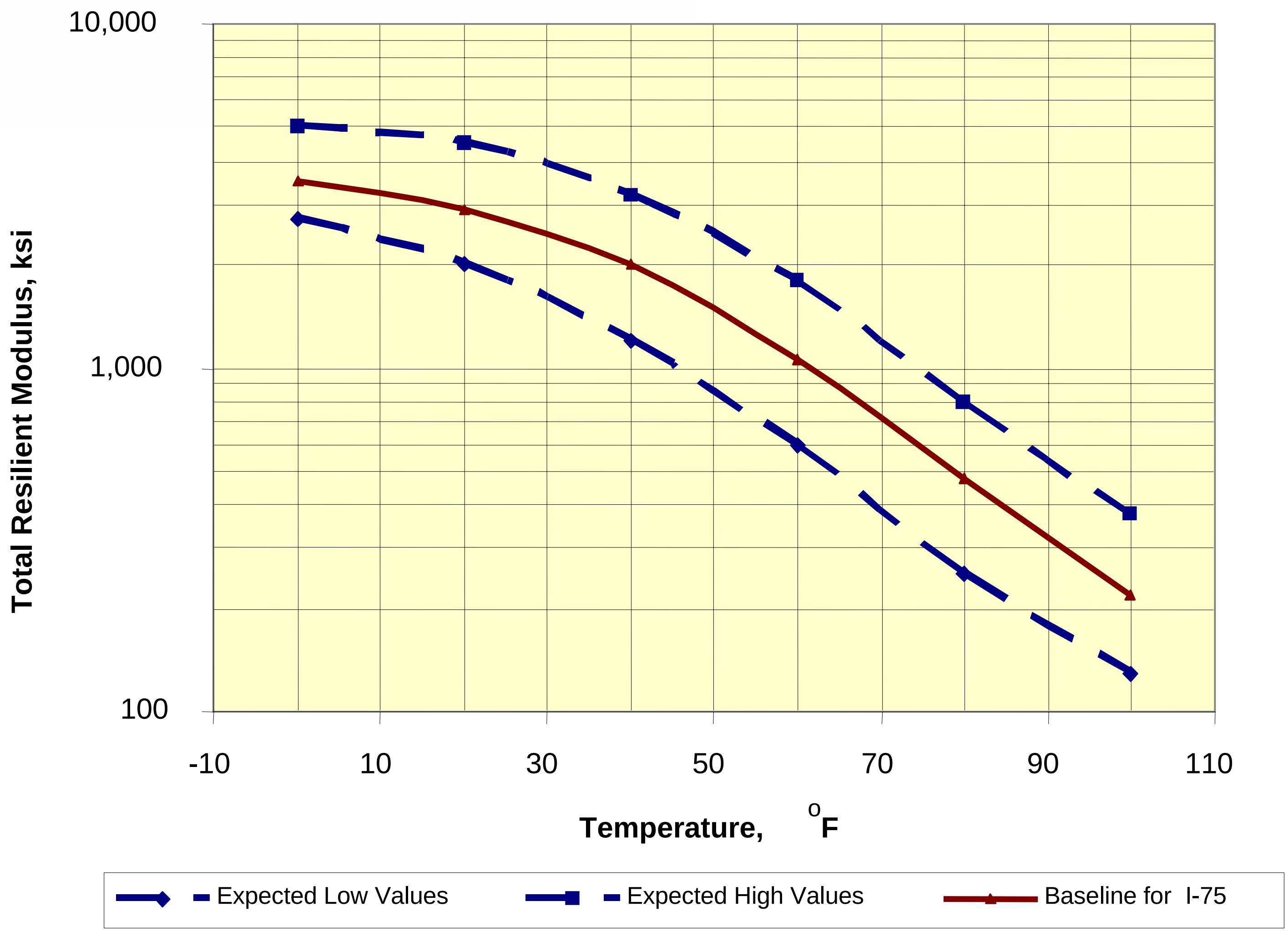
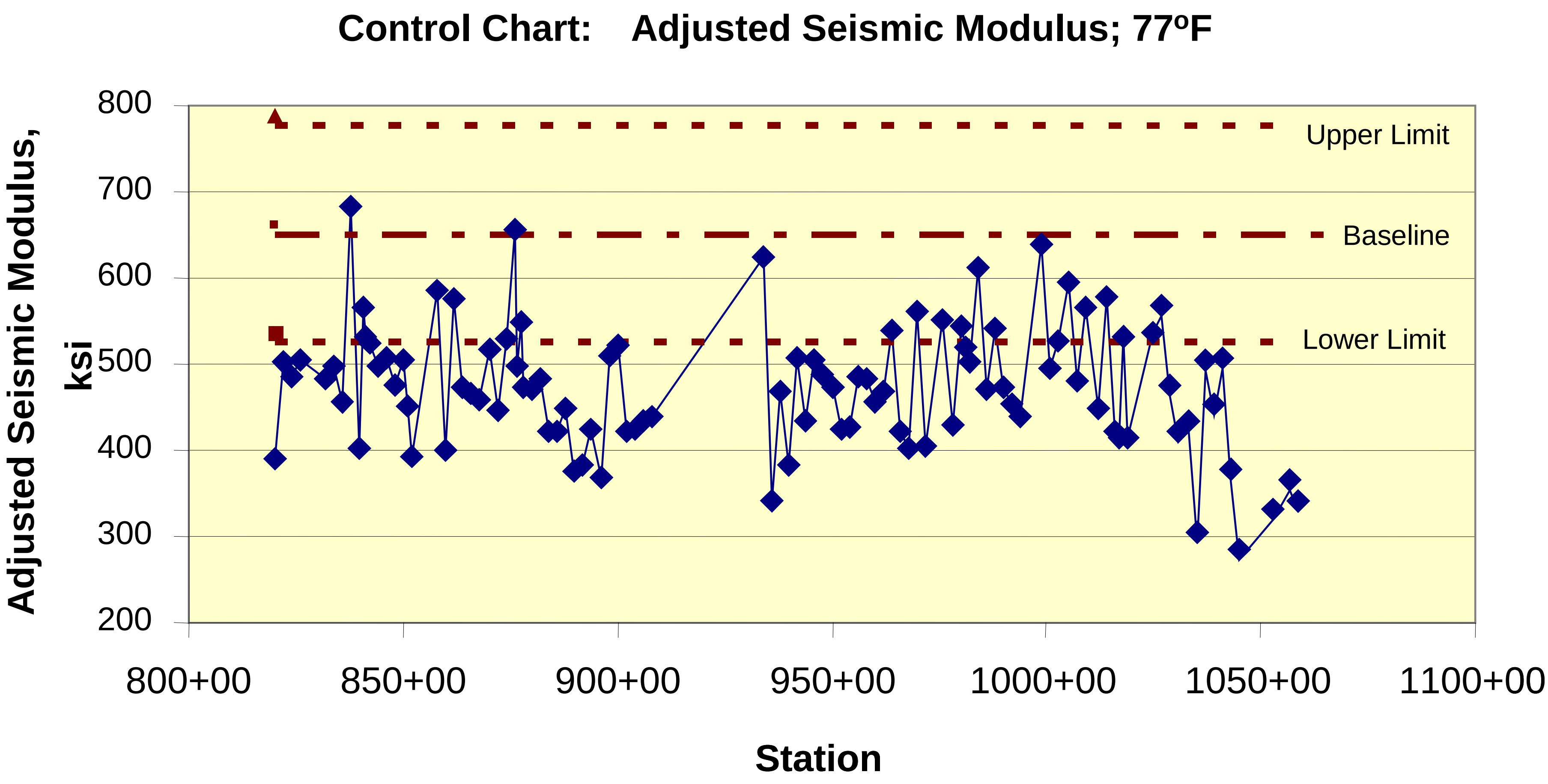
Baseline HMA Modulus



Phase I Seismic Chart



GPR Uniformity Index

- Changes in electromagnetic properties are associated with changes in physical properties characteristic of moisture damage
- Because moisture damage varies spatially, localized variability in electromagnetic properties can be an indicator of moisture damage
- Uniformity index measures local variability. A uniform condition results in UI = 1.0.

$$UI(x) = \frac{\overline{A}(x)}{\overline{A}\left(x \pm \frac{L}{2}\right)}$$

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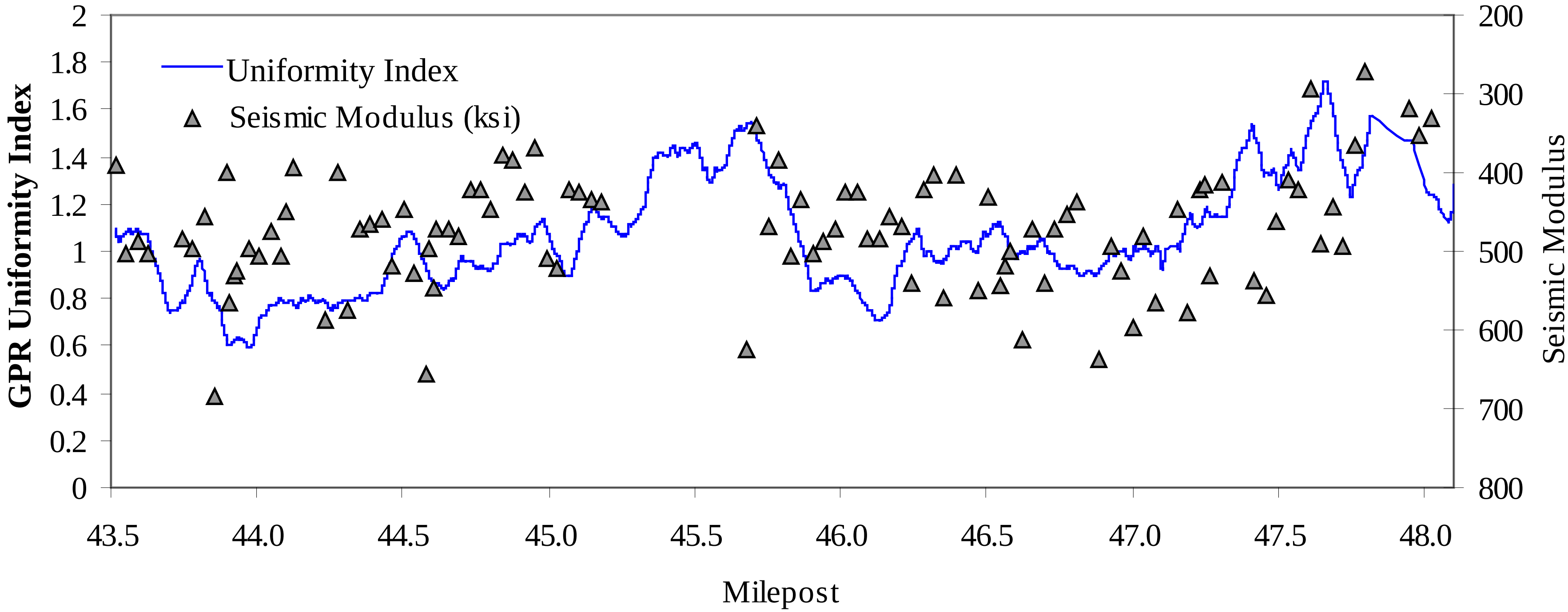
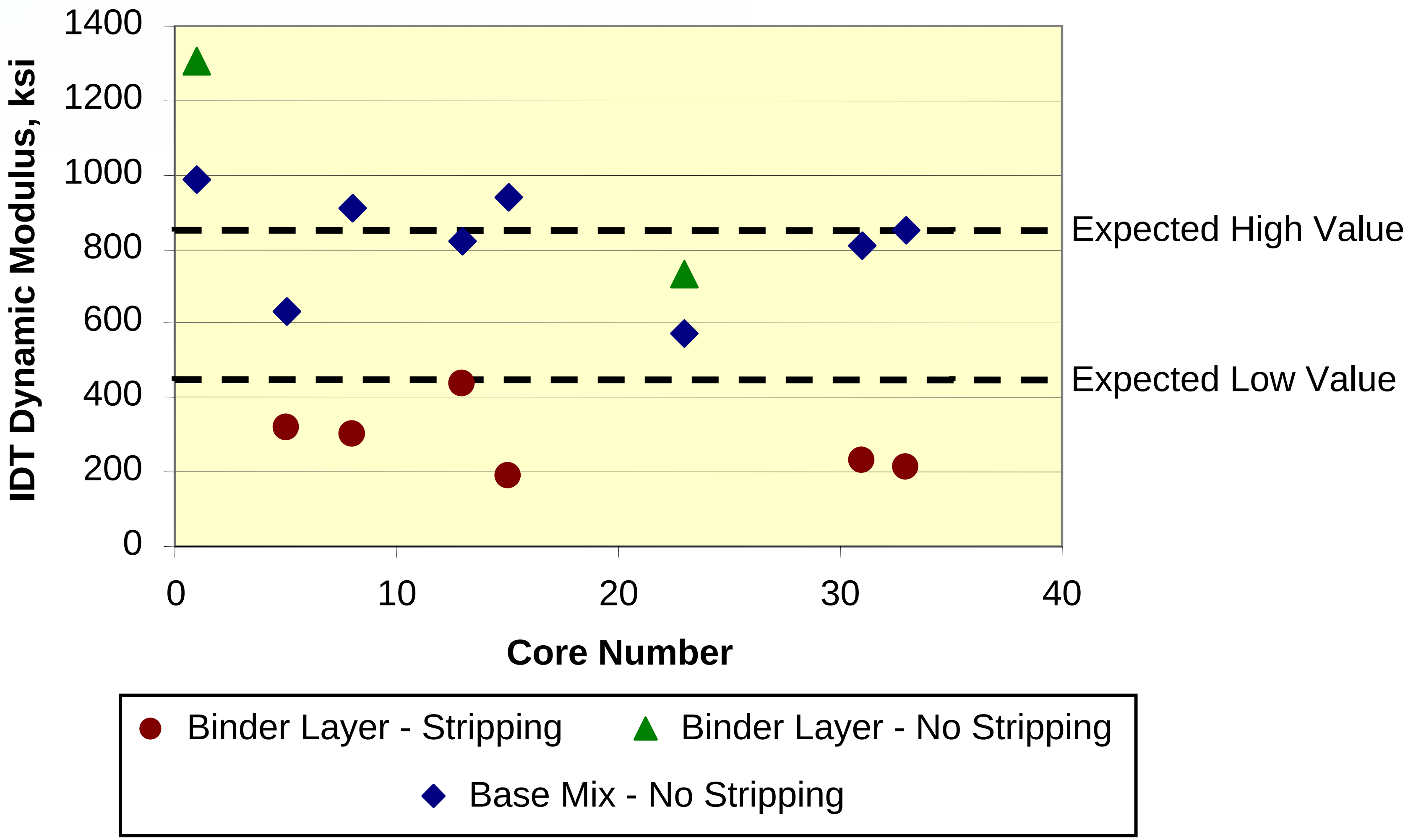
Phase I Uniformity Index



Phase I IDT Results



Phase I Findings

- Thermal anomalies were not good indicators of deterioration from stripping in full-depth asphalt pavements.
- Forward-calculated HMA moduli from FWD basins were not sensitive to moisture damage.
- Seismic tests indicate that the uppermost layer (3 to 4 inches) is in good condition with lower quality material between 4 and 6 inches below the surface.

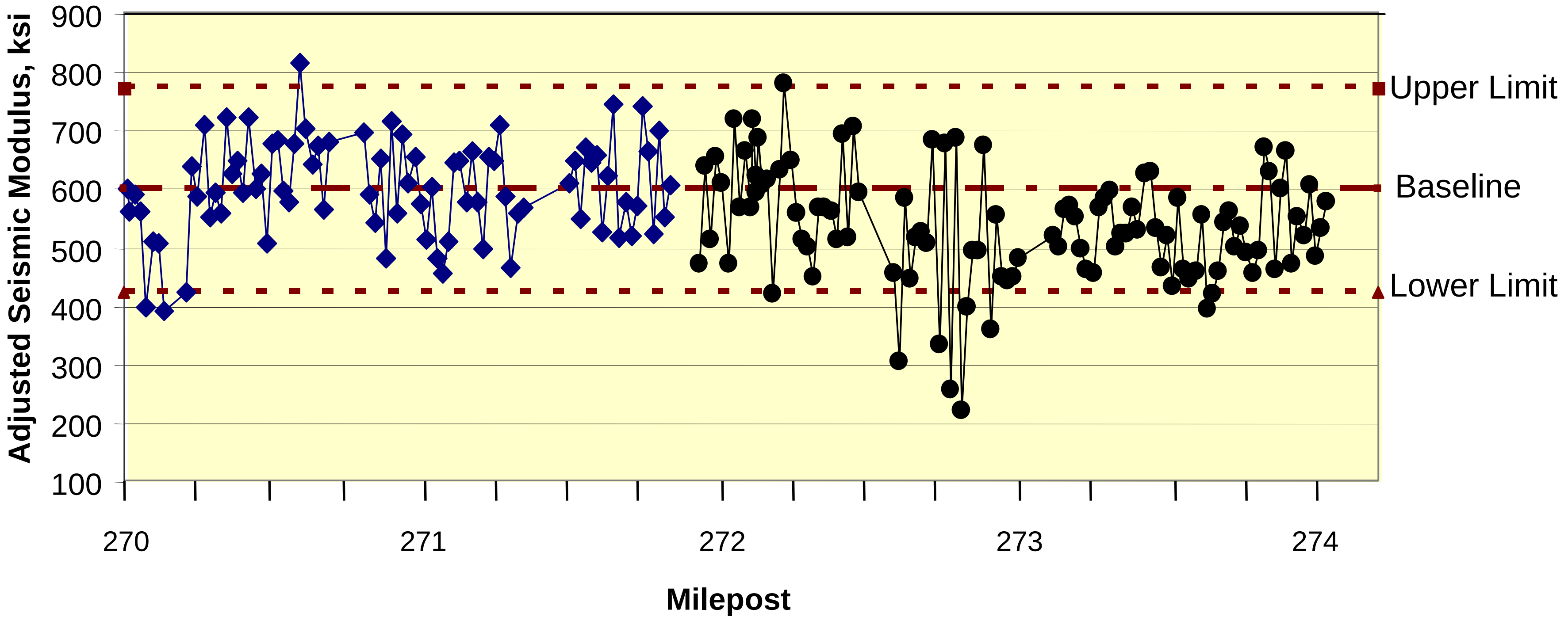
Phase I Findings (concluded)

- GPR is a effective screening tool to identify areas with changes in electromagnetic properties possibly caused by moisture damage.
- The GPR Uniformity Index provides a method to pinpoint localized non-uniformity within the pavement section.
- The upper 8 inches of HMA should be removed during rehabilitation to preclude significant distortions from construction traffic.

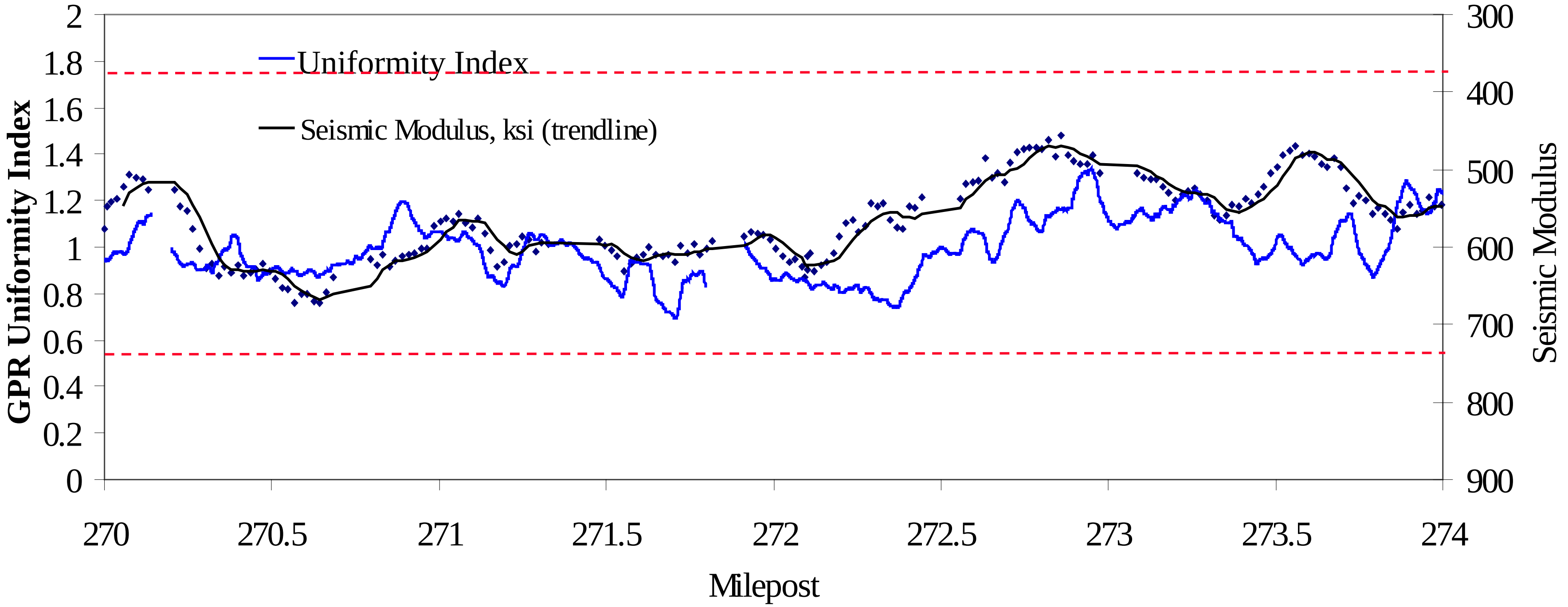
Recommendations for Phase II

1. Eliminate FWD and IR thermography from survey protocol.
2. Use GPR and seismic in combination to identify layers with moisture damage or other anomalies.
3. Obtain cores from pavement section and conduct IDT testing on selected cores.
4. Compare the GPR UI, seismic modulus, and core condition to confirm the initial criteria used. Make any adjustments for the specific HMA mixture.
5. Designate the areas with various levels of moisture damage for use in rehabilitation design.

Phase II Seismic Control Chart



Phase II GPR UI and Seismic Modulus



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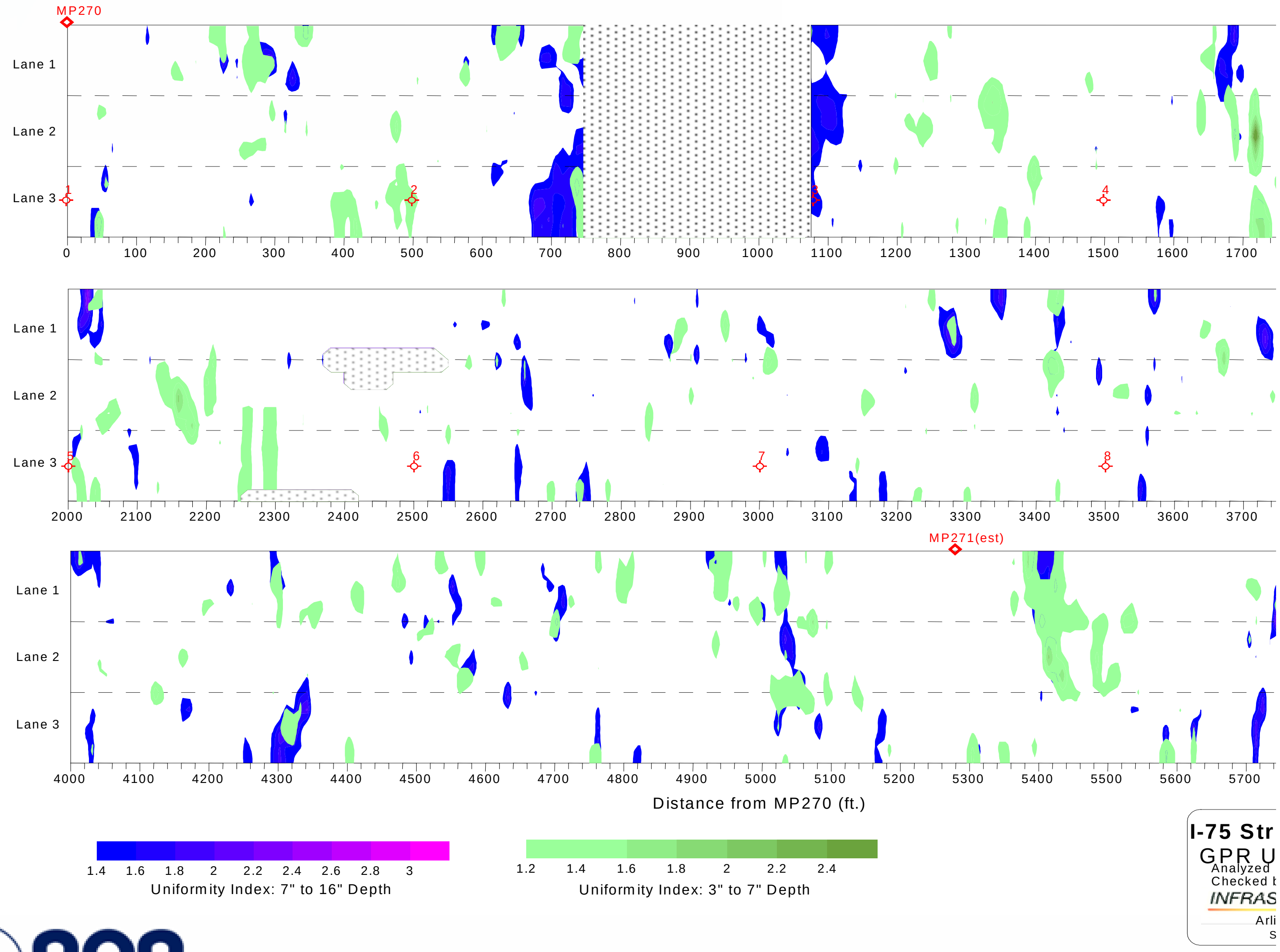
GPR Uniformity Index



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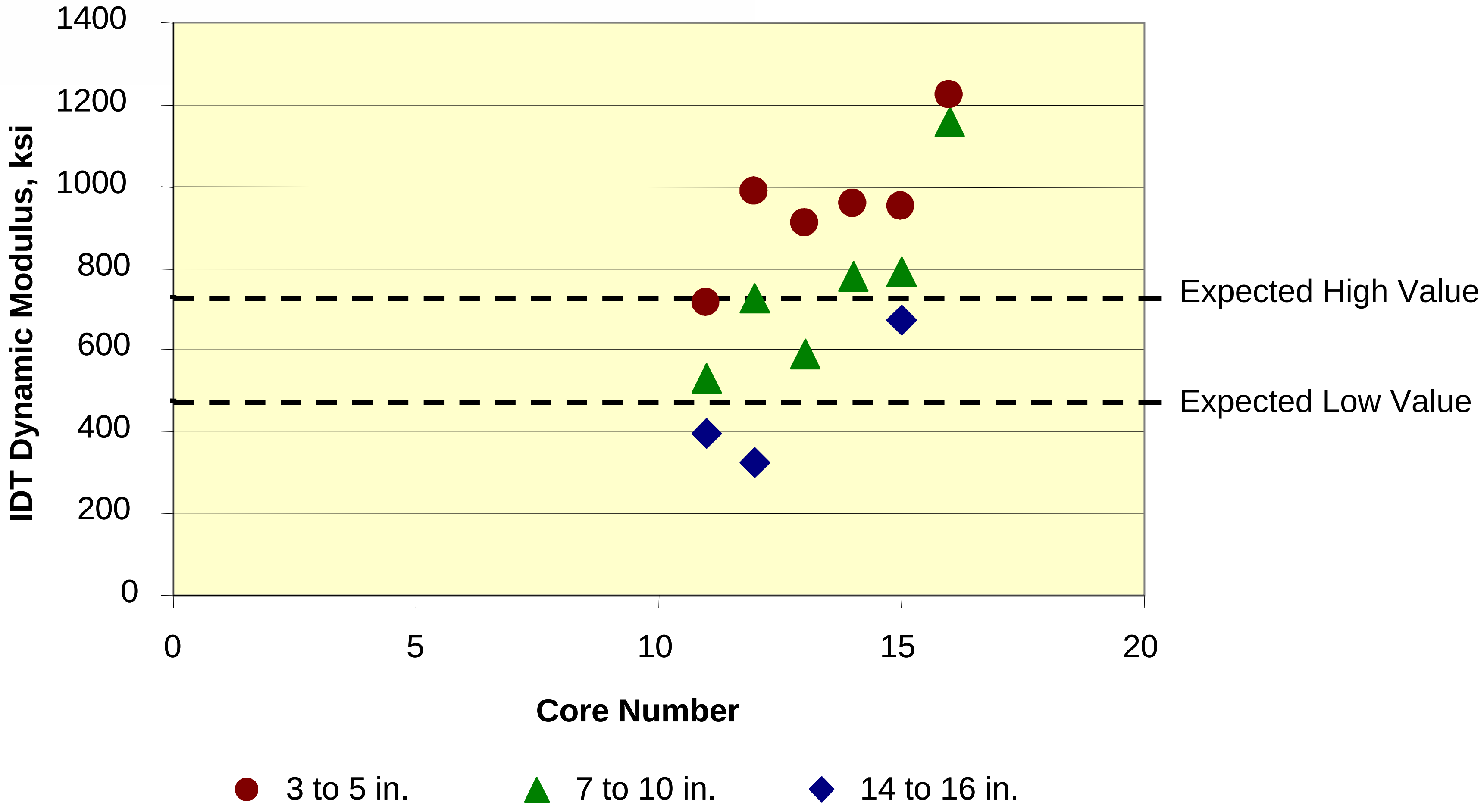
Phase II IDT Results



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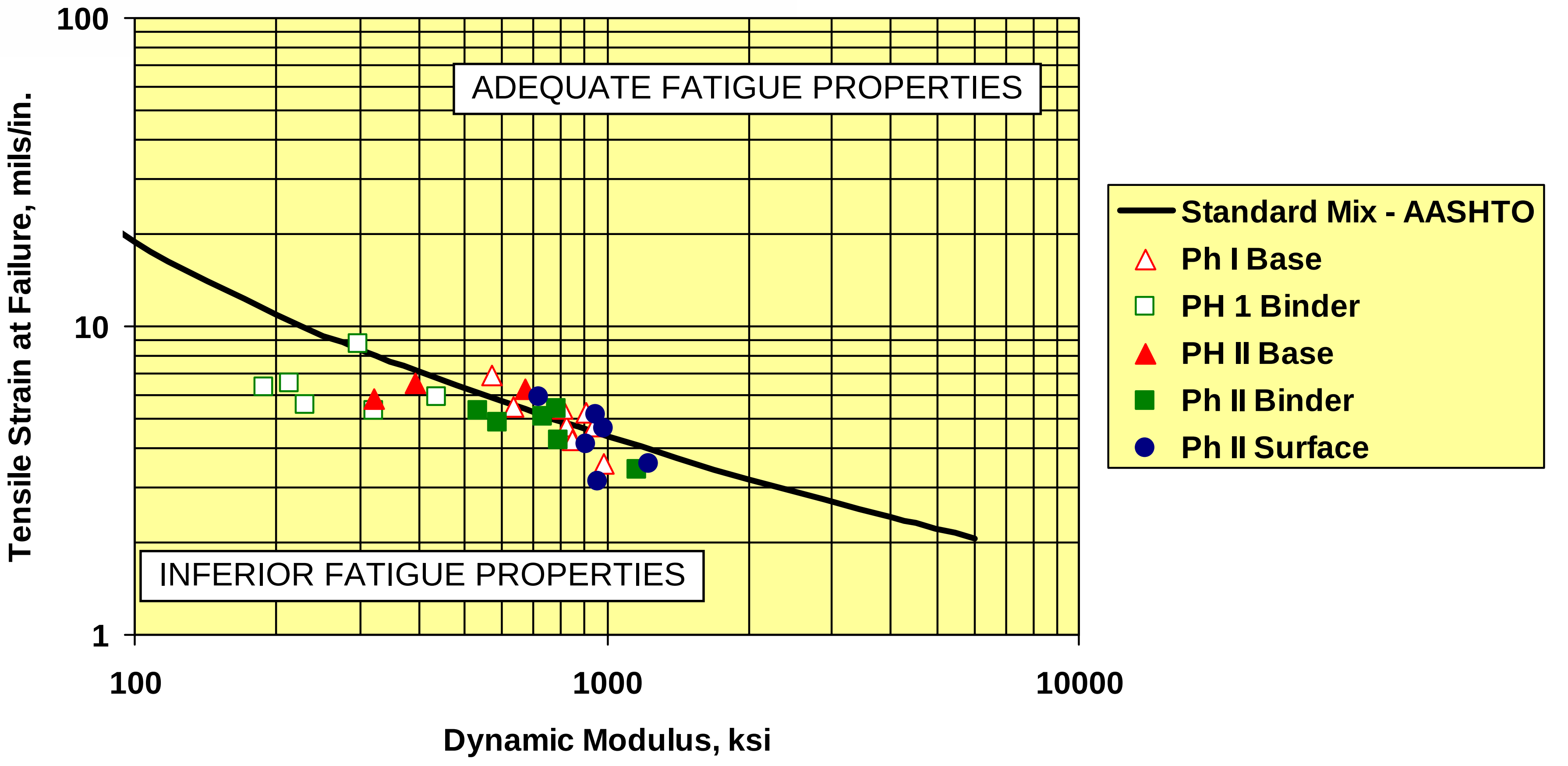
Phase I and II Fatigue Properties



General Conclusions

- Visual observations of cores are inconclusive. Laboratory tests on the cores are required to characterize the degree of the moisture damage.
- Seismic and GPR technologies should be used in combination to improve on the reliability of identifying layers with moisture damage, stripping, or other anomalies beneath the pavement surface.
- Output from procedure can be used directly in new mechanistic-empirical design guide.

Conclusions – Phase I

- Widespread moisture damage exists within the intermediate (binder) layer at a depth of 4 to 8 inches.
- While little of this damage has progressed to full-blown stripping, the integrity of the material has been compromised to the extent that rehabilitation design strategies will be impacted.
- Remove top 8 inches as a part of the rehabilitation strategy.

Conclusions – Phase II

- Moisture damage is isolated to localized areas.
- The GPR survey suggests that moisture is present along the entire length of the pilot project.
- GPR and seismic comparison shows that
  - Moisture is primarily confined to the interfaces between layers.
  - Moisture has reduced bond between layers, but has not affected the integrity of the HMA
- Most mix disintegration has occurred near the lower portion of the base layer.
- With the exception of a couple of isolated locations, any damaged material is far enough below the surface so that it should not influence the rehabilitation strategy.

Recommended Survey Strategy

1. Review the construction history.
2. Review the surface condition.
3. Estimate the threshold values of dynamic modulus.
4. Perform a complete GPR survey on the roadway and determine the UI along the project.
5. Segment the roadway based on the UI values by identifying areas were variability exceeds normal construction/materials variation.

Survey Strategy (Concluded)

6. Conduct seismic tests in each segmented area.
7. Develop a field sampling plan to take cores within each of the different segmented areas.
8. Compare the GPR UI, seismic modulus, and core condition.
9. Validate by performing laboratory tests from each segmented area.
10. Designate the areas with various levels of moisture damage for use in rehabilitation design.

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