VERIFICATION OF ASPHALT CONCRETE PERFORMANCE PREDICTION USING LEVEL 2 AND LEVEL 3 INPUTS OF MECHANISTIC-EMPIRICAL PAVEMENT DESIGN GUIDE FOR FLEXIBLE PAVEMENTS OF THE STATE OF NEW JERSEY

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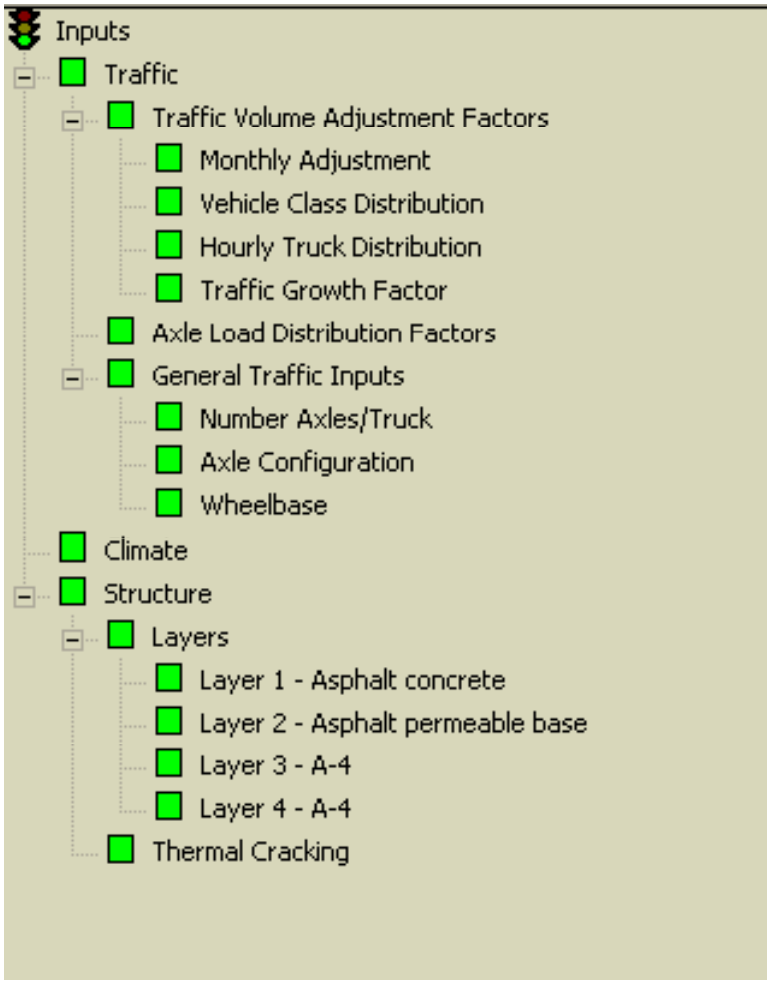
Outline

- Background
- Problem statement
- Objective
- Hypothesis
- Research approach
- Literature Review
- Comparisons of results to measured data for
  - Permanent deformation (rutting)
  - Bottom-up fatigue (alligator cracking)
  - Top-down fatigue (longitudinal cracking)
  - thermal cracking
  - IRI (International Roughness Index)
- Summary
- Conclusion

www.trb.org/mepdg/guide

Background

- M-EPDG is an evolving software
- M-EPDG has three levels of input
- Regardless of the input level, the damage models remain the same.



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Levels of Inputs

Level	Level of accuracy	General Input Sources
Level 1	Highest	Site specific data
Level 2	Intermediate	Agency database
Level 3	Minimal	Default or user defined

- **Problem**

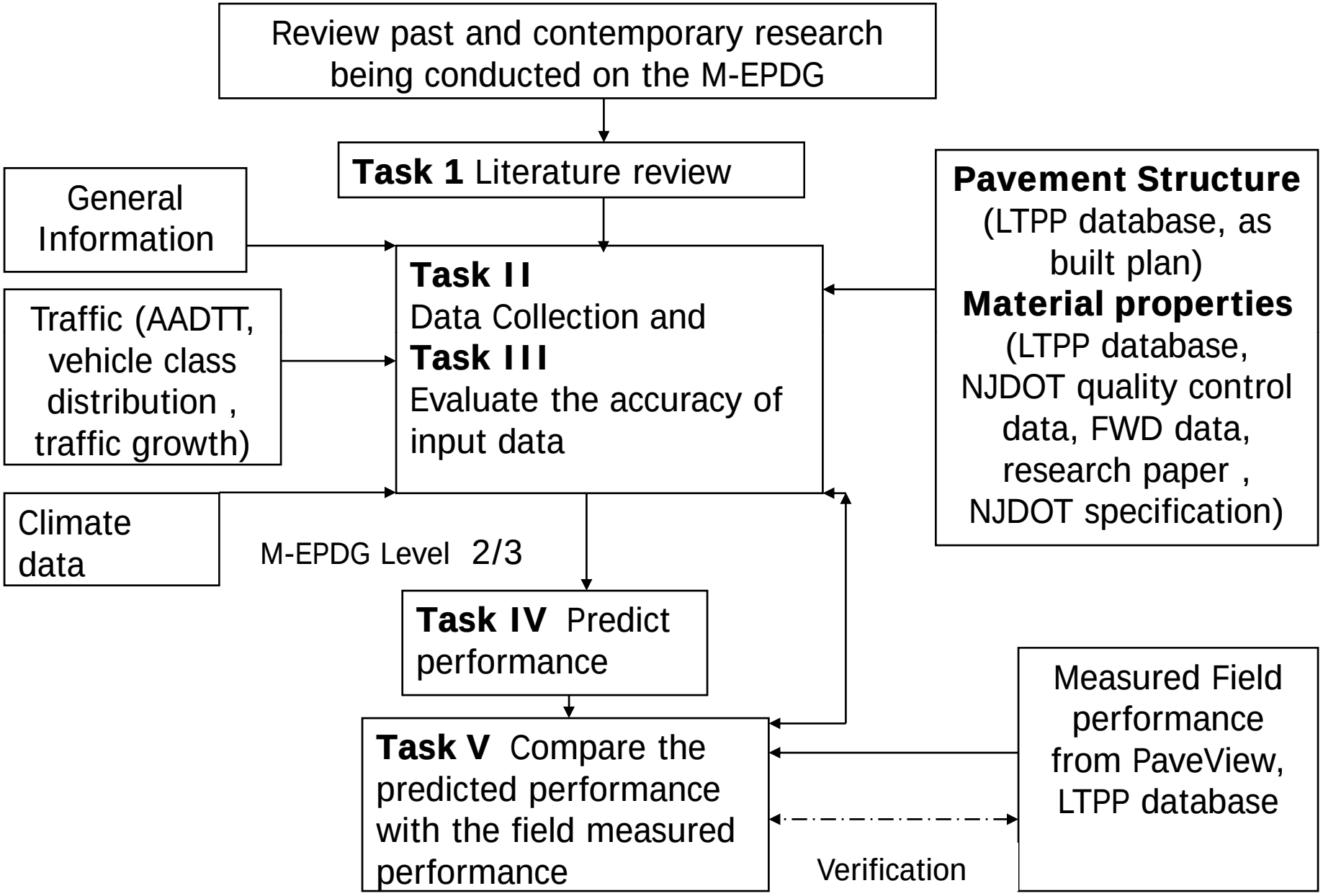
  The predicted performance from M-EPDG for New Jersey roads need to be verified before implementation.

- **Objectives**

  To verify the accuracy of the predicted performance from the M-EPDG software for the state of New Jersey for level 2 and level 3 inputs.

  To demonstrate the process of verification that can be followed by any state agency or research institution as a tool for verification.

Research Approach



Studies conducted on M-EPDG based on field measured data

Author	Conclusions
Muthadi et al., 2008	•The M-EPDG predicted rutting values matched very well with the measured values for the LTPP sections. •The M-EPDG predicted rutting did not match well to the NCDOT measured rutting.
Kang et al., 2008	•Occasionally, distress quantities appeared to increase then drop back down.

Distress modes

- Rutting
- Alligator cracking - Bottom up fatigue.
- Longitudinal cracking -Top down fatigue.
- Thermal cracking
- Roughness (IRI - International Roughness Index)

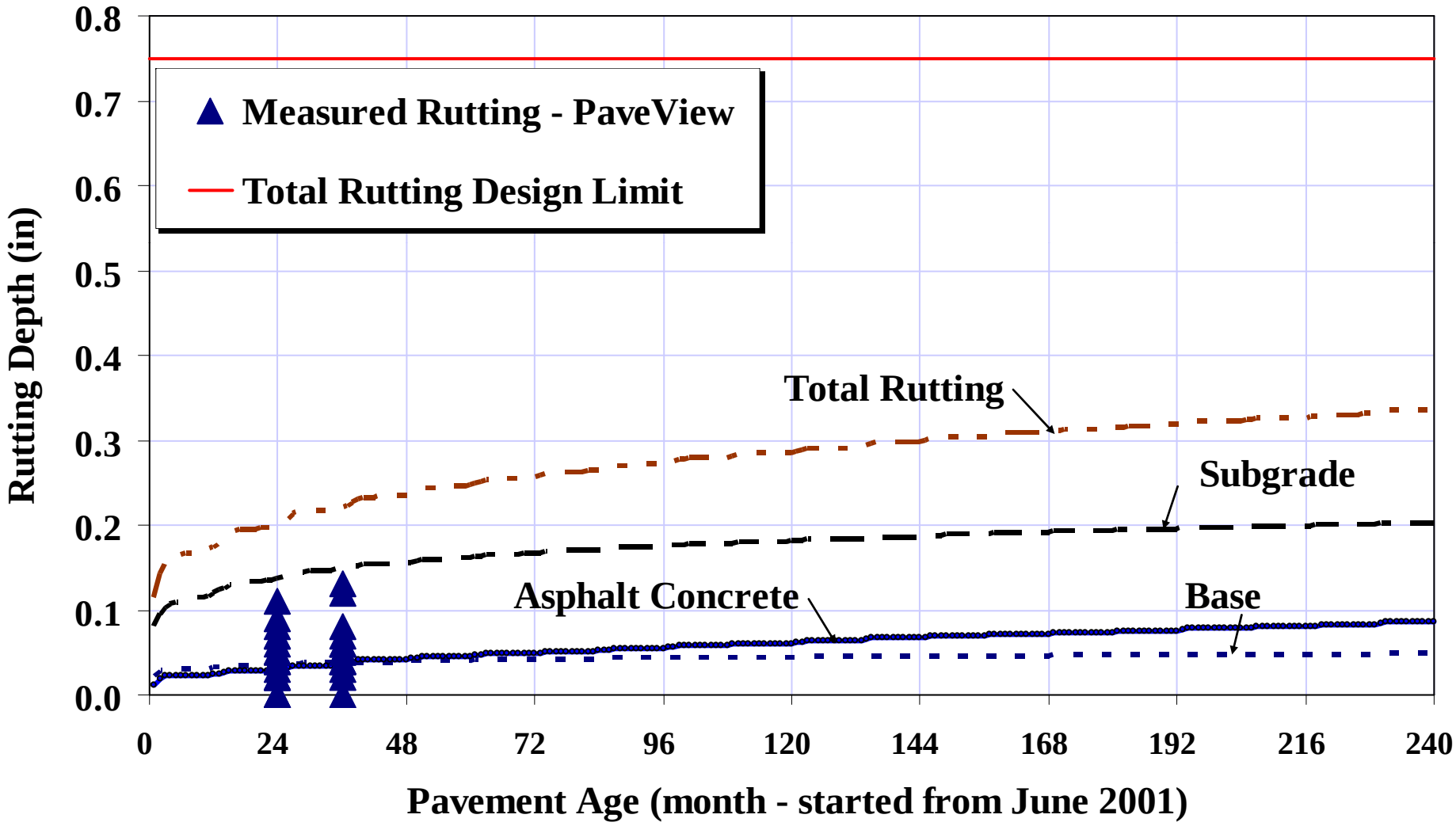
Scope of Study

- 25 sections in North, Central, and South regions
  - 9 LTPP and 16 non-LTPP sections
  - The regions primarily identified by subgrade

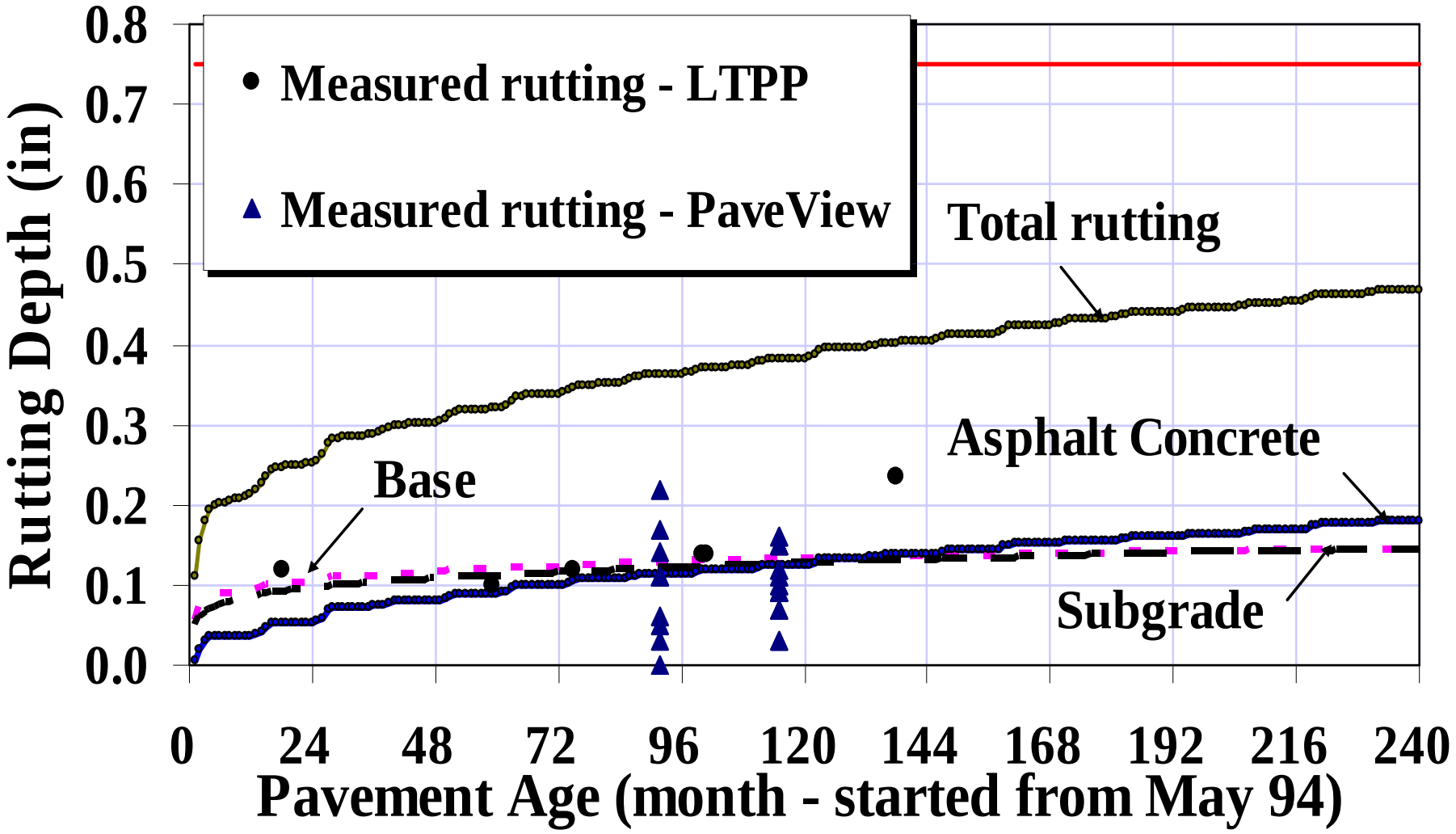
- Availability of data dictated the selection of sections

Comparison of Measured Rutting vs. Predicted Rutting

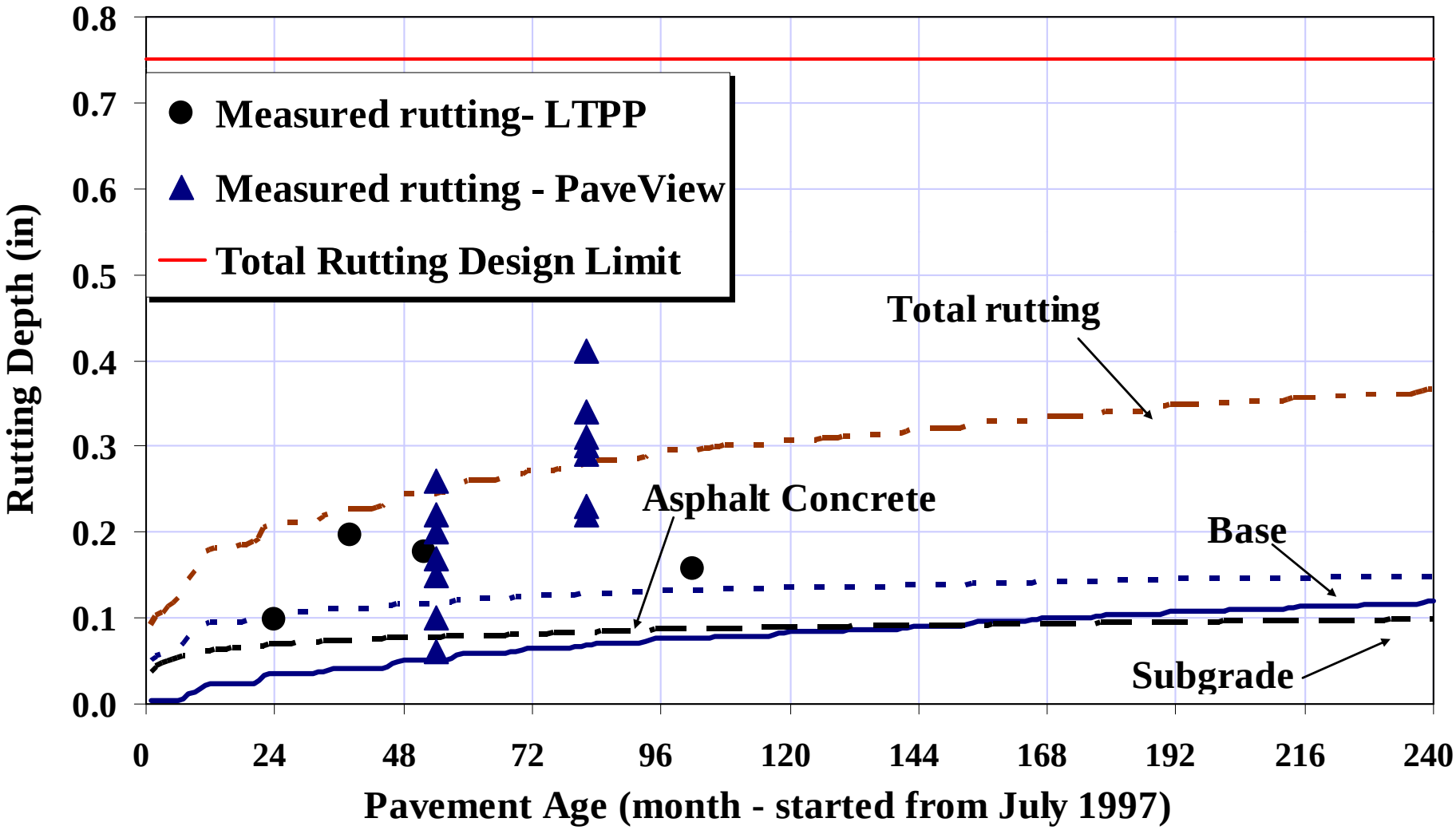
Route 70 W (MP 55.8)



Route 15 (1003)



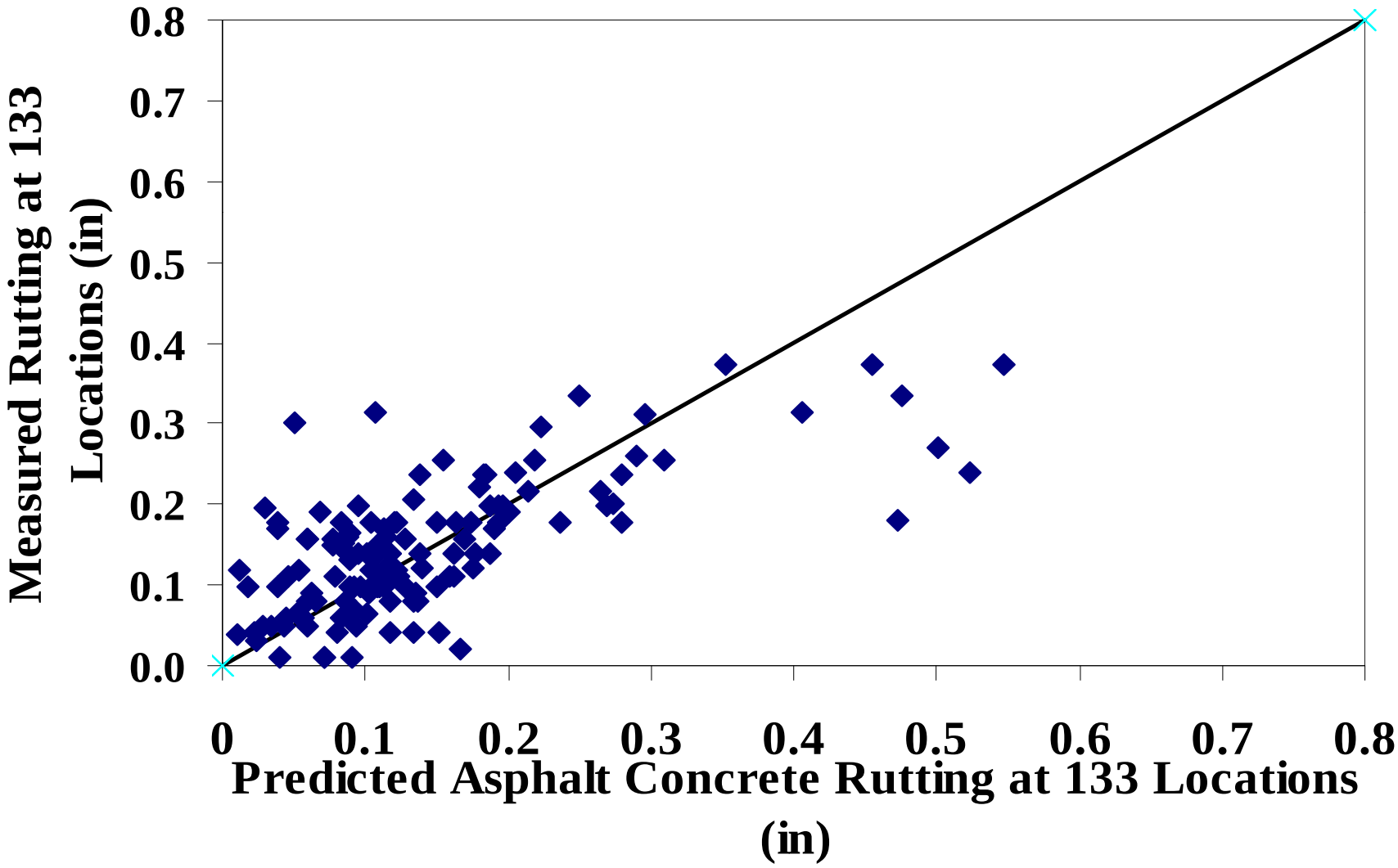
Route 23 S (1030)



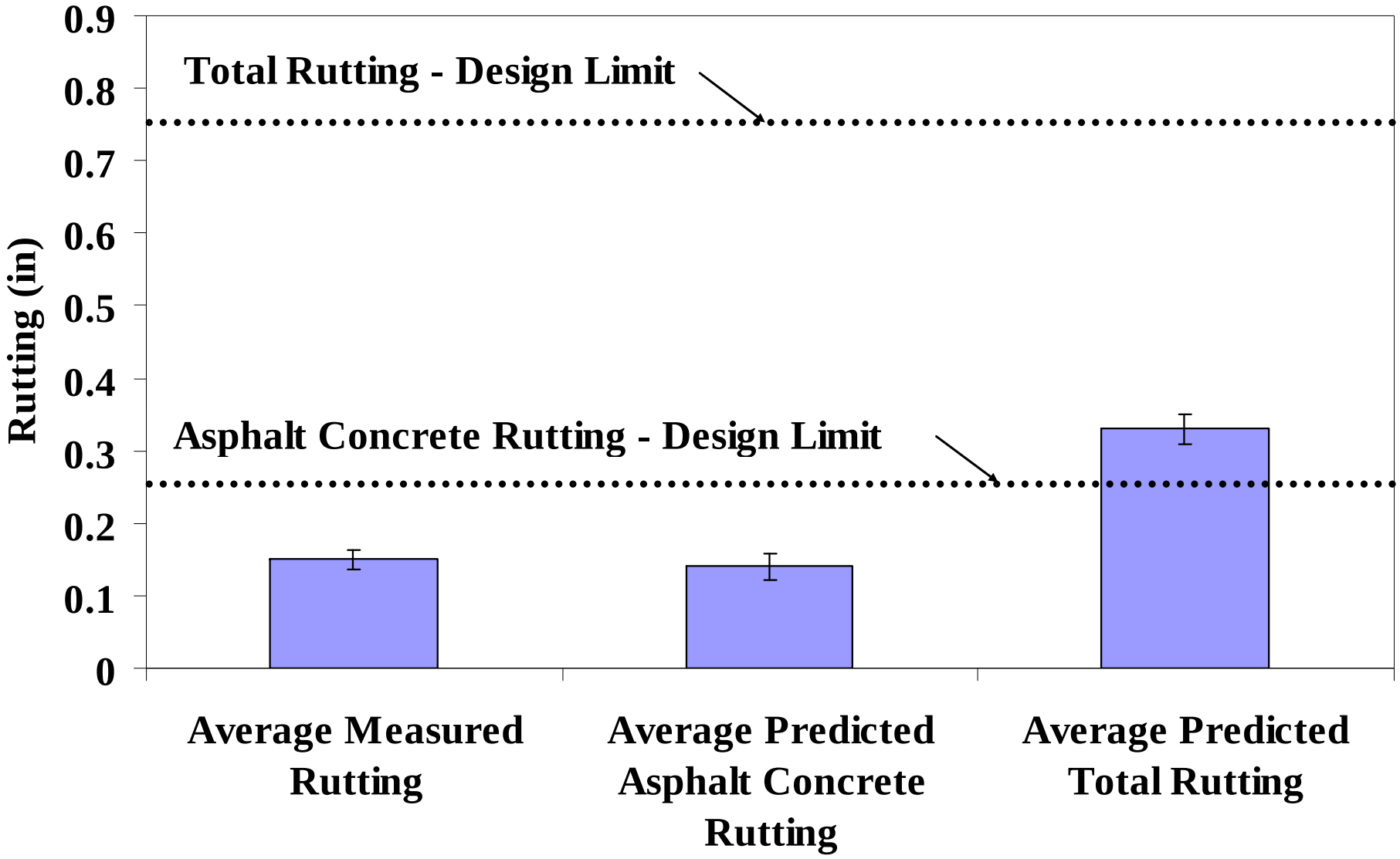
Calibration of the Unbound Layer Rut Models Using LTPP Sections

The final step in this calibration effort was to determine the final value for the calibration factors for both the granular base and subgrade, using the results from set 8-CB with the LTPP pavement sections. The assumptions made in the subsequent study is that the average value of the rut in the granular base layer should be about 0.075 inches. This value yielded a calibration factor (β_{GB}) for the unbound granular base of 1.05. For the subgrade layer it was desirable to have the average subgrade rut depth to be approximately 0.2 inches. It should be noted that these rut depths are associated with a design life of 20 years. For performance periods, above or below this value, rut depths would change accordingly. This required a calibration factor for the subgrade (β_{SG}) to be 1.35. These assumptions were based, in part, on a questionnaire send to nearly 40 Department of Transportation material engineers to indicate their opinion as to the expected layer rut depth in different pavement structures (17).

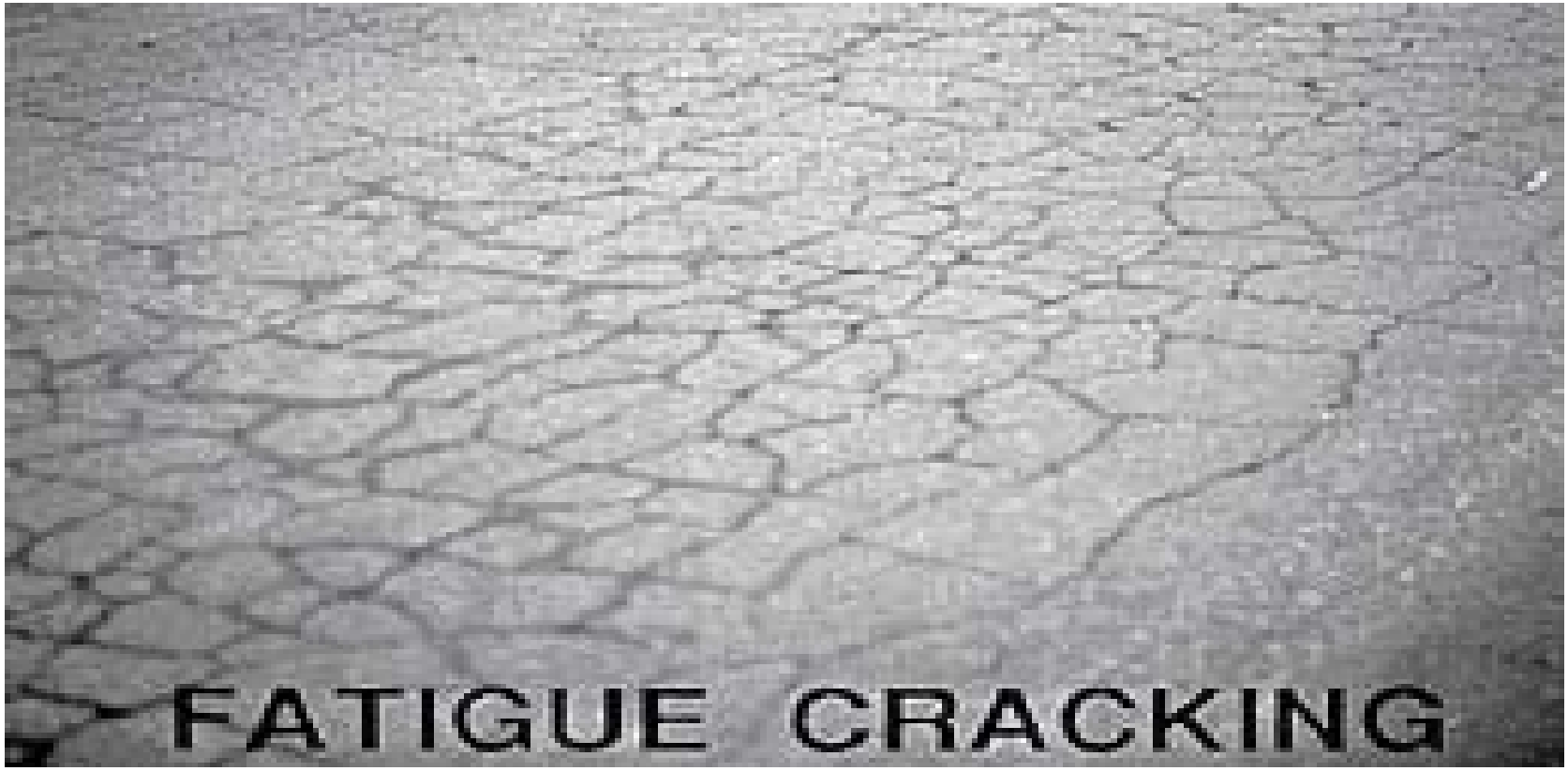
Measured and predicted rutting for 25 New Jersey sections



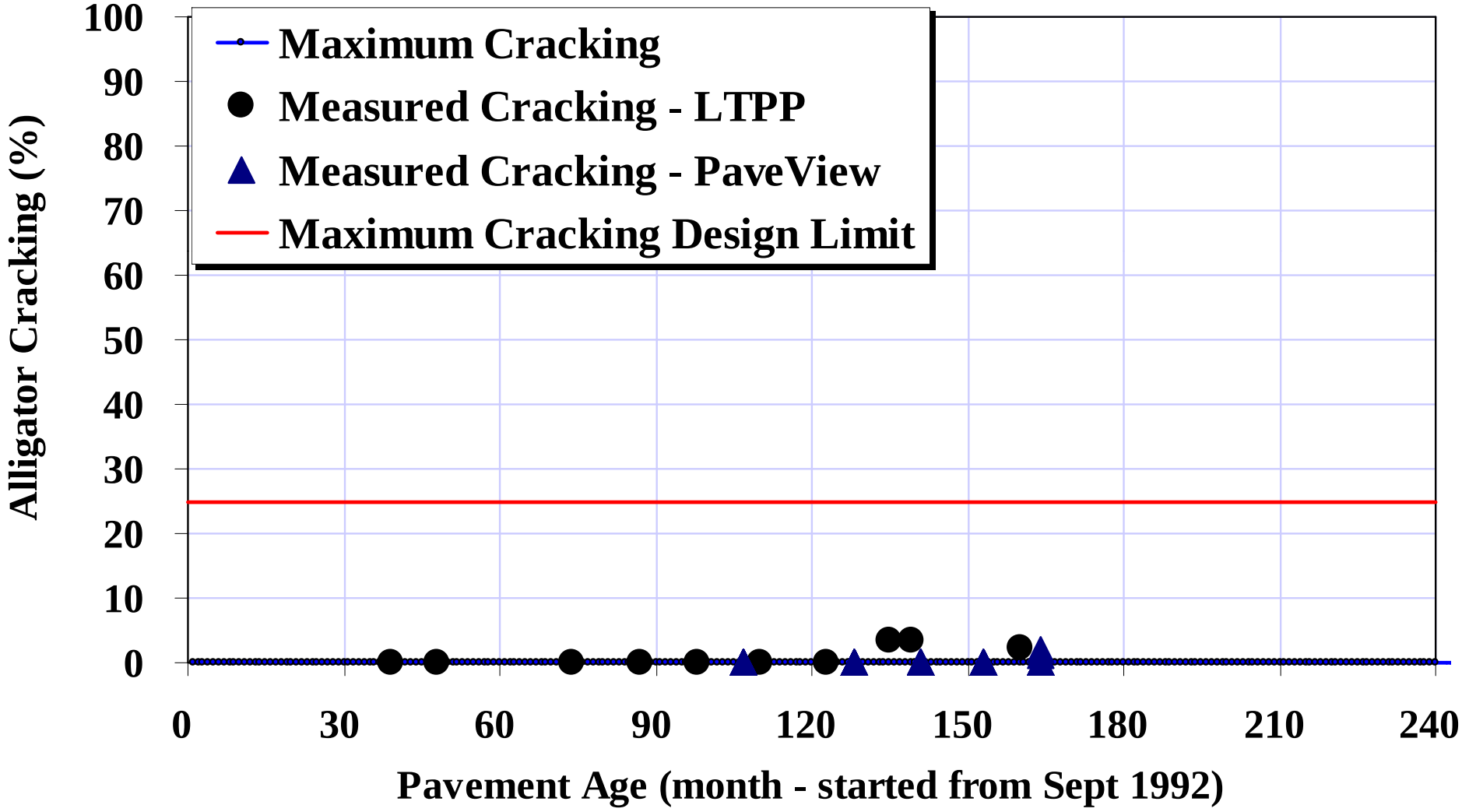
Average measured and predicted rutting for 25 New Jersey sections



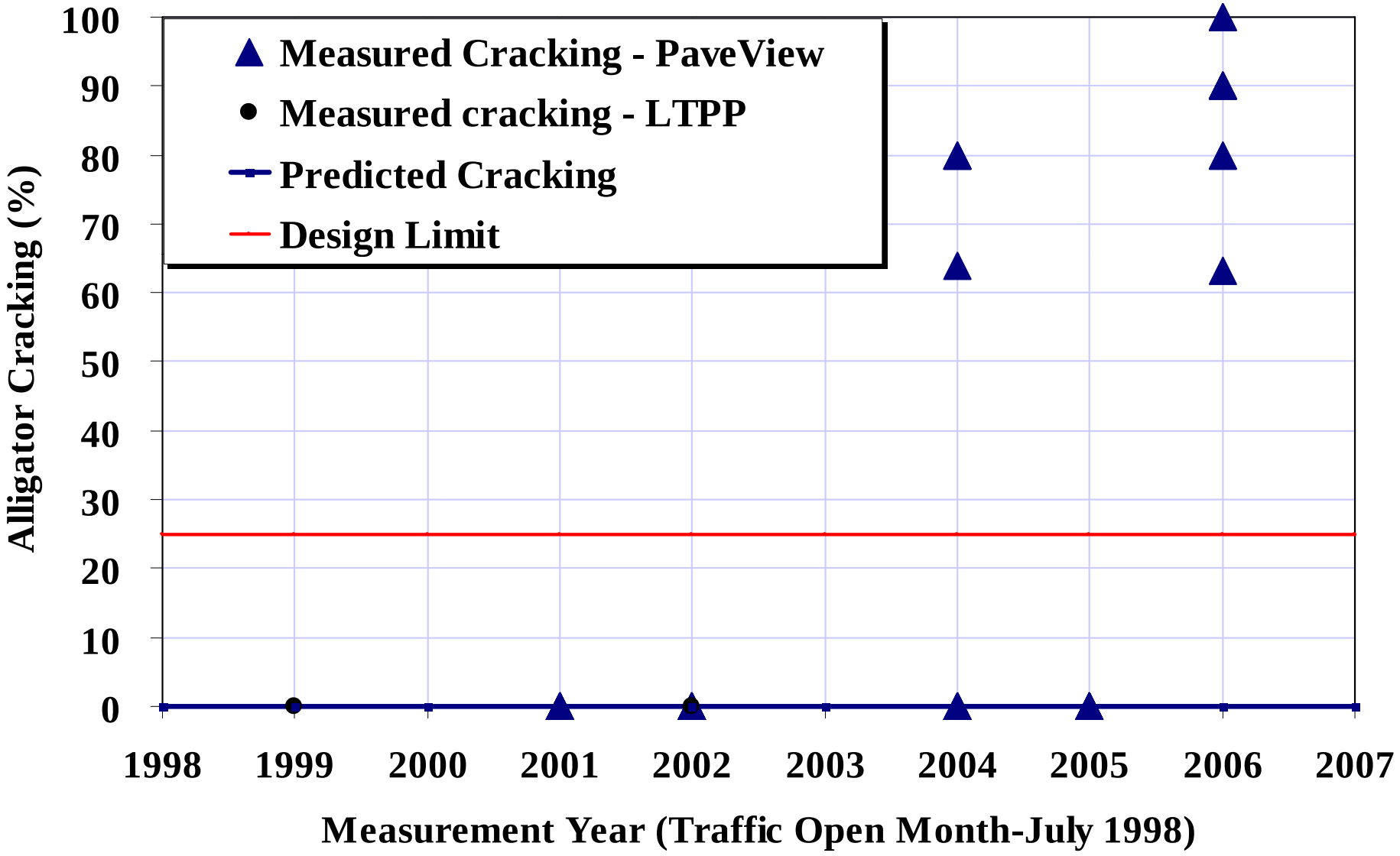
Comparison Of Measured Alligator Cracking vs. Predicted Alligator Cracking



Route I-195 W (LTPP section 0508)
Alligator Cracking



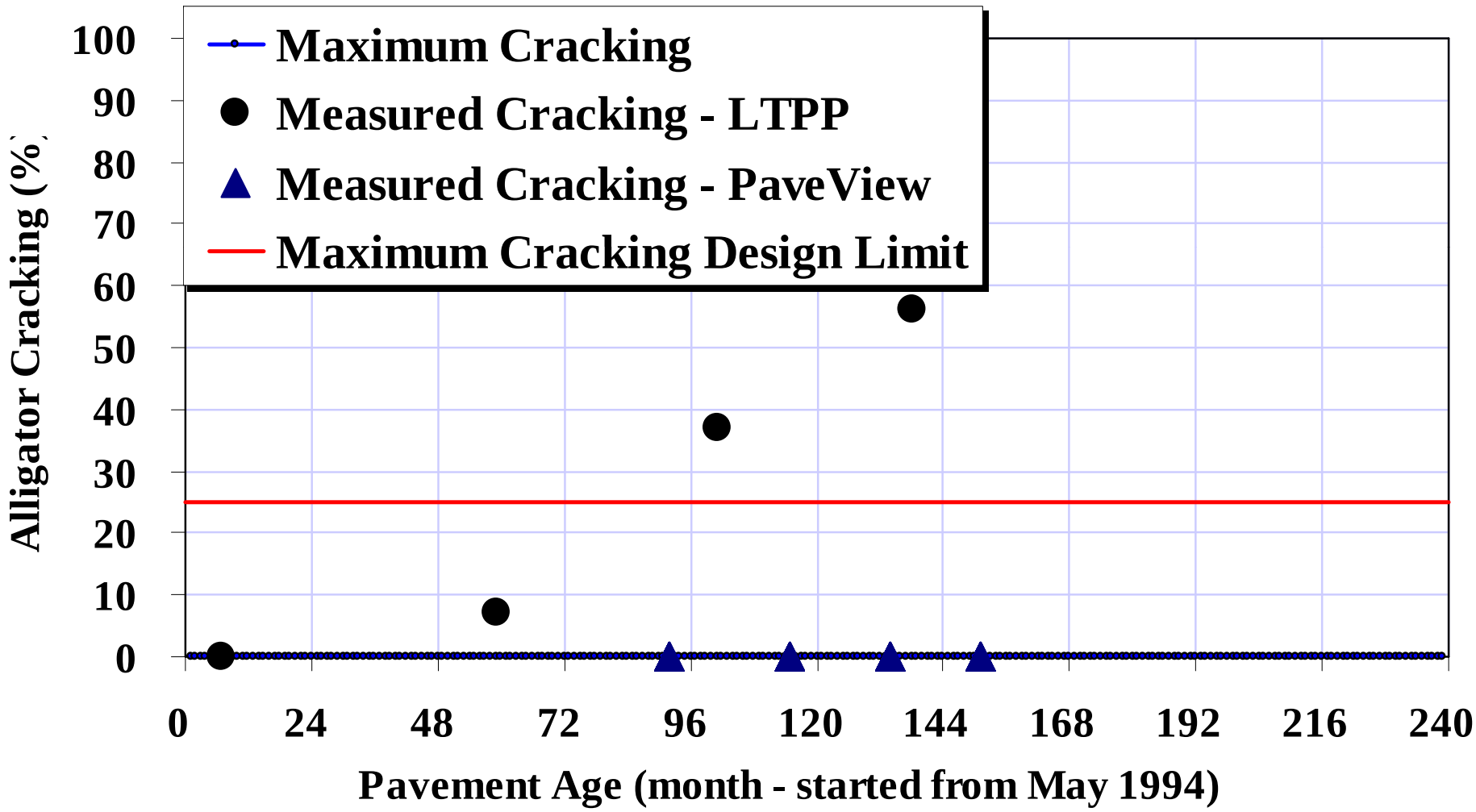
Route 195 (LTPP section 1011)
Before correction



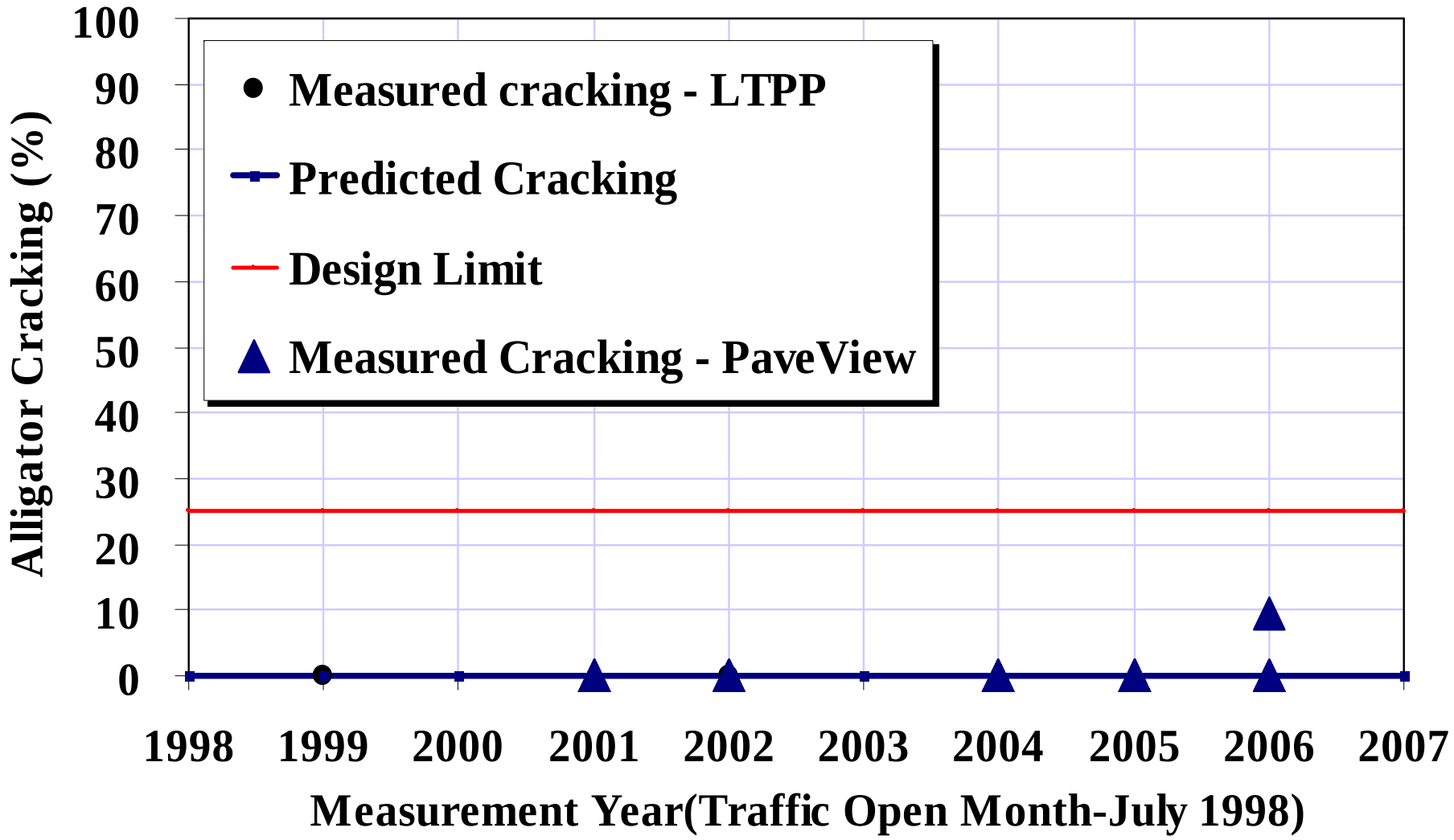
Raw measured PaveView data for LTPP section 1011: 2004

MP	Multiple Crack (Slight) %	Load Multiple Crack (Slight) %
9.7	100	100
9.8	100	100
9.9	100	100
10.0	80	80
10.1	0	0
10.2	0	0
10.3	0	0
10.4	0	0
10.5	0	0
10.6	0	0

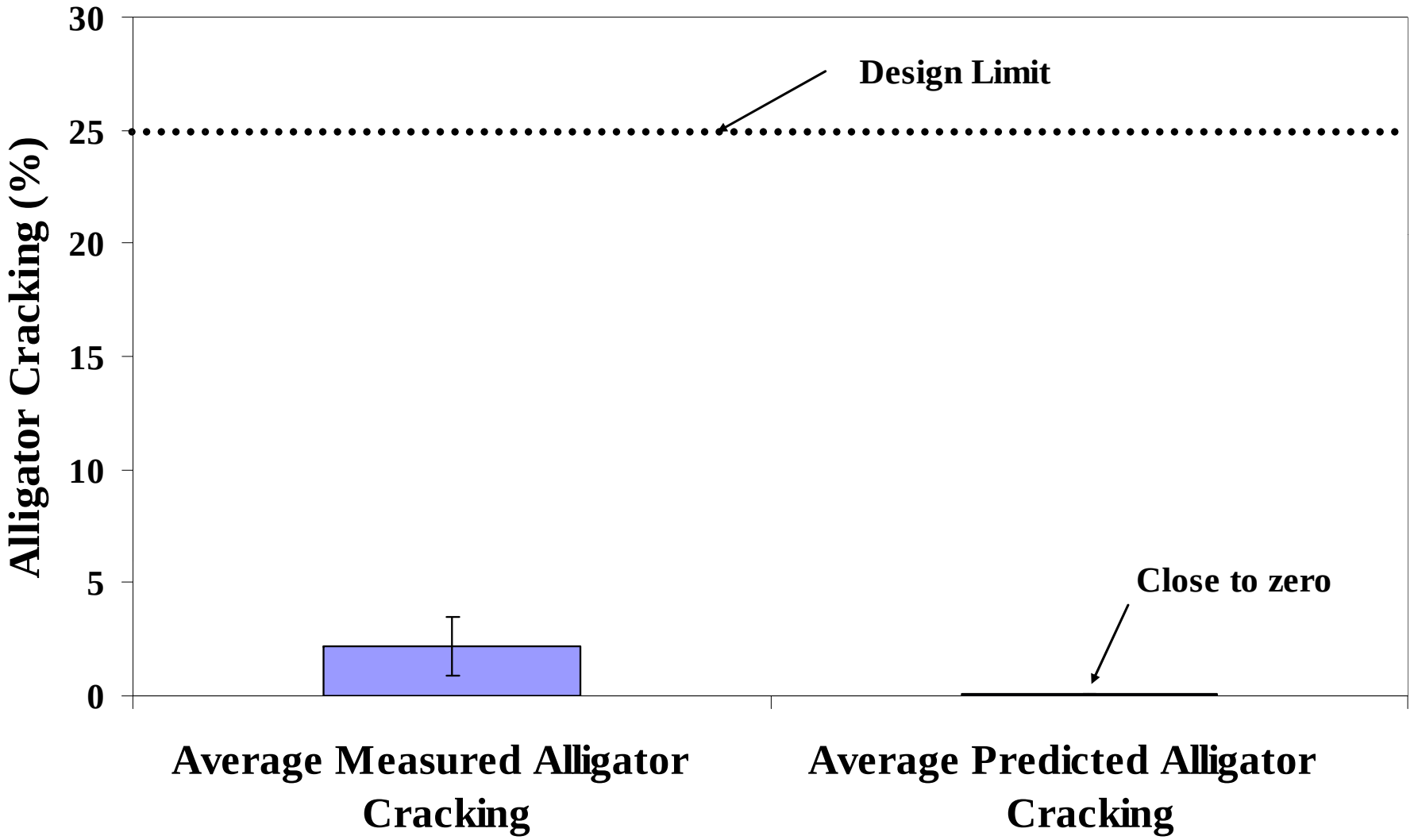
Route 15 N (LTPP section 1003)



Route 195 (LTPP section 1011)
After correction



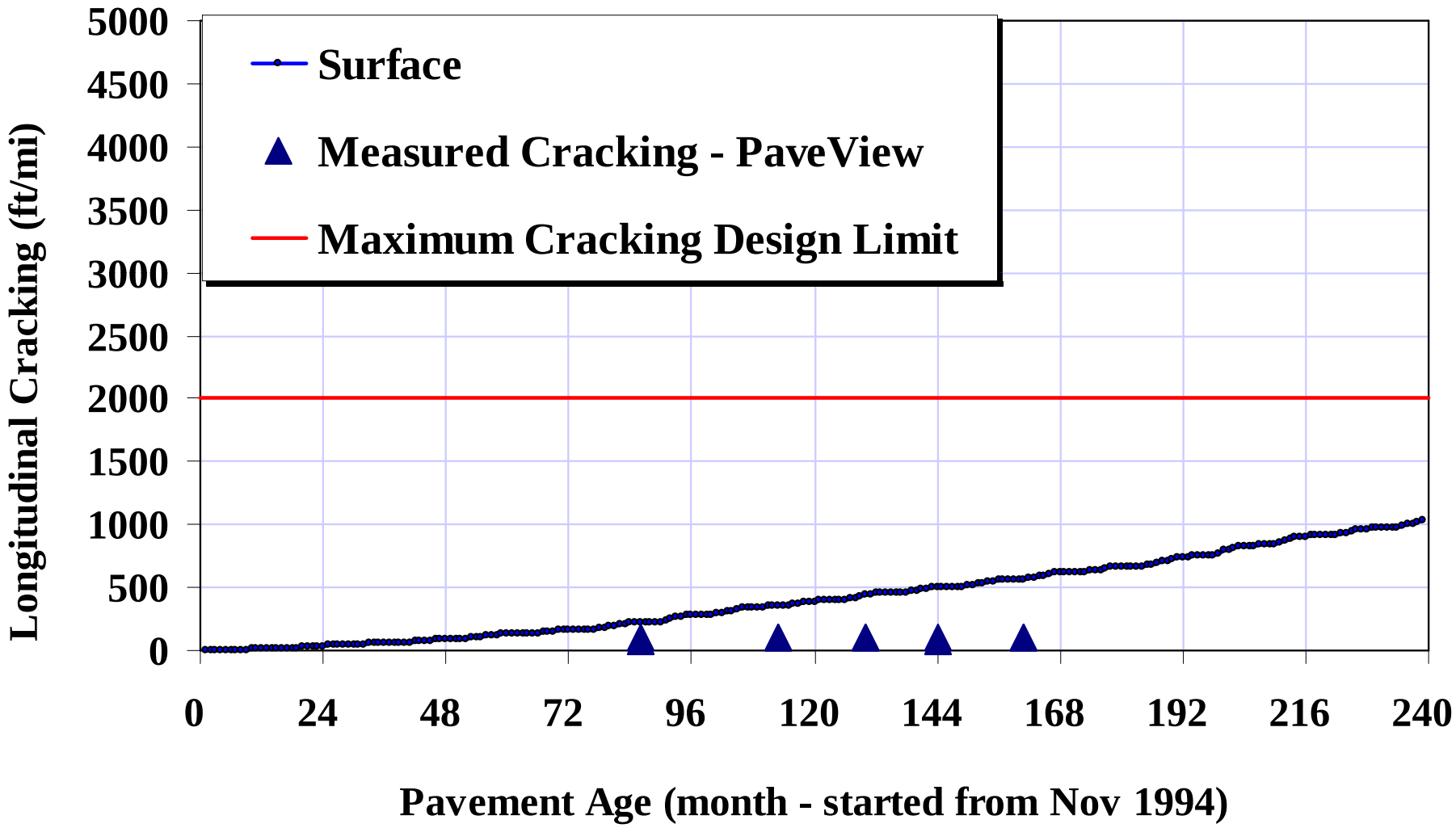
Average measured and predicted alligator cracking for 25 New Jersey sections



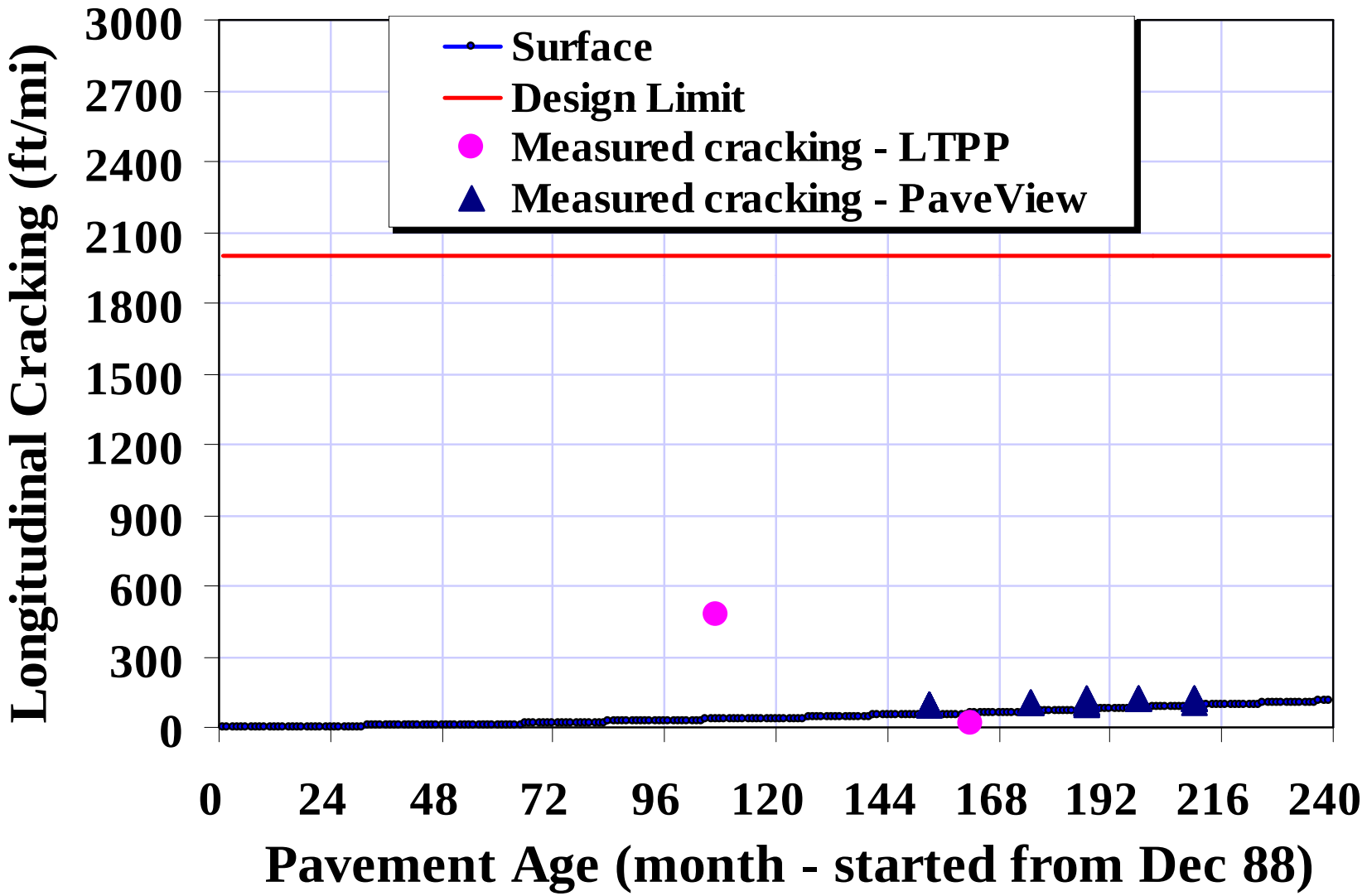
Results

Longitudinal Cracking
(Top-Down Fatigue)

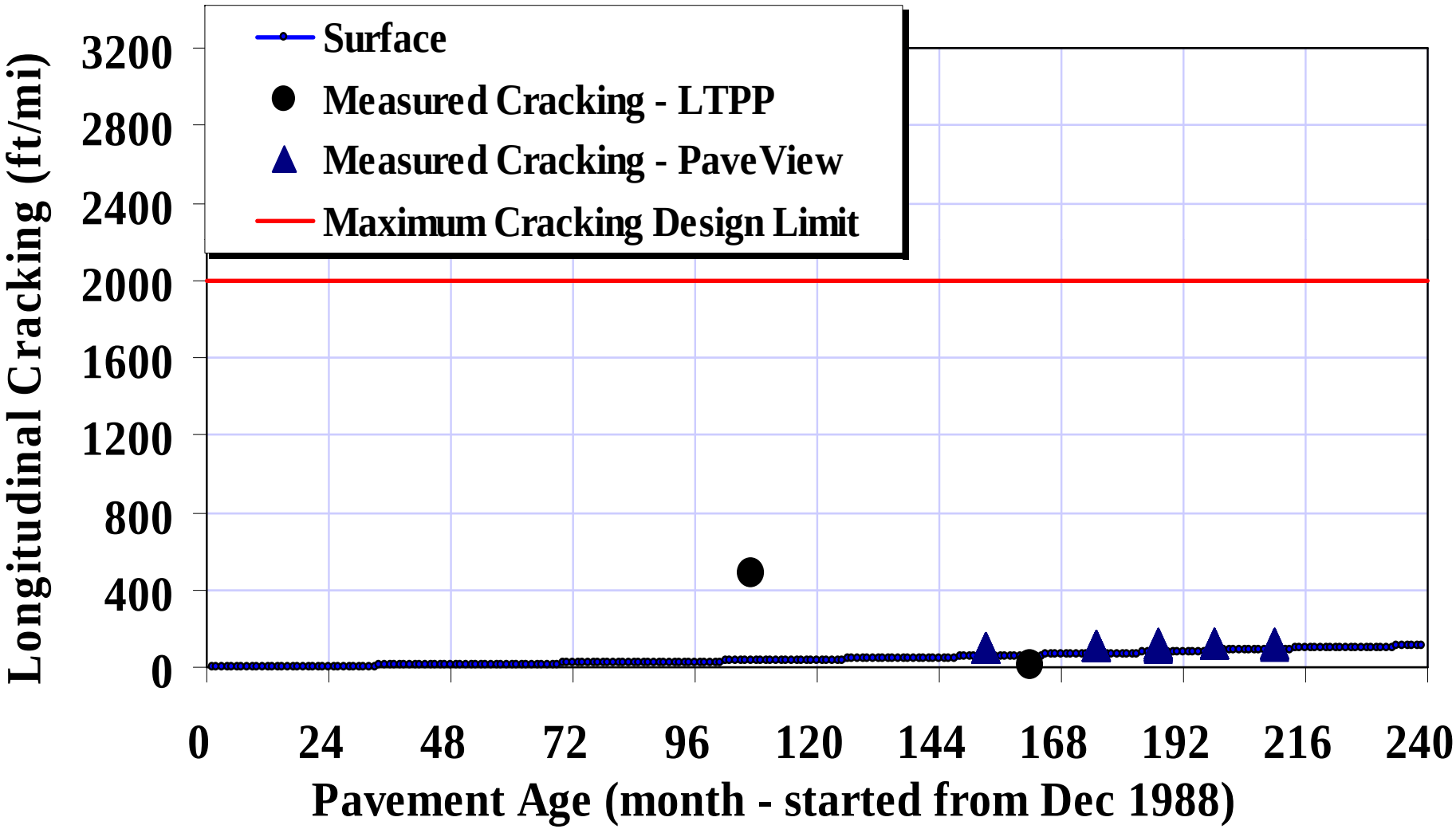
Route 159 E (MP 0.1 – 0.3)



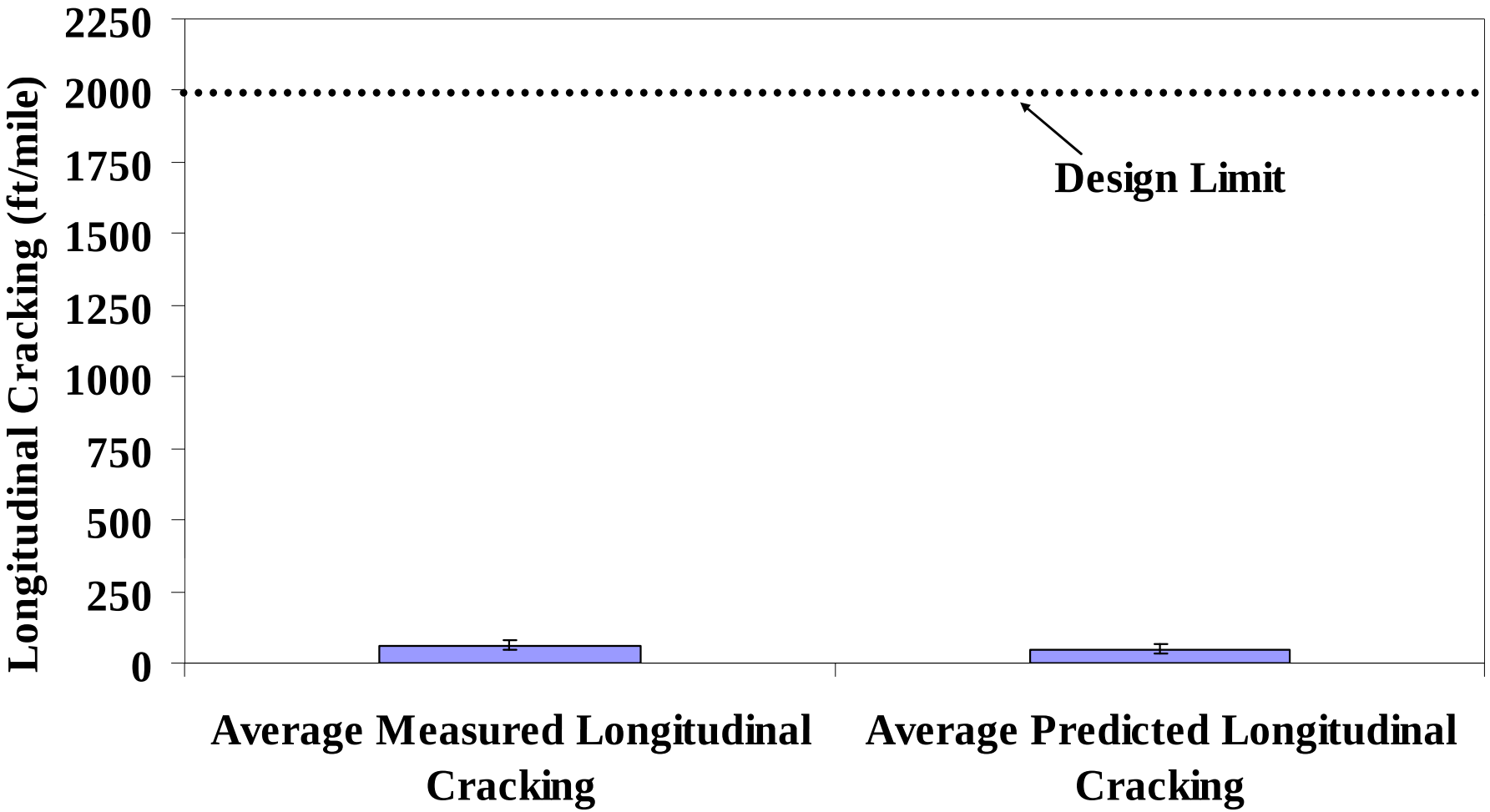
Route 95 S (6057)



Route 95 S (LTPP section 6057)
Longitudinal Cracking

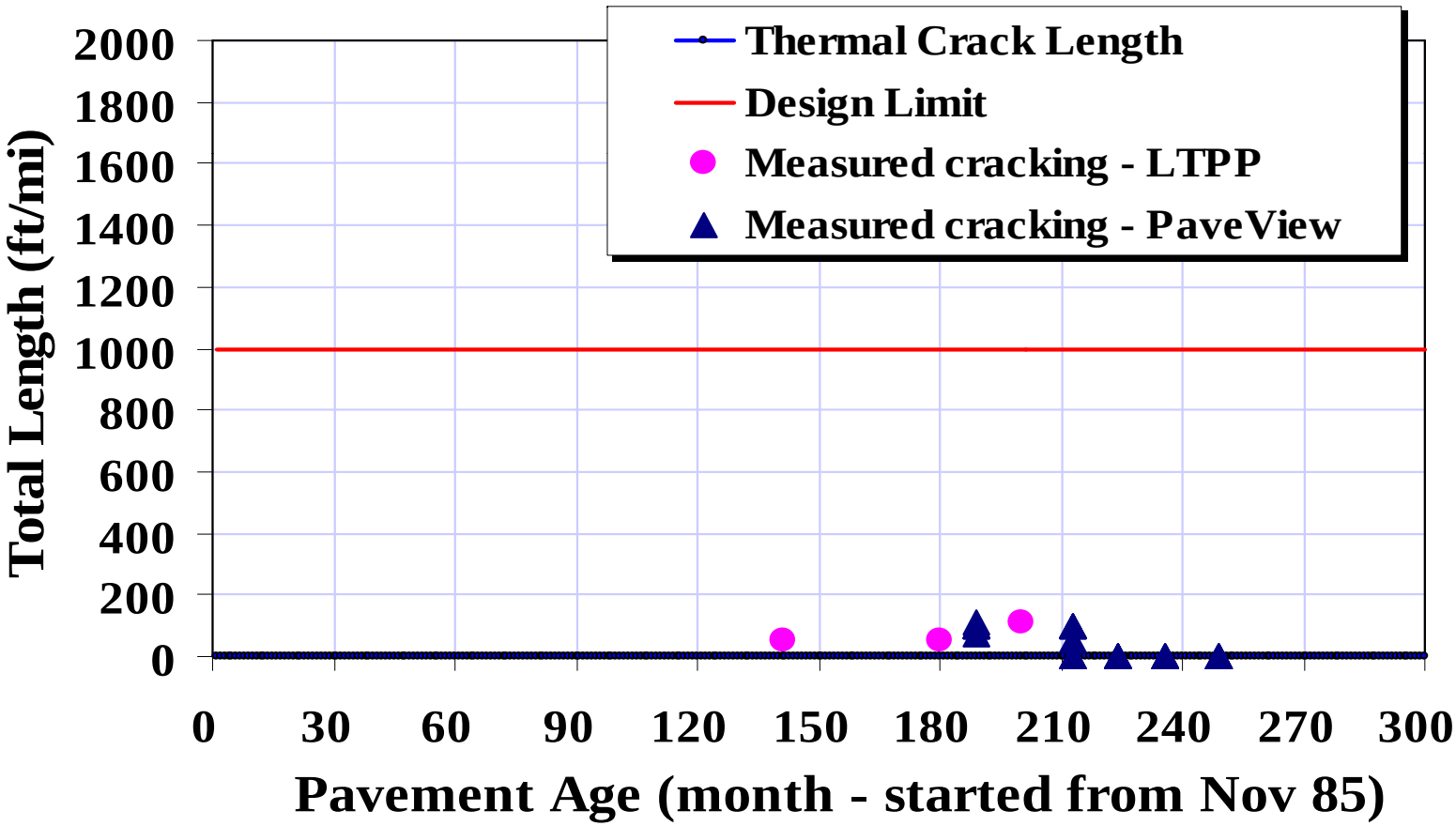


Average measured and predicted longitudinal cracking for 25 New Jersey sections

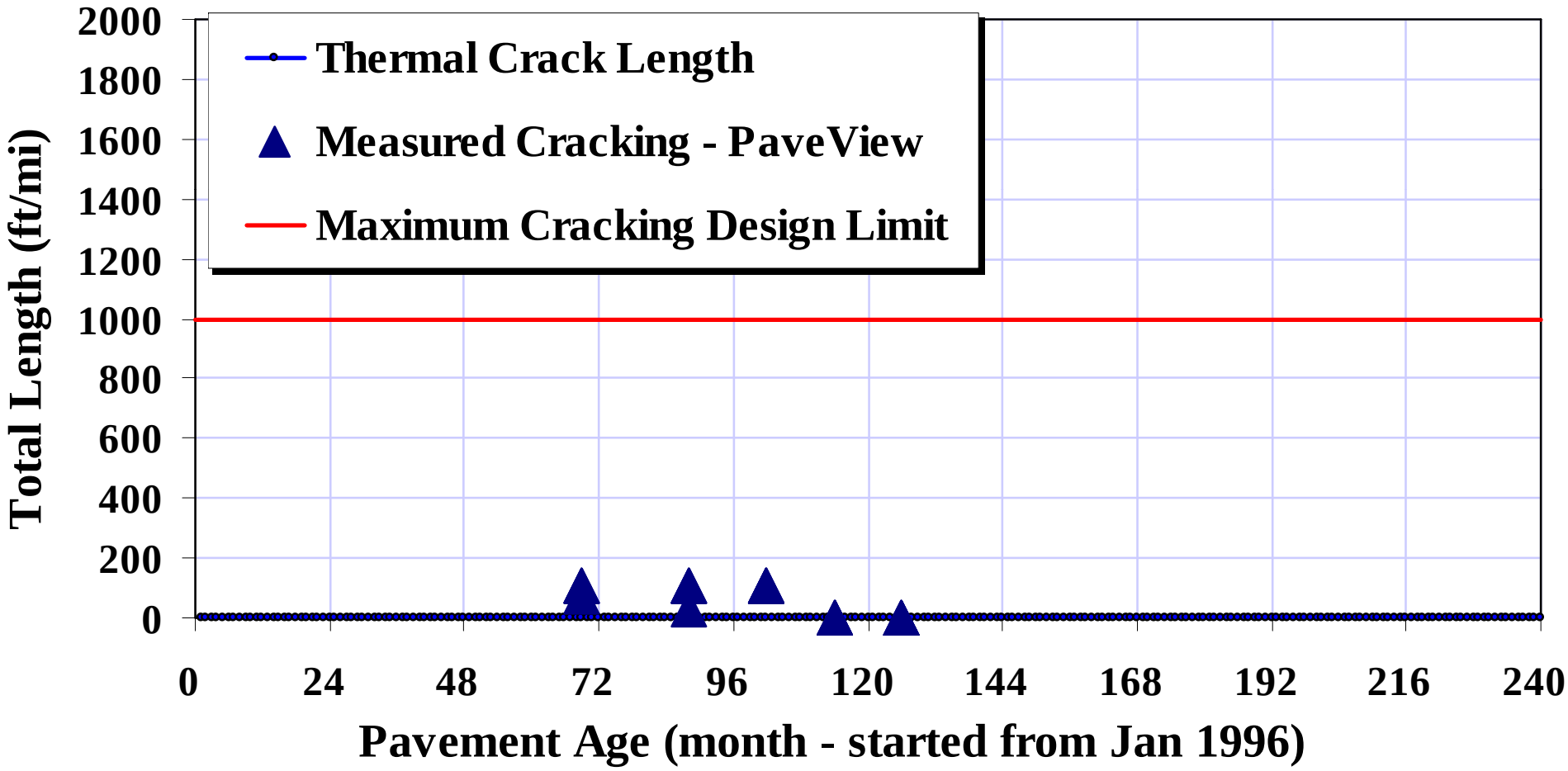


Comparison Of Measured Thermal Cracking vs. Predicted Cracking

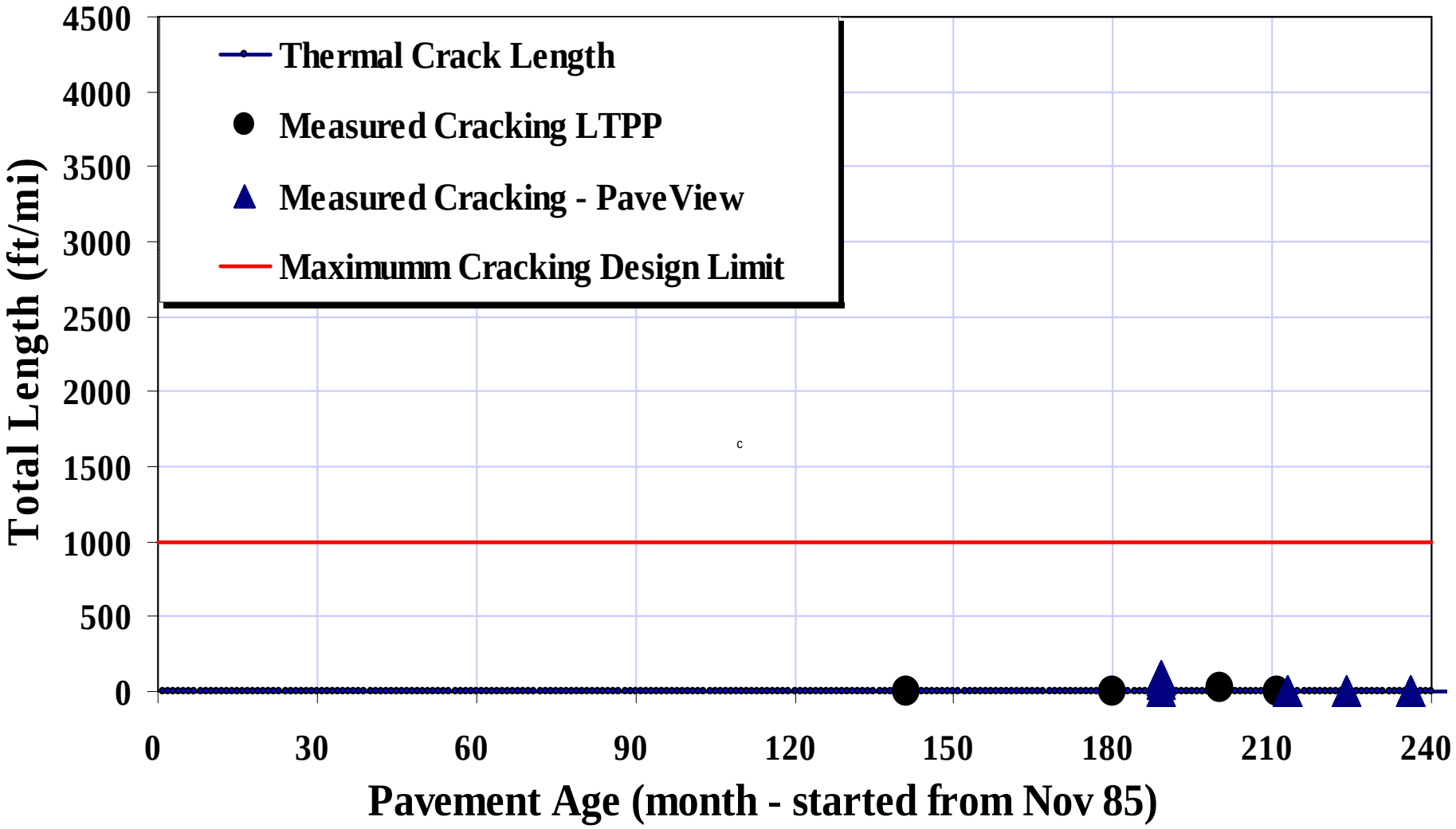
Route 55 S (1034)



Route 31 S (MP 5.9 – 6.3)



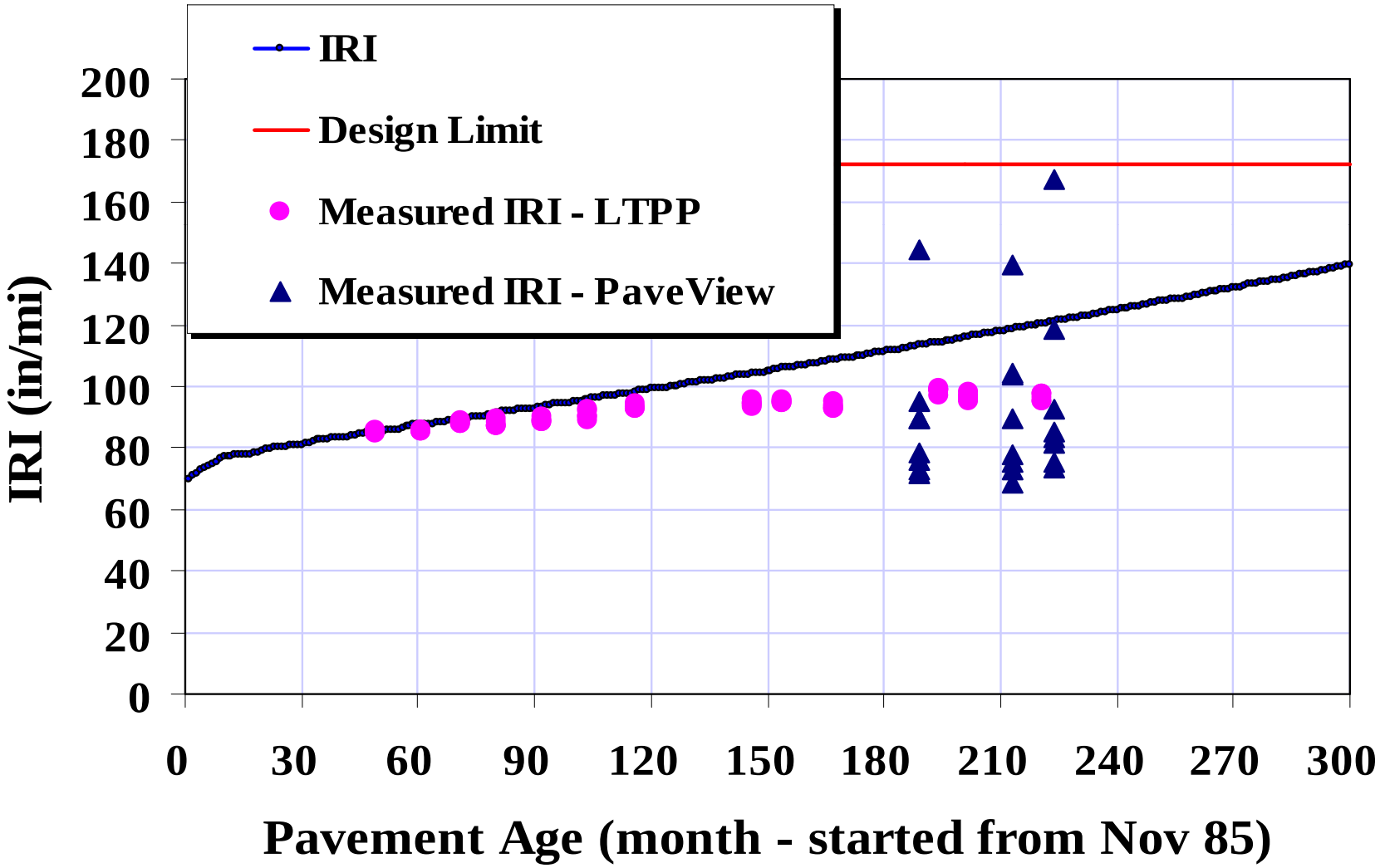
Route 55 N (LTPP section 1638)



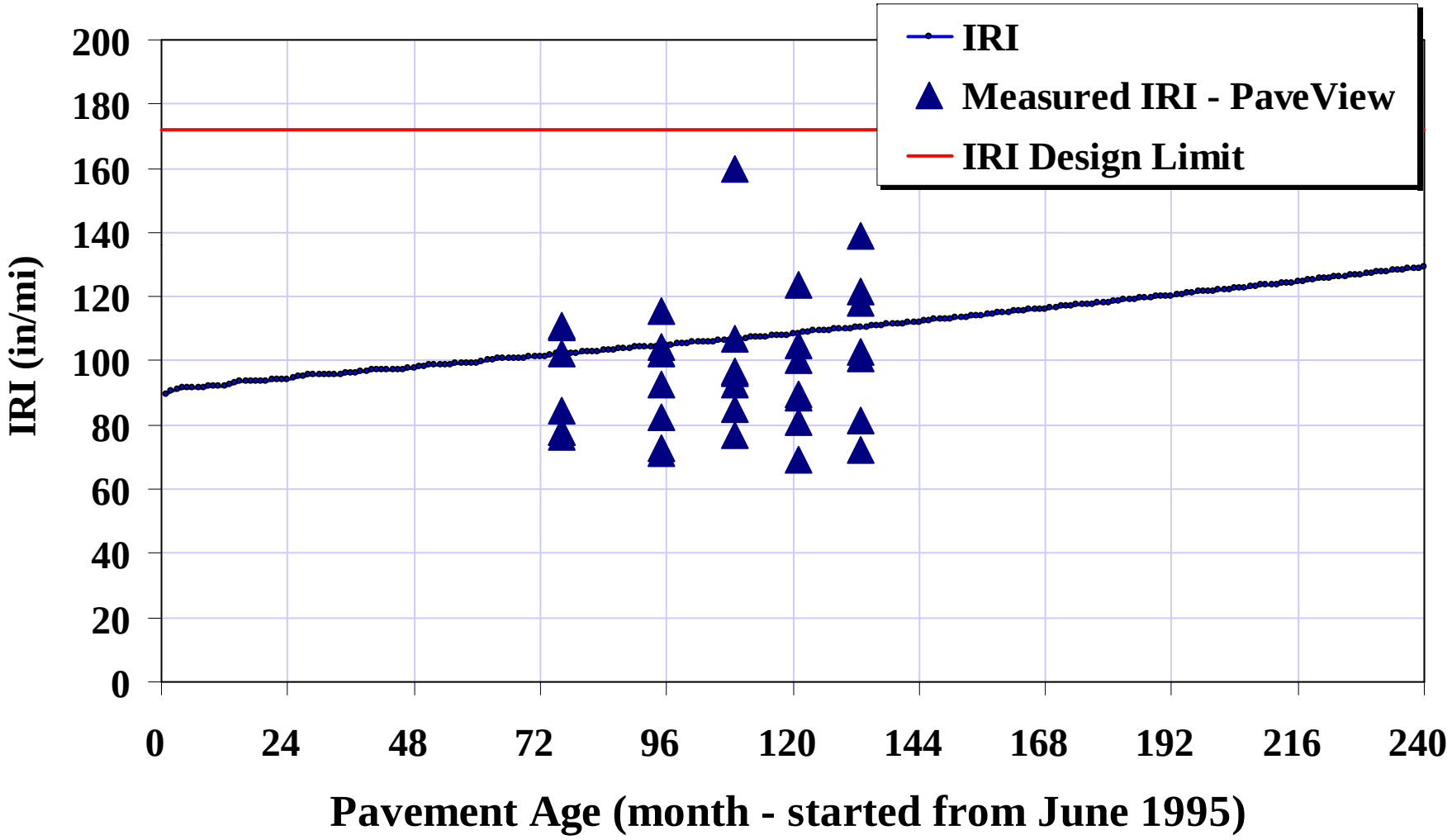
Results

Roughness

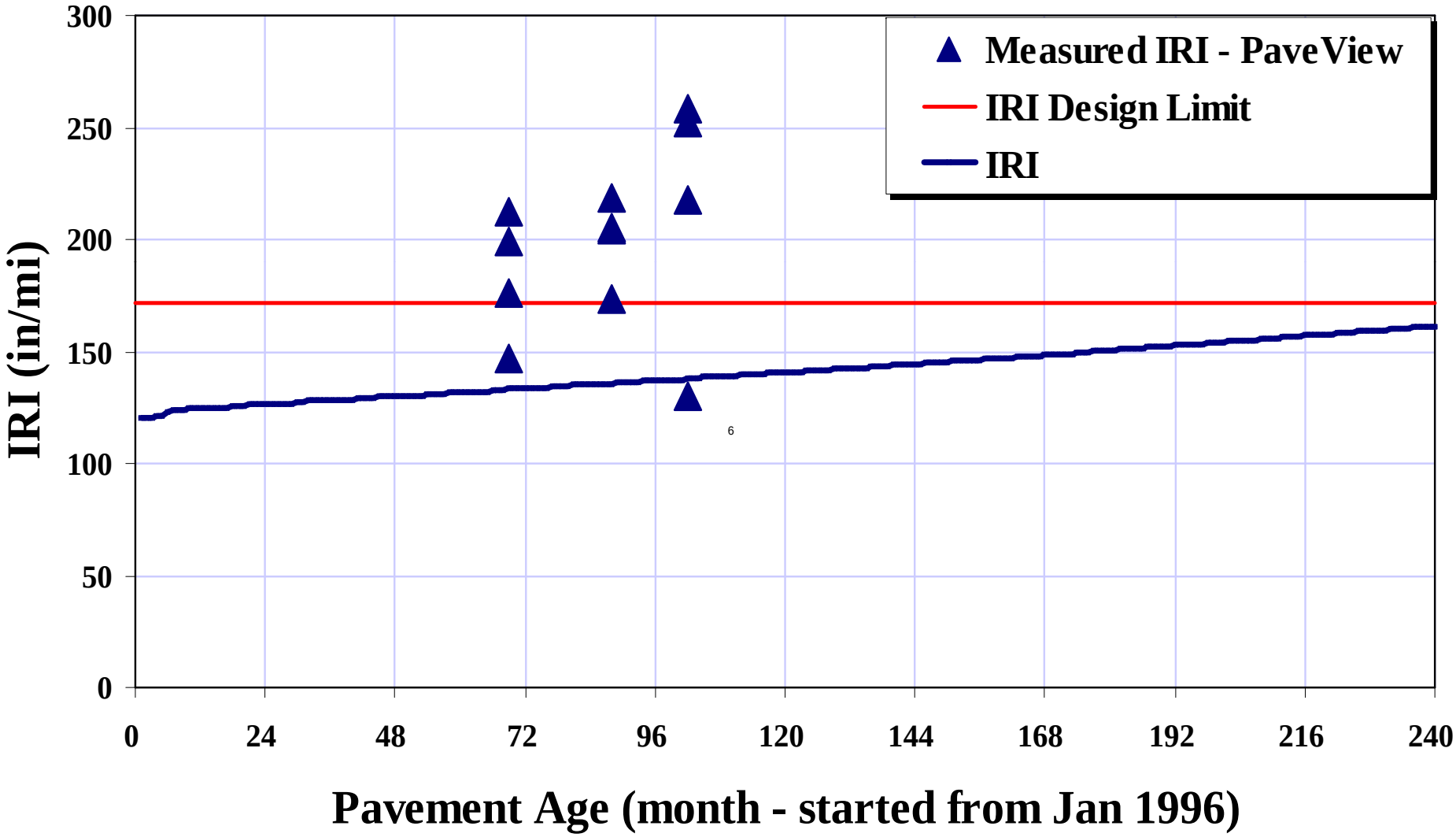
Route 55 S (1034)



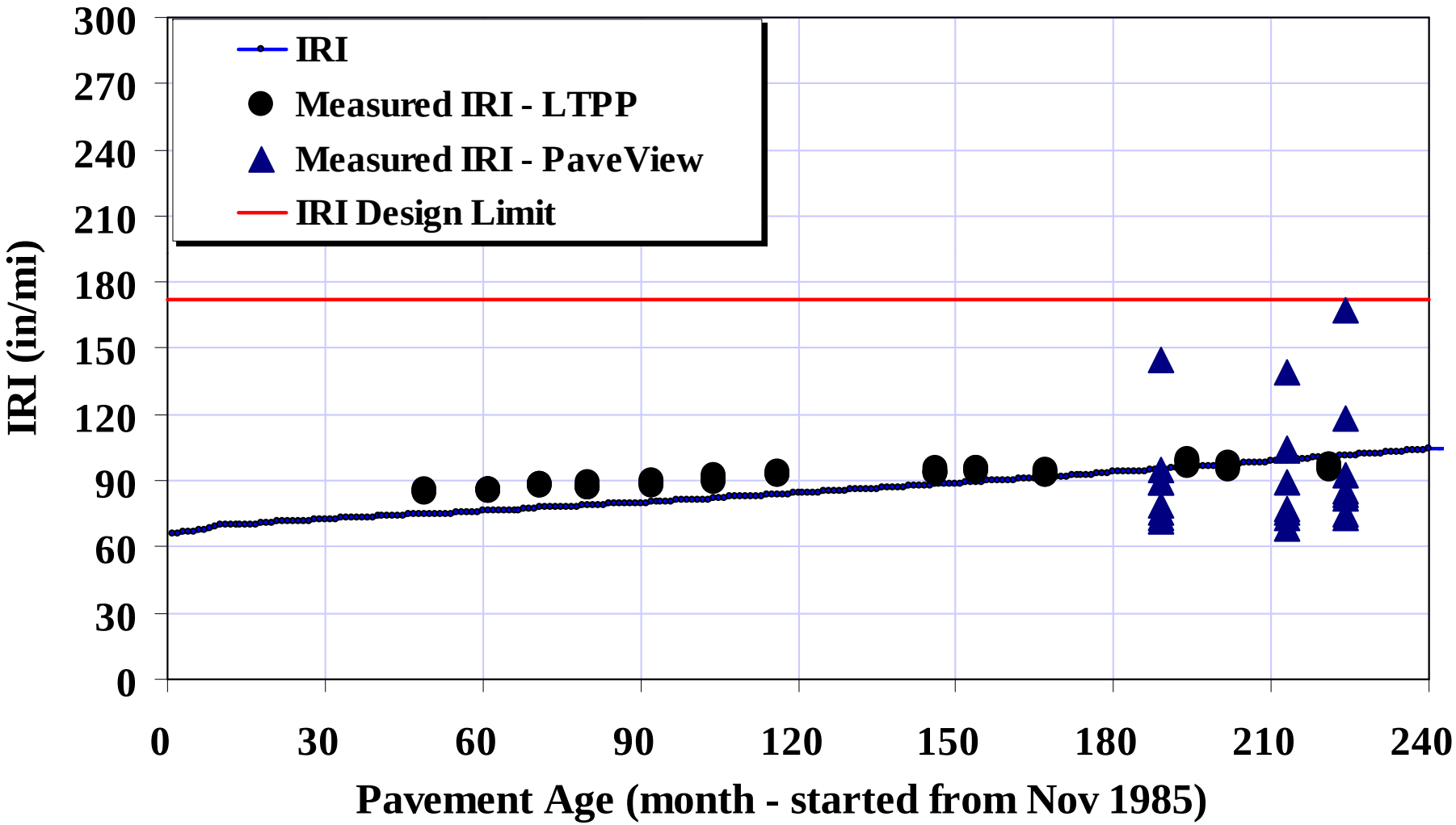
Route 31 S (MP 8.7 – 9.4)



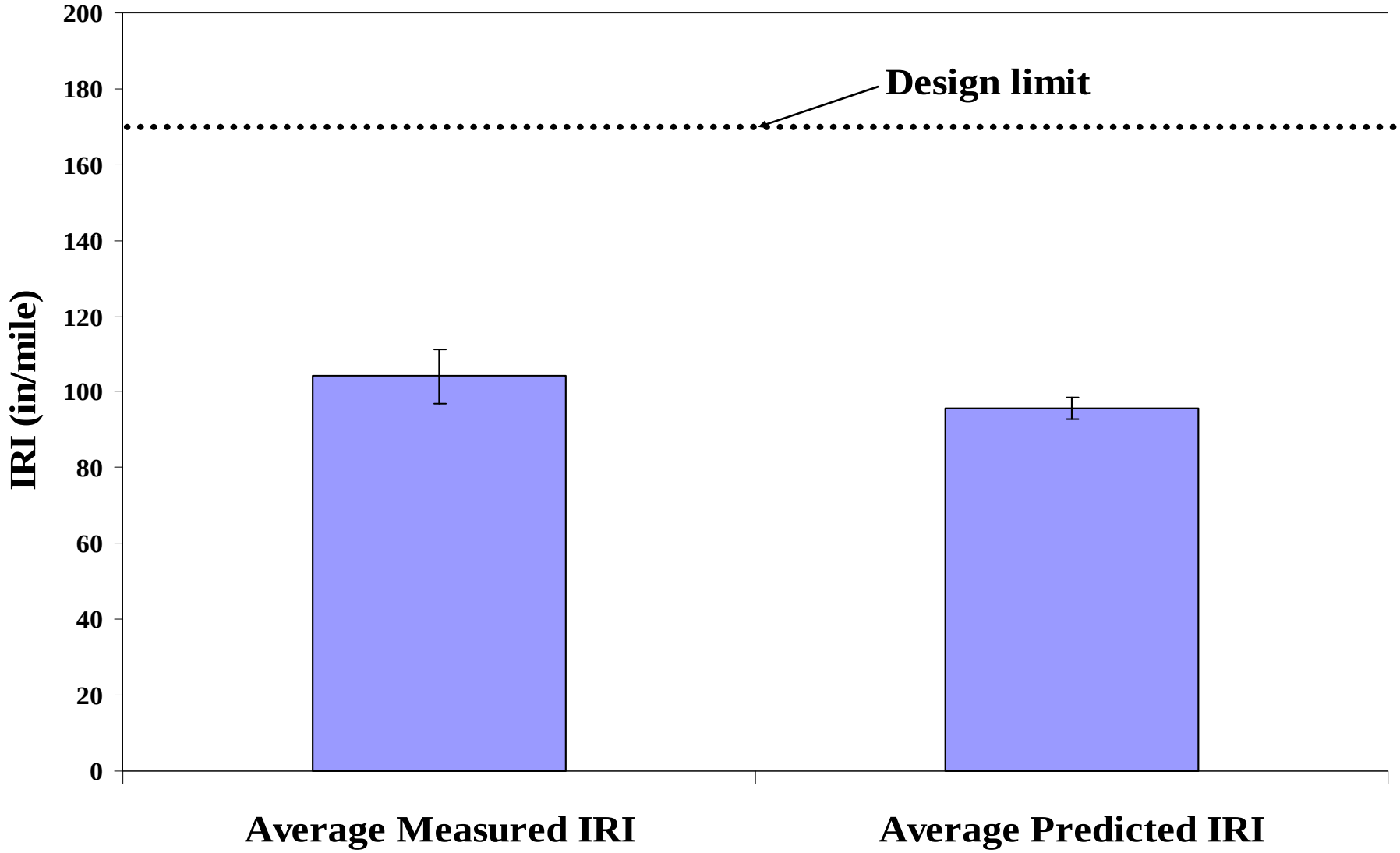
Route 31 S (MP 5.9 – 6.3)



Route 55 S (LTPP section 1034)



Measured and predicted roughness (IRI) for 25 New Jersey sections



Overall Summary

- Over prediction of rutting in the subgrade was observed in overlay construction as well as new construction.

- The measured rutting and the predicted asphalt concrete layer rutting was statistically insignificant at 95% confidence level for all analyzed sections in the state of New Jersey.

- The measured alligator cracking (average value of 2.22 %) was higher than the predicted alligator cracking (average value of 0.04%).
  - The difference between measured and predicted alligator cracking was reasonable considering the error of field measured data, and prediction error due to level 3 material input.

Overall Summary

- The measured longitudinal cracking, thermal cracking and roughness (IRI) were statistically similar to the predicted values in all the analyzed sections.

- A case-by-case comparison of performance was conducted for all sections and distresses to ensure thorough verification
  - considering the variability of measured field data,
  - incomplete input values,
  - discrepancy of data between and within sources

Conclusions

- The rutting, bottom-up fatigue (alligator cracking), top-down fatigue (longitudinal cracking), thermal cracking and roughness (IRI) predicted performance from M-EPDG is verified for level 2 traffic input and level 3 material input for the state of New Jersey.

- Through this verification study for the state of New Jersey,
  - the challenges of verification process using field measured data is demonstrated.

Conclusions

- The rutting, bottom-up fatigue (alligator cracking), top-down fatigue (longitudinal cracking), thermal cracking and roughness (IRI) predicted performance from M-EPDG is verified for level 2 traffic input and level 3 material input for the state of New Jersey.

- Through this verification study for the state of New Jersey,
  - the challenges of verification process using field measured data is demonstrated.

Recommendations

- Alligator cracking is not statistically verified for the state of New Jersey.
  - Need to evaluate the accuracy of using existing model of alligator cracking with level 2 traffic and level 3 material input for the state of New Jersey.

- Verification of the prediction models for unbound layers rutting is needed for the state of New Jersey. Recalibration of the model may be required if it fails in the verification process

Recommendations

- Default vehicle class distribution appeared to be significantly different than the regional or actual vehicle class distribution.
  - Therefore, the state of New Jersey and the other agency may not utilize default vehicle class distribution as much as possible even for level 3 analysis.

Thank you