

Analysis of the FWD Data Collected on Flexible Pavements during First Cycle of Accelerated Pavement Testing at NAPTF

Rongzong Wu, Qi Ren and John T. Harvey
University of California Pavement Research Center

Navneet Garg
FAA Technical Center

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Outline

- **Background**
- **FWD Testing Procedure and Schedule**
- **Back-Calculation Method**
- **Results and Discussions**
- **Summary and Conclusions**

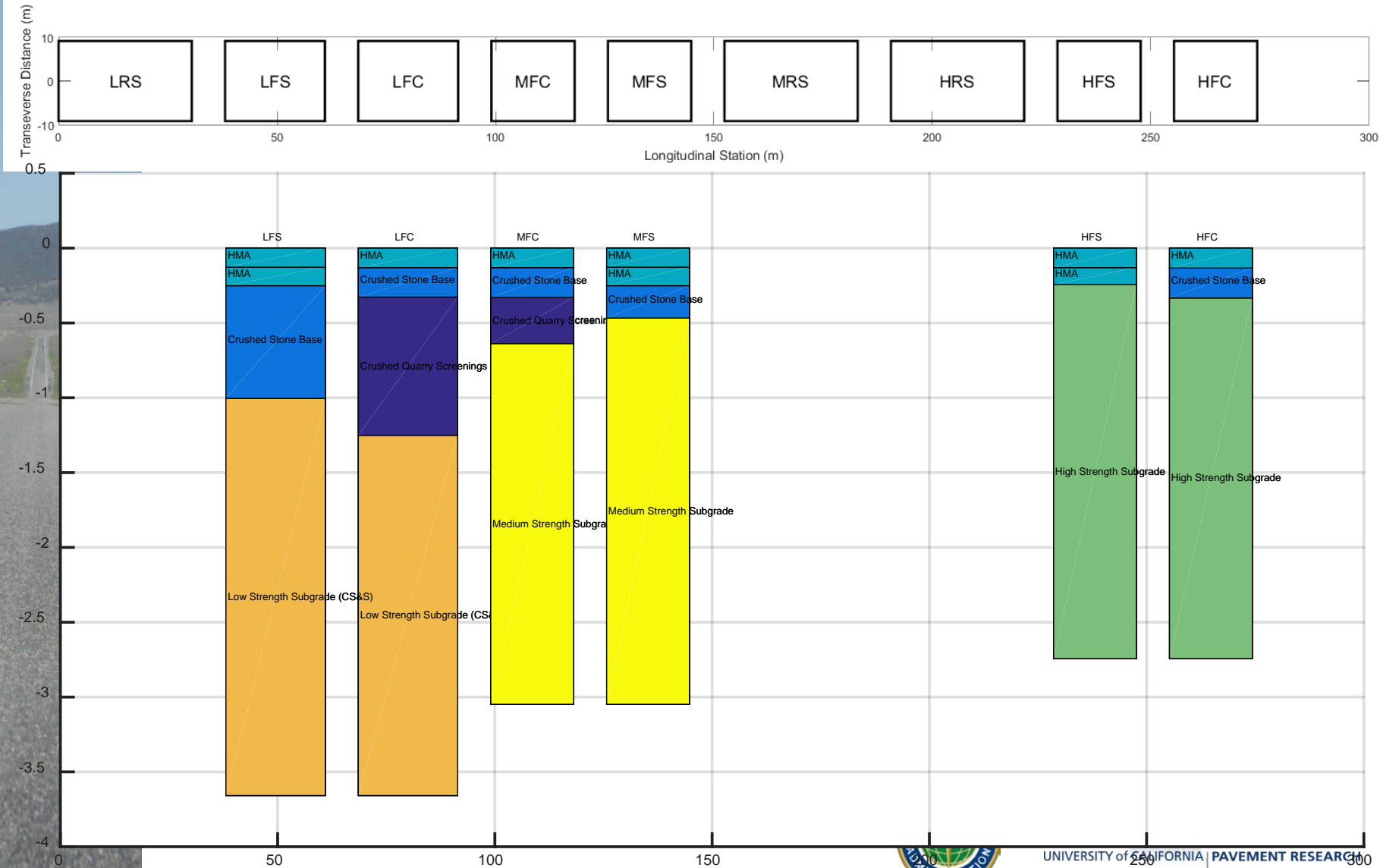


Background – The Facility

■ The Test Vehicle

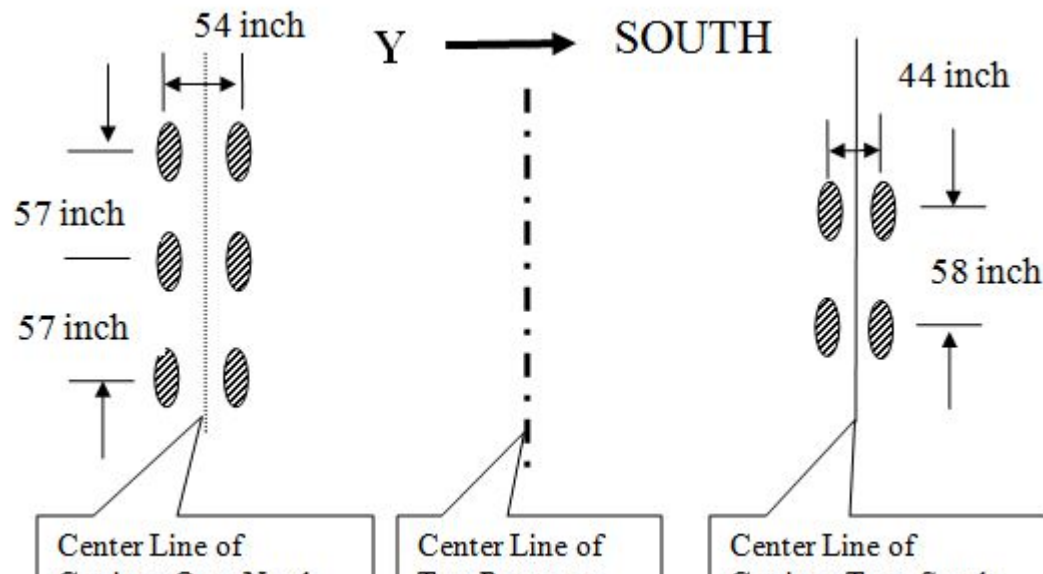


Background - Layout and Cross Section



Background – Traffic Program

- Six-wheel gear for the north half
- Four-wheel gear for the south half
- Wheel load history
 - 45 kips (200kN) for 20,000 passes
 - 65 kips (289kN) for the next 30,000 passes



FWD Testing – Schedule and Layout

■ Uniformity Tests

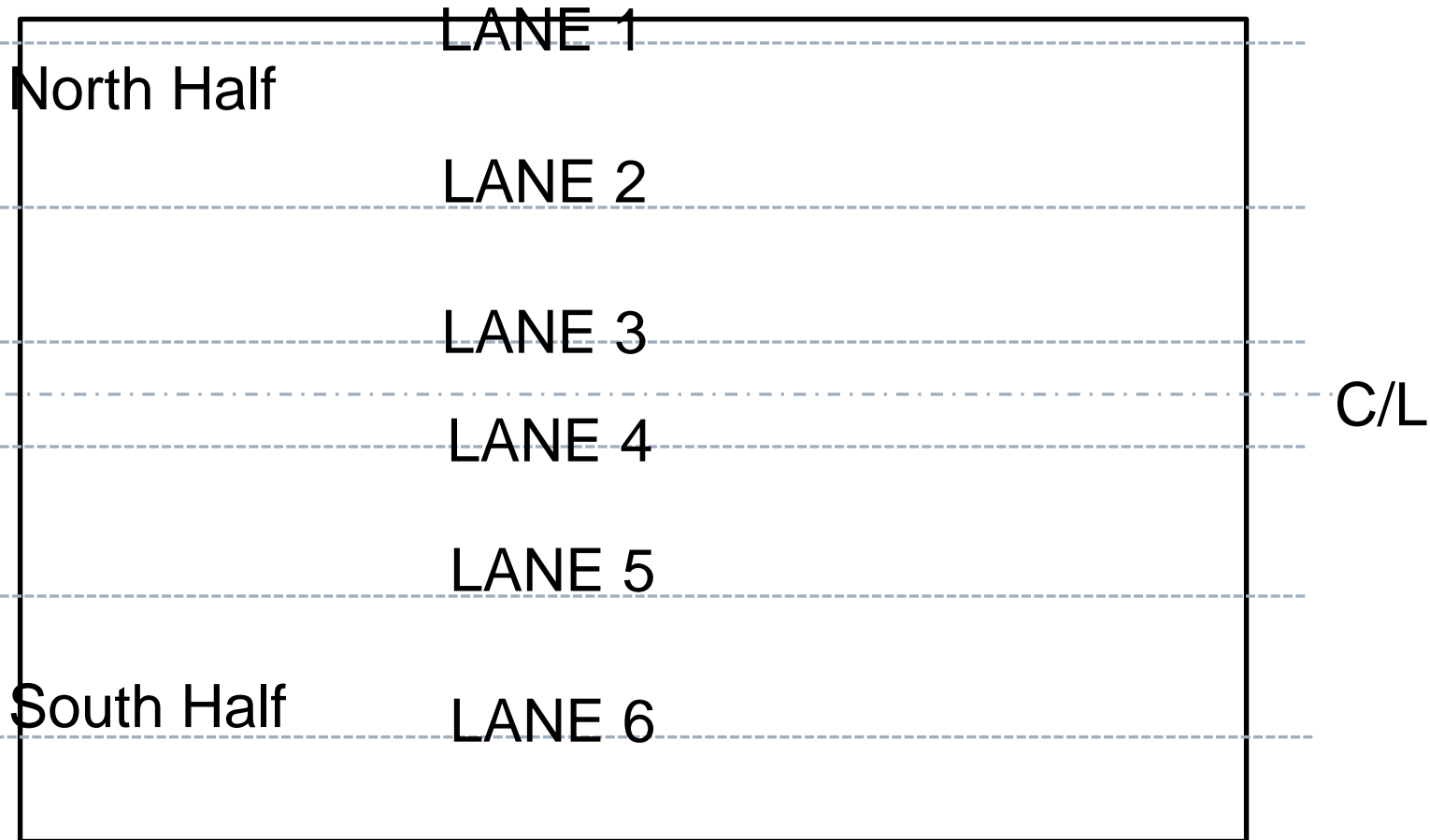
- 10 ft x 10 ft grid
- 8 months before trafficking

■ Routine Tests

- Three lines:
 - North and south wheelpaths
 - Centerline of the test track
- Every now and then during trafficking



FWD Testing Lines



FWD Back-calculation Procedure

- **Three layer system**
 - Combine HMA layer
 - Combine AB and ASB layer
 - Bedrock below thick subgrade except for two layer pavements
- **Multi-layer elastic theory**
- **Kalman Filter based search algorithm**
- **Matching measured deflections by adjusting layer stiffness**

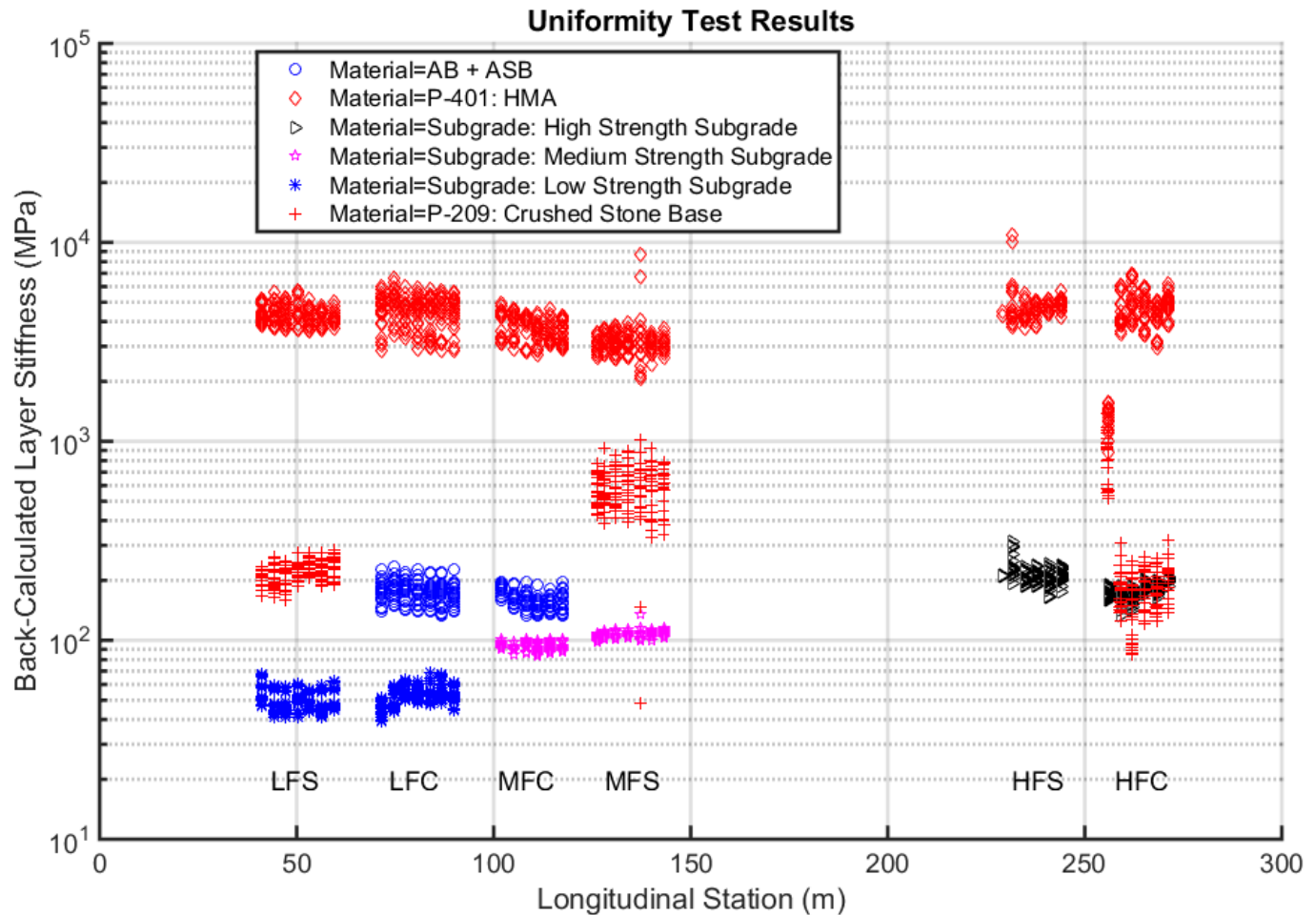


Results and Discussions

- **Overall layer stiffness shortly after construction**
- **Effect of Temperature and Age on HMA stiffness**
- **Comparison of back-calculated and estimated stiffness master curves**
- **Effect of traffic on stiffness**
 - HMA layer
 - Base layer
 - Bas + subbase combined layer
 - Subgrade



Overall Layer Stiffness – Chart

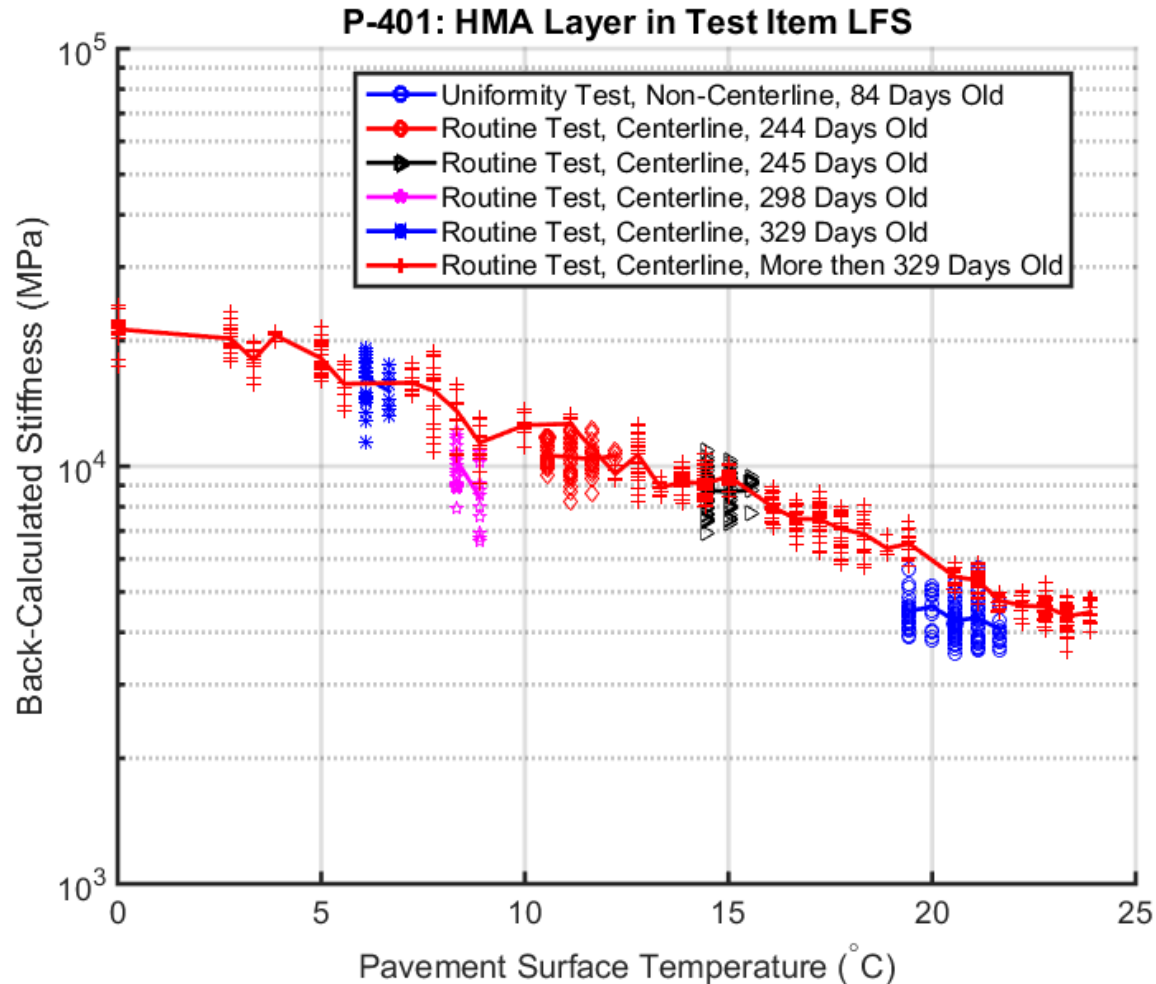


Overall Layer Stiffness - Numbers

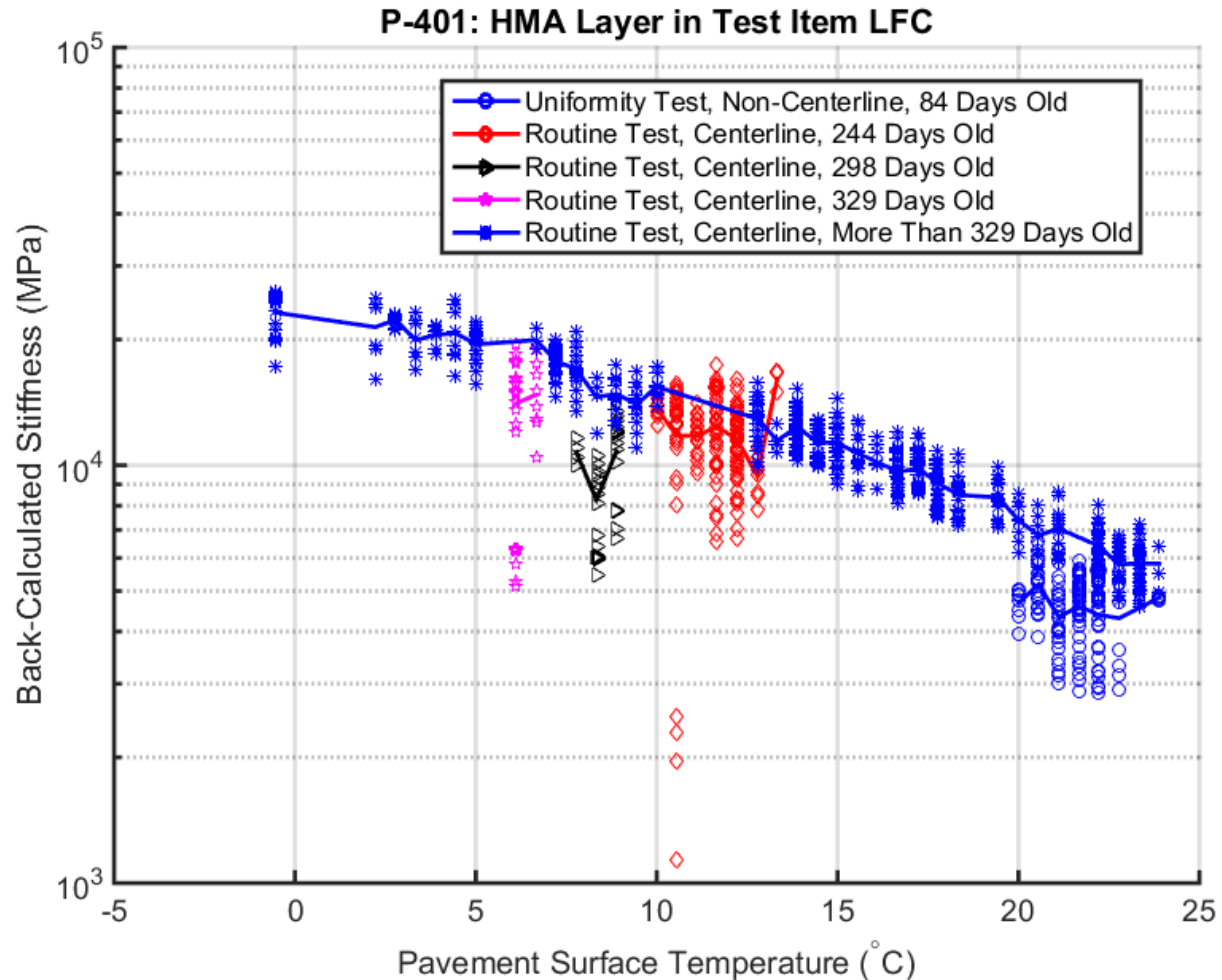
Test Item ID	P-401: HMA	P-209: Crushed Stone Base	AB + ASB	Subgrade
LFS	4,326 (0.11)	219 (0.12)		50 (0.12)
LFC	4,558 (0.18)		176 (0.12)	52 (0.11)
MFC	3,783 (0.14)		161 (0.10)	93 (0.05)
MFS	3,166 (0.19)	584 (0.25)		106 (0.04)
HFC	4,683 (0.18)	182 (0.26)		179 (0.09)
HFS	4,759 (0.20)			215 (0.11)



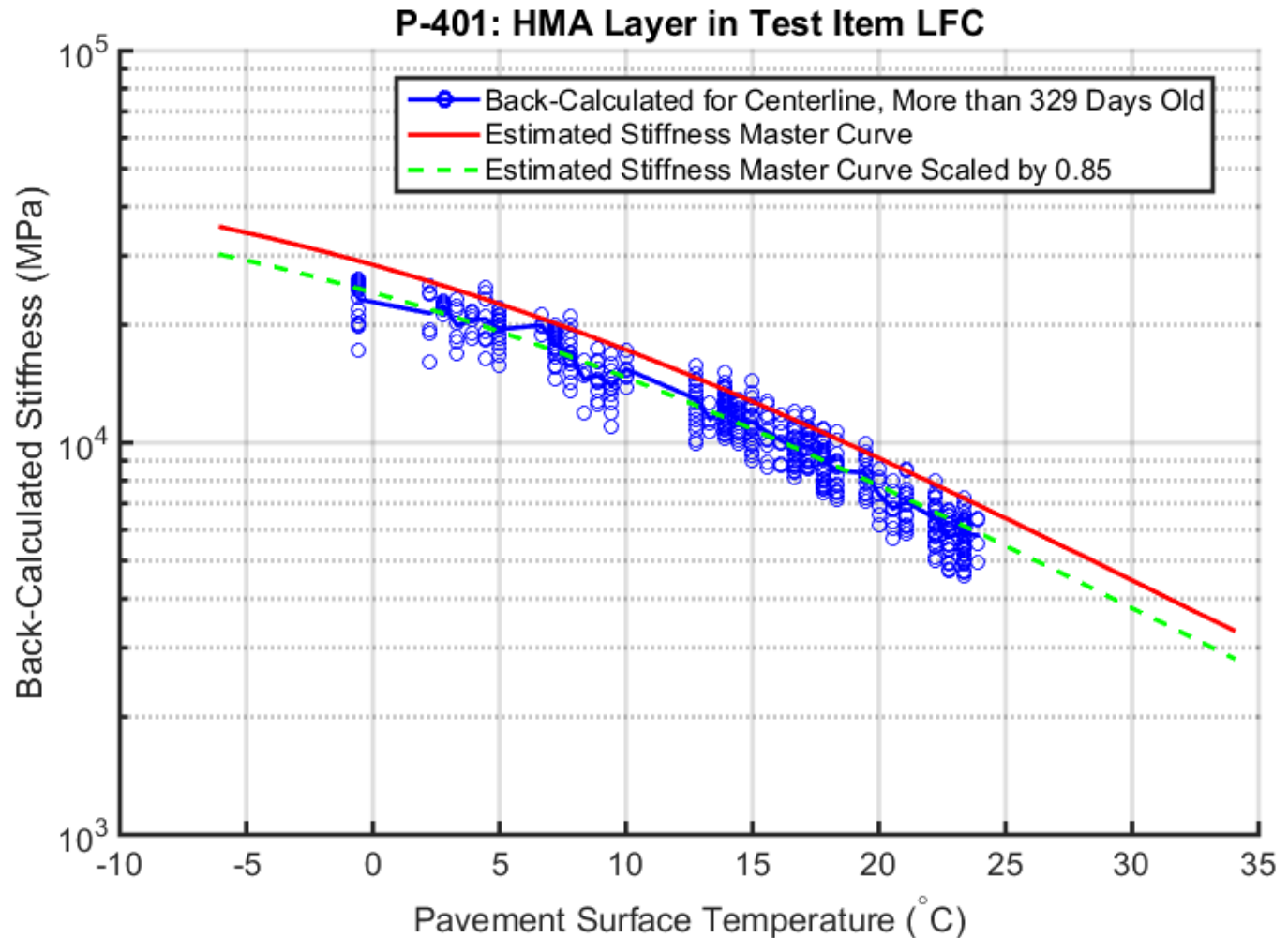
Effect of Temperature and Aging on HMA Stiffness – LFS



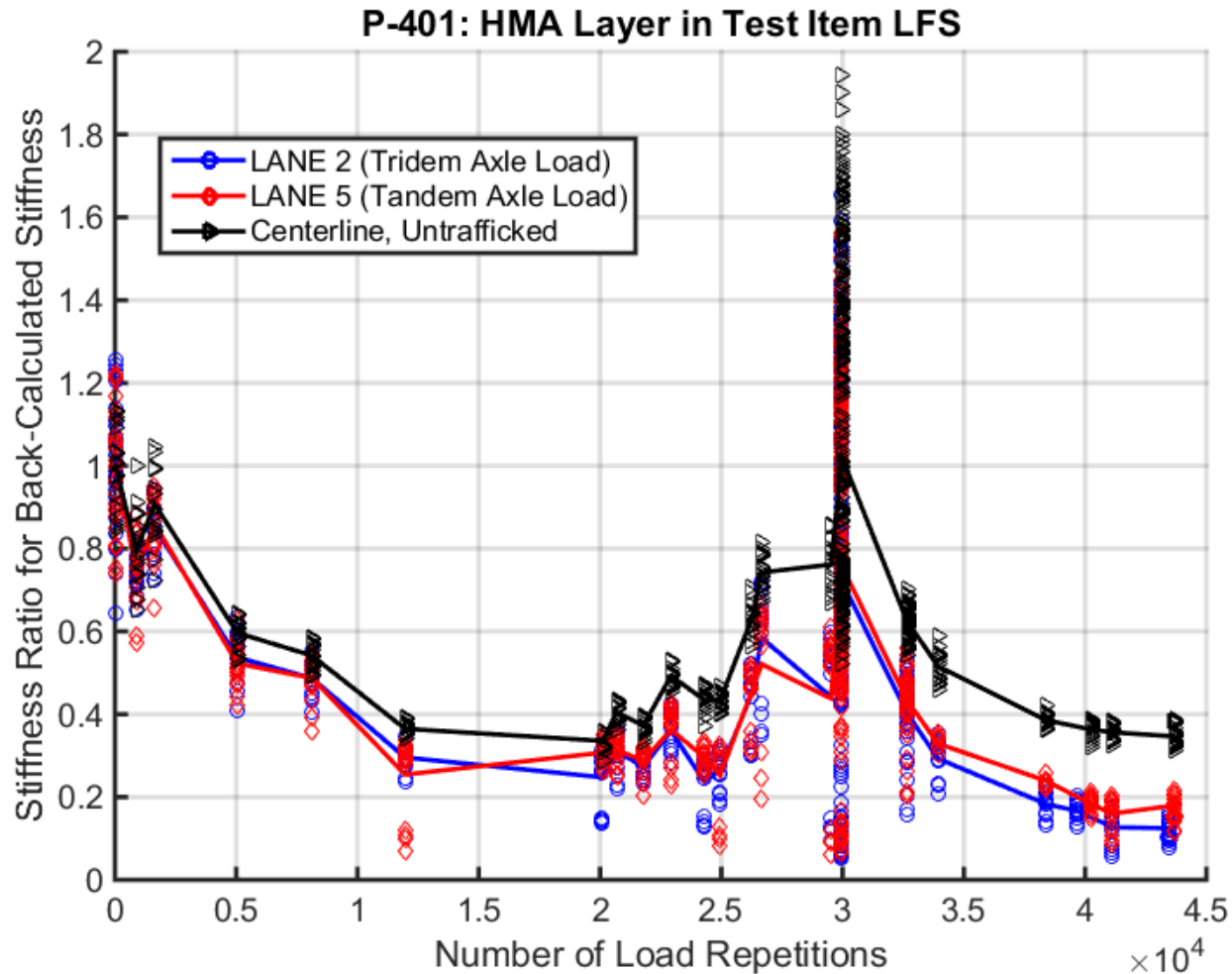
Effect of Temperature and Aging on HMA Stiffness – LFS



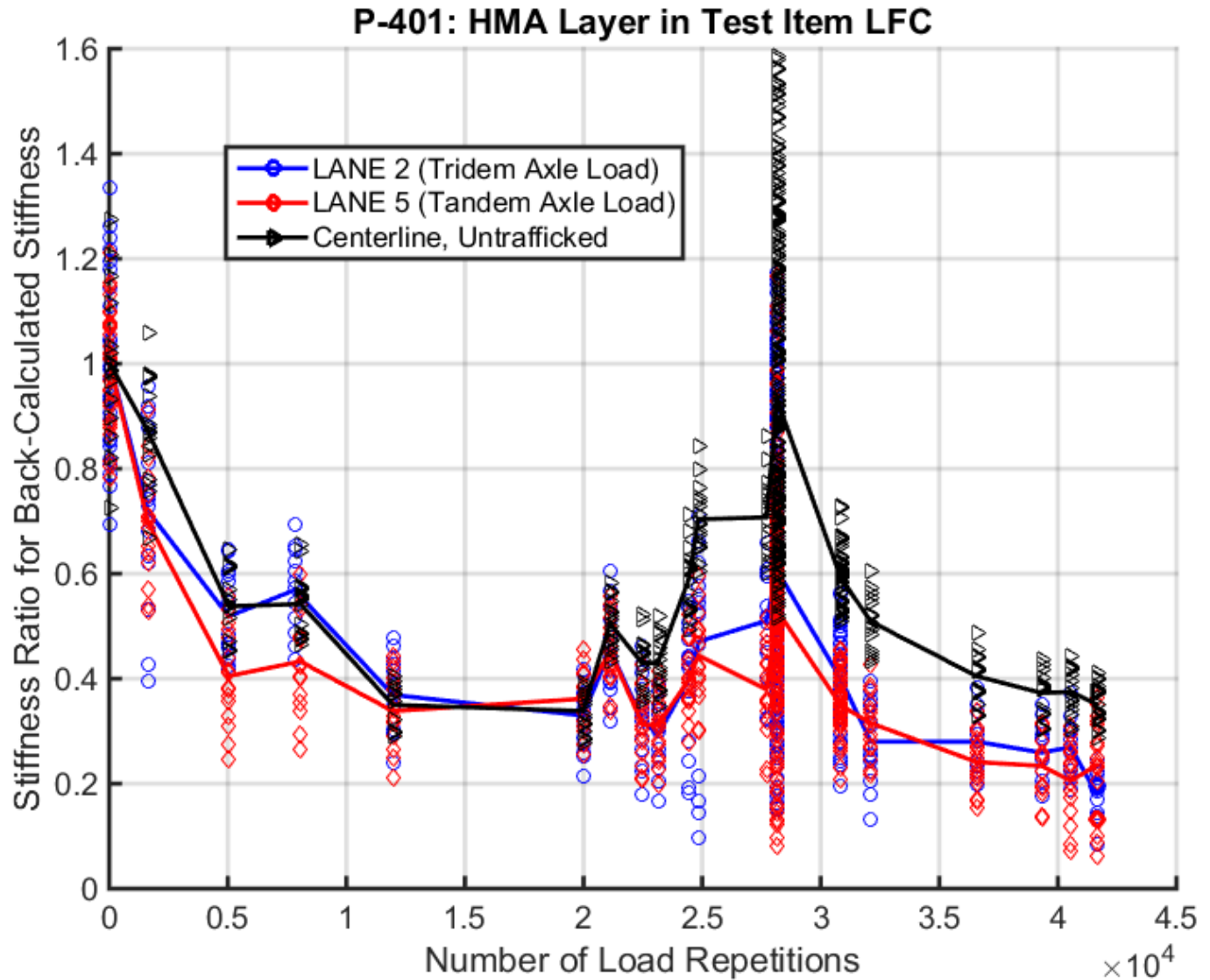
Comparison of Stiffness Master Curves



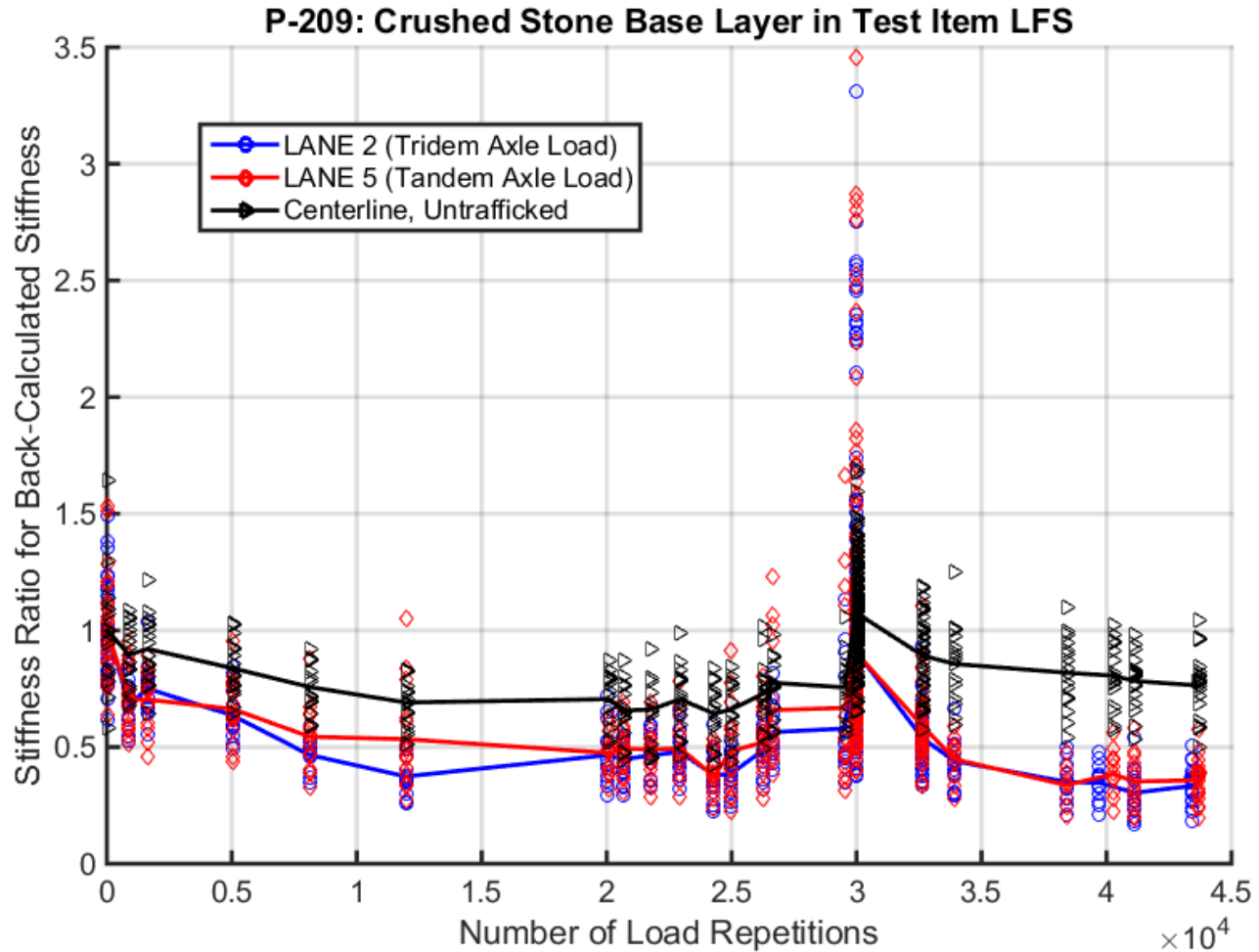
Effect of Traffic on HMA Stiffness - LFS



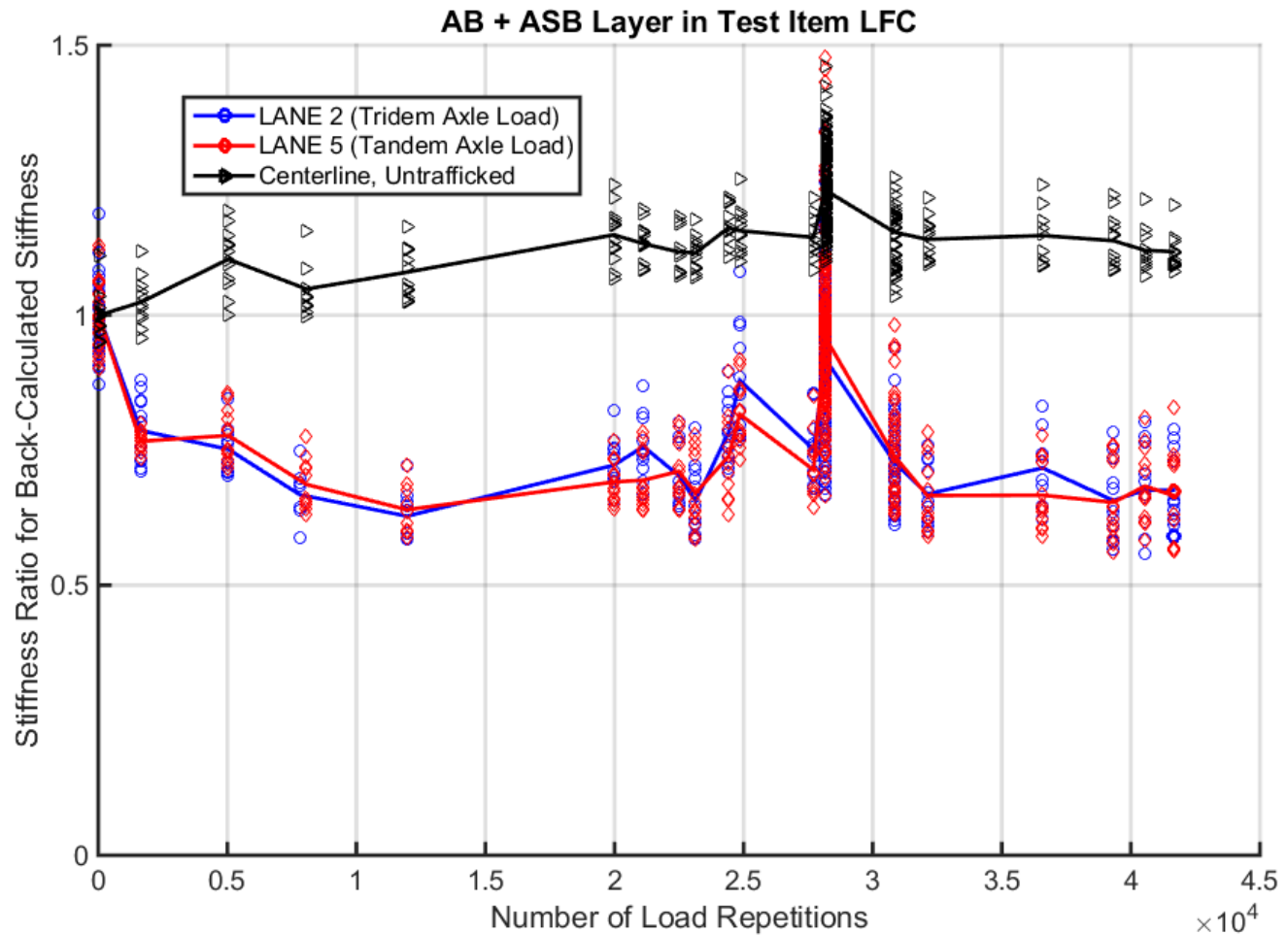
Effect of Traffic on HMA Stiffness - LFC



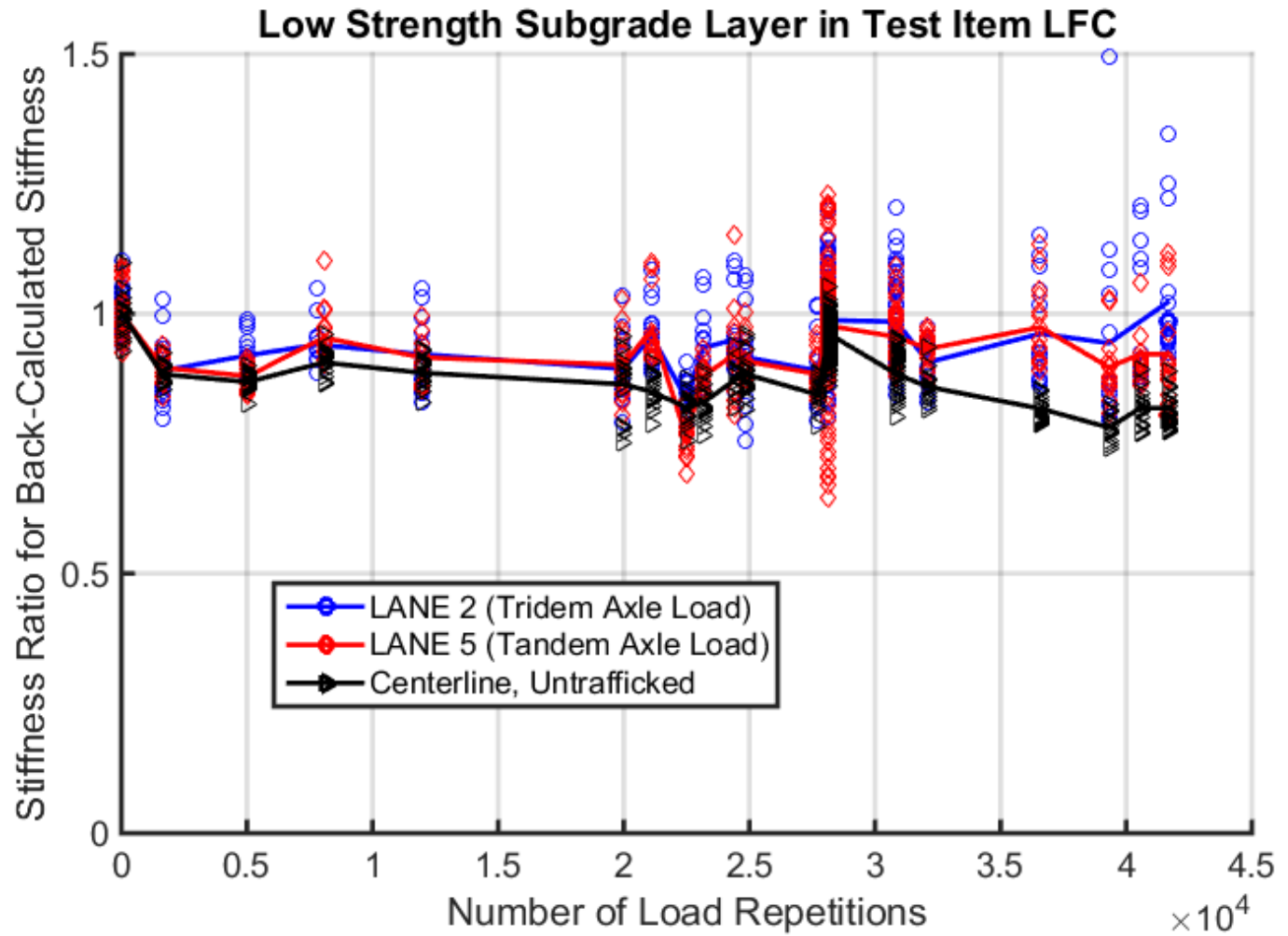
Effect of Traffic on Base Stiffness - LFS



Effect of Traffic on Base + Subbase Stiffness - LFC



Effect of Traffic on Subgrade Stiffness - LFC



Observations

- **Subgrade stiffnesses are strongly correlated to CBR values.**
- **Aging did occur in the first year but very little afterwards**
- **Temperature effect on HMA stiffness can be predicted from mix design data**
- **Effect of APT trafficking**
 - Softening for HMA, crushed stone base, crushed stone base and aggregate subbase combined layer.
 - Stiffening for low strength subgrade



Recommendations

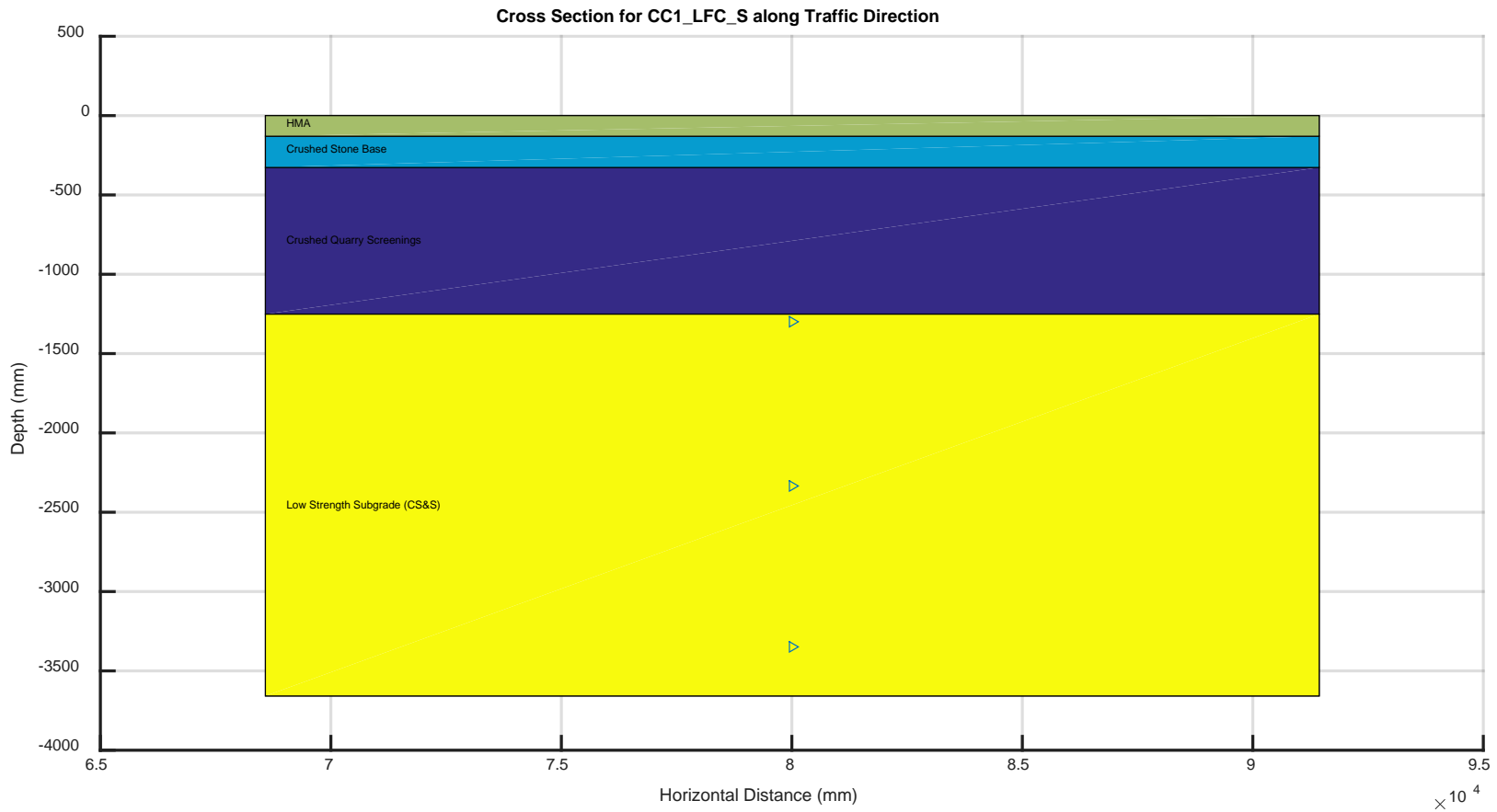
- **FWD data needs to be extensive to allow trend identification**
- **May need to account for material deterioration or strengthening when predicting pavement performance**
- **Temperature effect of HMA can be estimated from mix design**



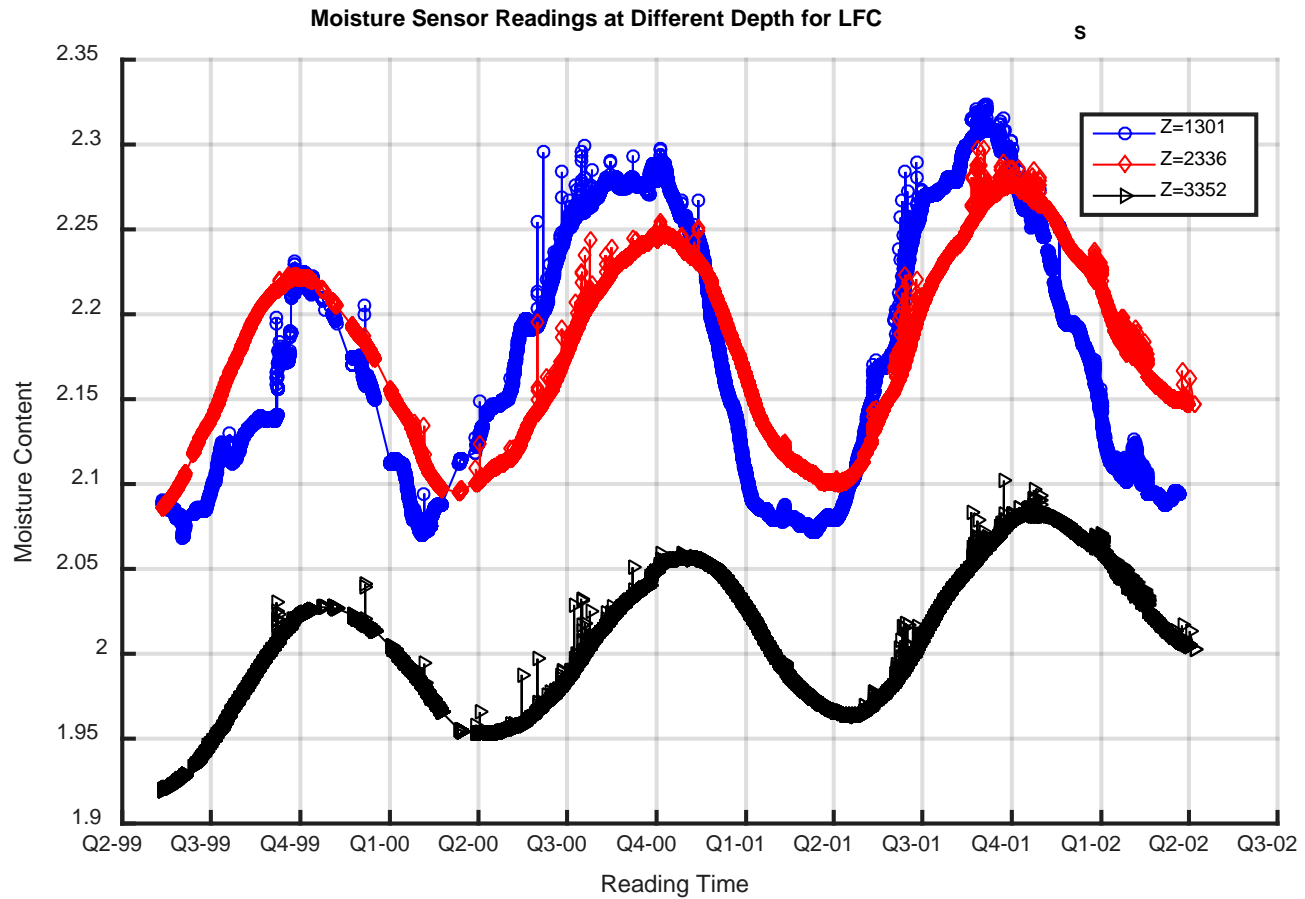
Questions?



Moisture Sensors in LFC



All Moisture Readings



Subgrade Moisture Content Change While Trafficking - LFC

