Geosynthetics /Construction Cycle 9

Presented to: REDAC

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Date: March 4, 2020

FAA Reauthorization Act of 2018

H.R.4 of the 115th Congress –
FAA Reauthorization Act of 2018

Received May 8, 2018

Signed October 5, 2018

540 pages

AN ACT: To reauthorize programs of the Federal Aviation Administration, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled

Title V - Miscellaneous

SEC. 558. GEOSYNTHETIC MATERIALS.

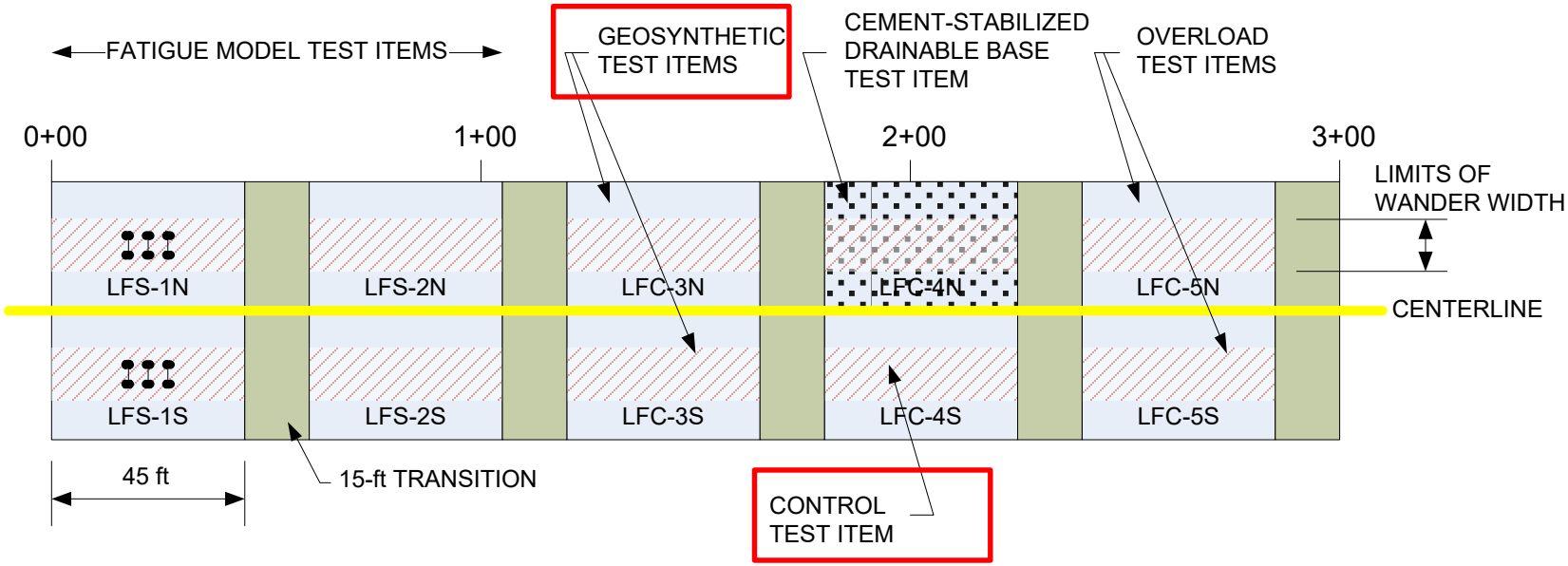
The Administrator of the Federal Aviation Administration, to the extent practicable, shall encourage the use of durable, resilient, and sustainable materials and practices, including the use of geosynthetic materials and other innovative technologies, in carrying out the activities of the Federal Aviation Administration.

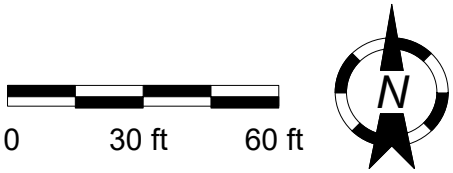
Construction Cycle 9 - Asphalt

Objectives

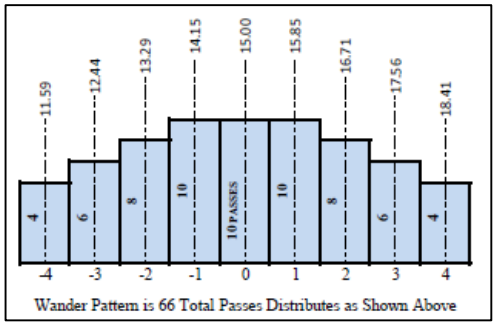
- Verify/Refine/Modify fatigue model based on the ratio of dissipated energy change (RDEC)
- Effect of P-209 Layer Thickness on Pavement Life
- ***Effect of Geosynthetics use on Flexible Pavement Performance***
- Cement Treated Permeable Base Performance
- Strain Criterion for Allowable Overload

Construction Cycle 09 Layout

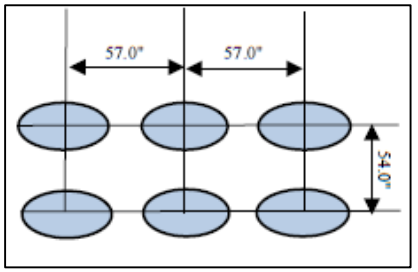




Standard NAPTV Wander Pattern



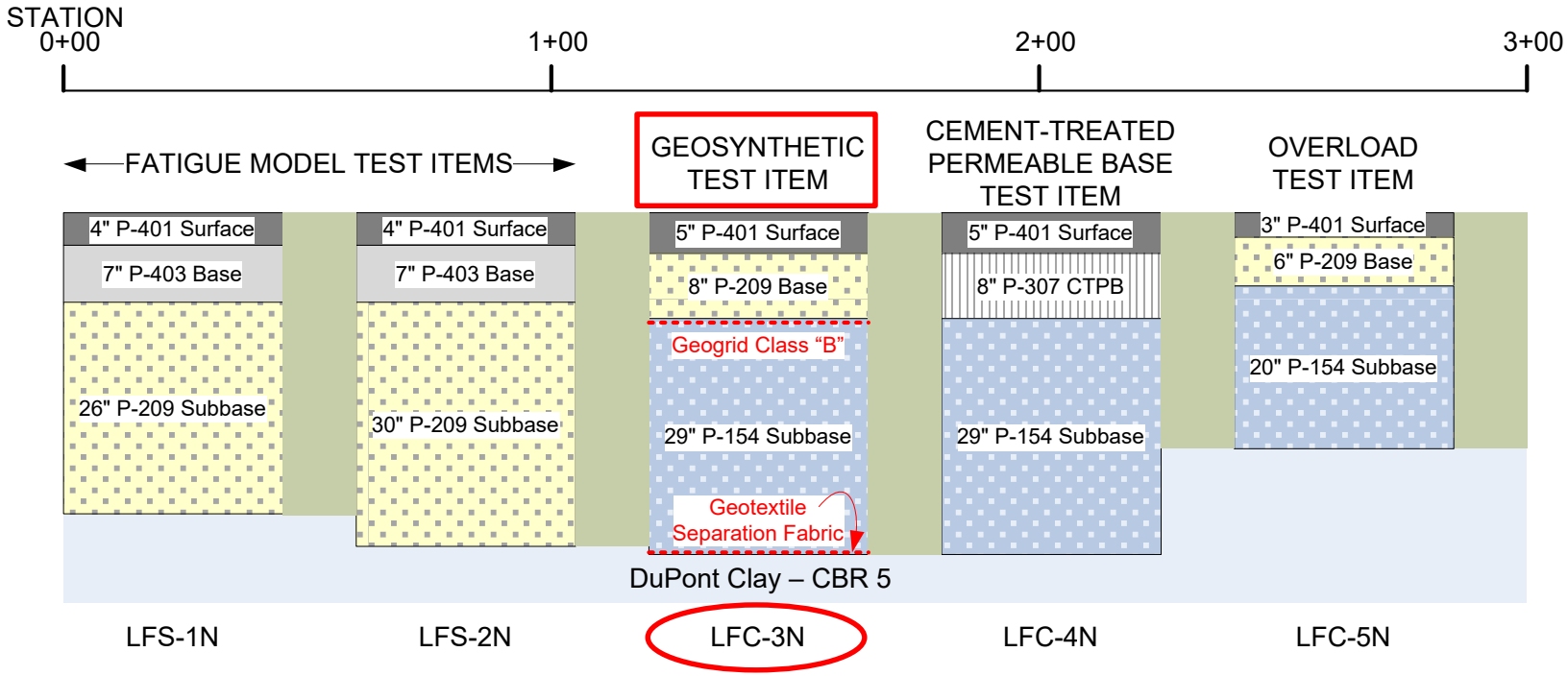
Standard NAPTV Gear Configuration 58,000 lbs/wheel



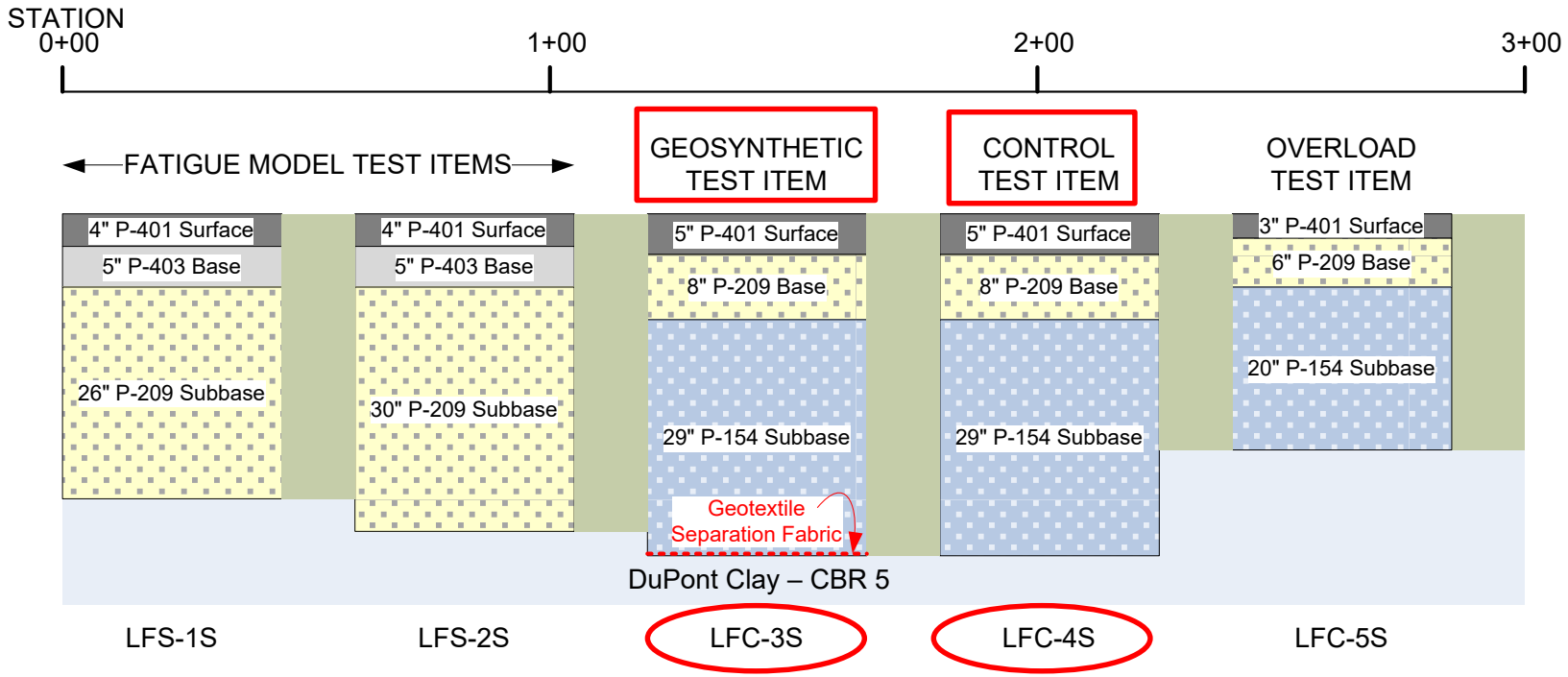
Design Failure Passes (FAARFIELD 1.4)

Test Item	Experiment	Gear Load	Failure Passes
LFS-1N	Fatigue Model	58,000 lb. 3D	5,870
LFS-1S	Fatigue Model	58,000 lb. 3D	2,250
LFS-2N	Fatigue Model	58,000 lb. 3D	38,860
LFS-2S	Fatigue Model	58,000 lb. 3D	13,010
LFC-3N	***Geosynthetic***	***58,000 lb. 3D***	***> 1,230 (unknown)***
LFC-3S	***Geosynthetic***	***58,000 lb. 3D***	***> 1,230 (unknown)***
LFC-4N	CTPB	58,000 lb. 3D	3,090
LFC-4S	**Control**	**58,000 lb. 3D**	**1,230**
LFC-5N	Overload	36,000 lb. D	27,000
LFC-5S	Overload	36,000 lb. D	27,000

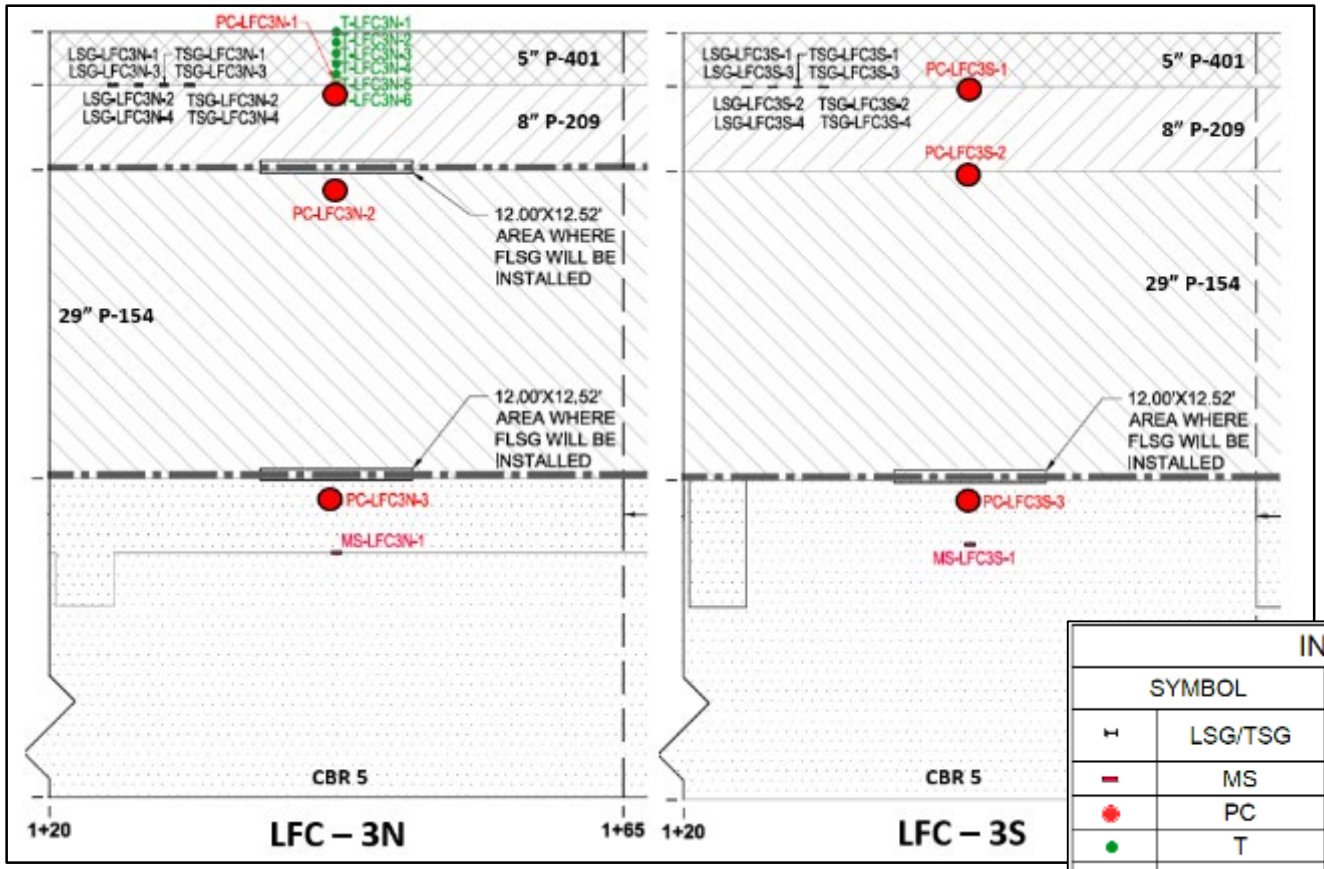
CC9 North
Longitudinal Cross Section



CC9 South
Longitudinal Cross Section



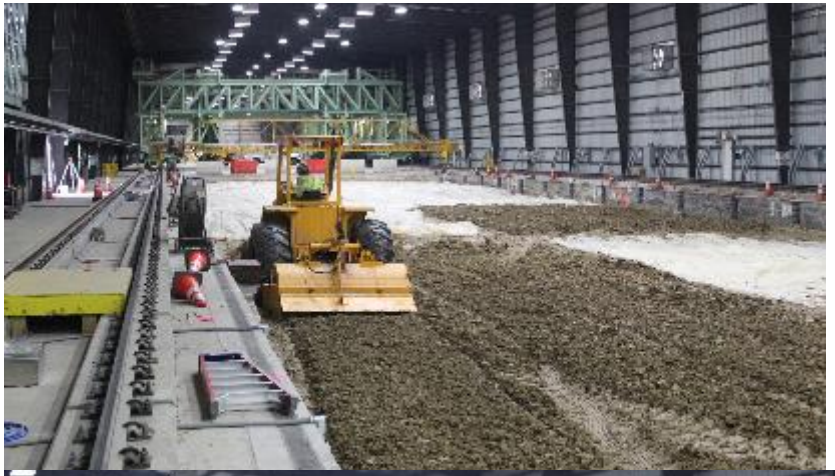
CC9 Geosynthetic Instrumentation Layout

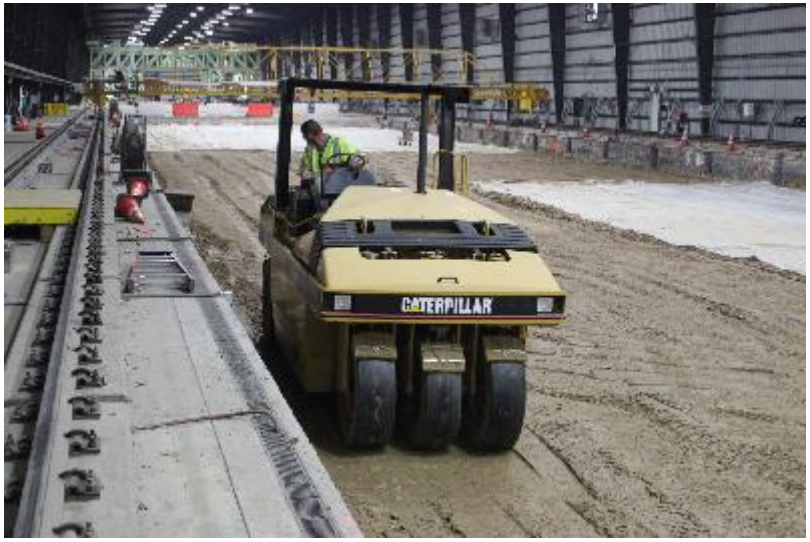


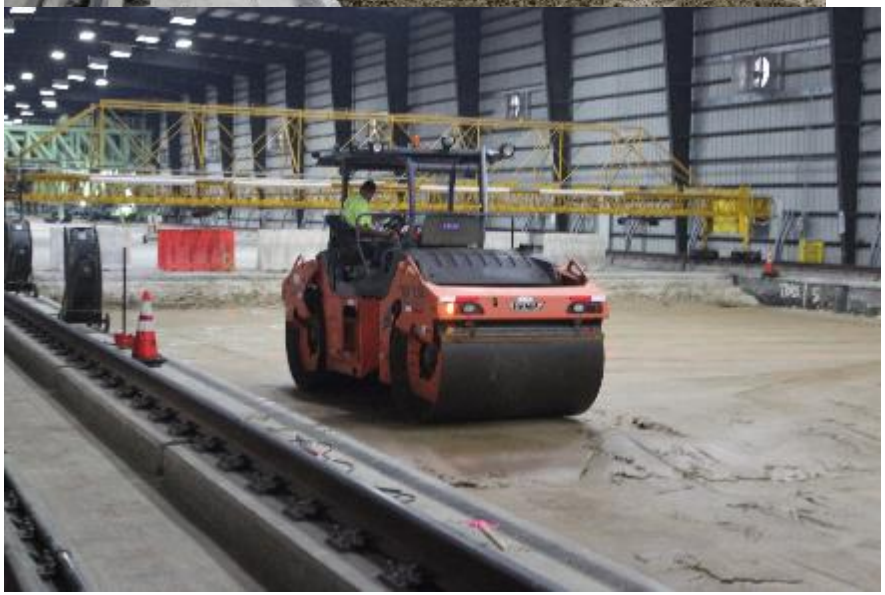
Potential Additional Sensors:

INSTRUMENT KEY		
SYMBOL		SENSOR TYPE
⊢	LSG/TSG	LONGITUDINAL/TRANSVERSE ASPHALT STRAIN GAUGE
–	MS	MOISTURE SENSOR
●	PC	9" PRESSURE CELL
●	T	THERMOCOUPLE
•	FLSG	FOIL STRAIN GAUGE

CC9 Construction-Subgrade





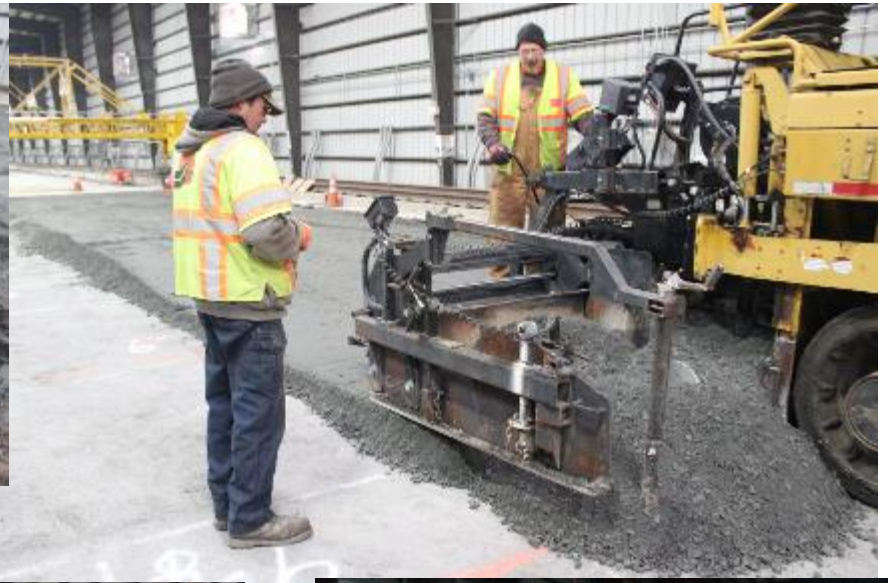


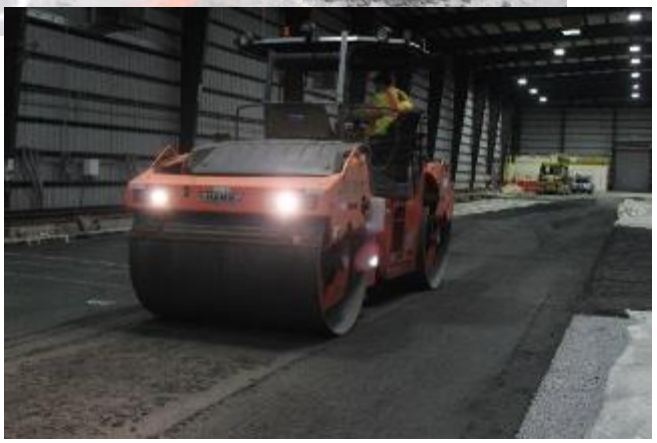
CC9 Construction-Geofabric

CC9 Construction-Subbase

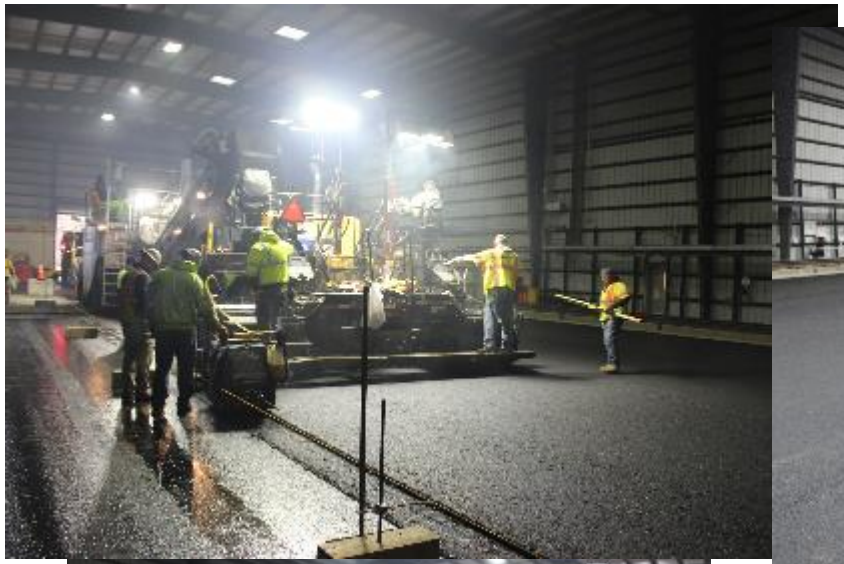
CC9 Construction- Geogrid

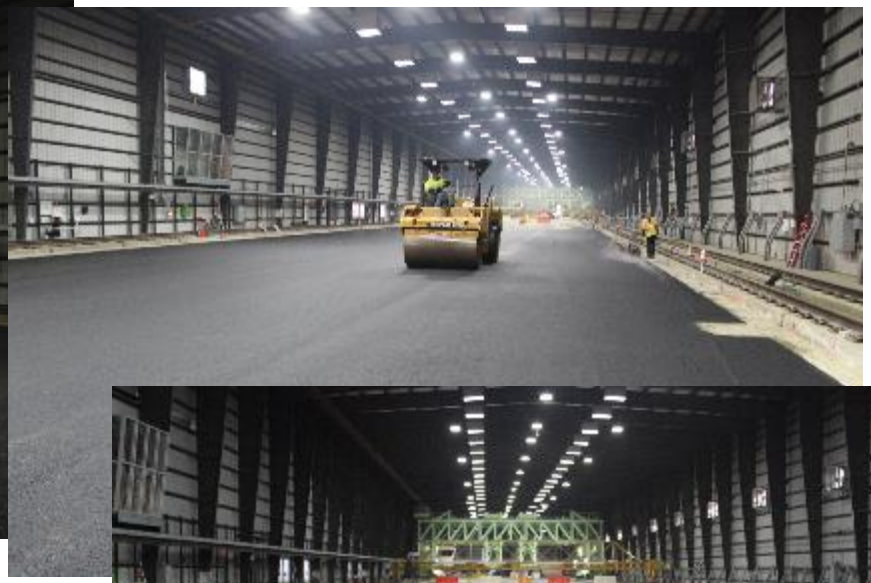
CC9 Construction-Base

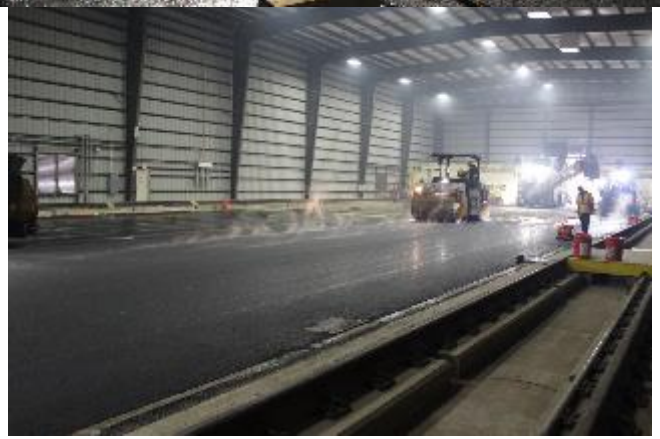




CC9 Construction -Paving







Definition of Failure-
Flexible Pavement

- Flexible Pavement Structural Design Life
  - Default "structural design life" is for 20 years
  - Indicates pavement performance in terms of allowable load repetitions (coverages) before failure is expected.
  - Design failure criteria is 1-inch upheaval in the subgrade ie. shear failure of the subgrade material.

(Surface rutting is not addressed by thickness design)

Definition of Failure-
Flexible Pavement

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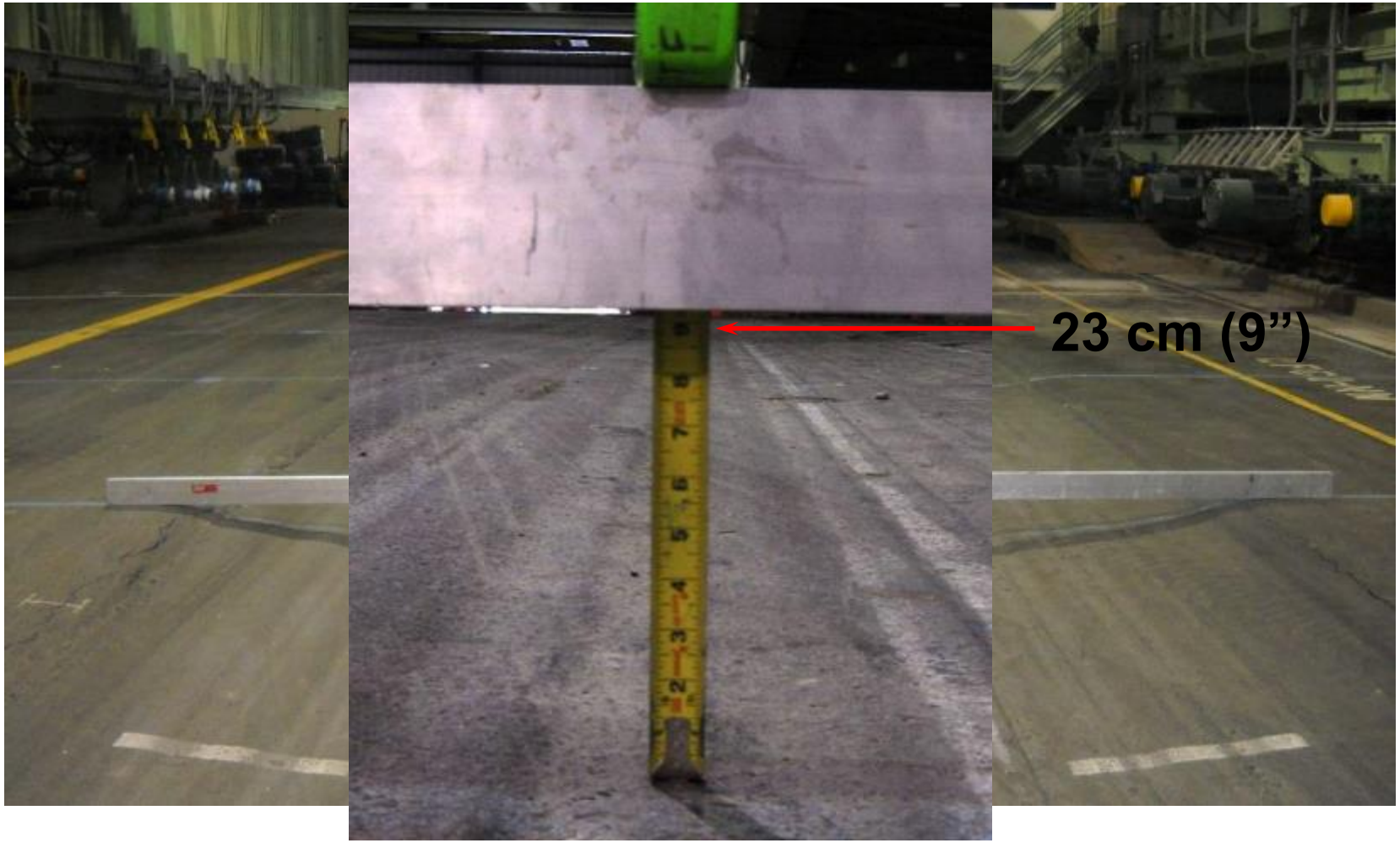
Flexible Pavement



Definition of Failure-
Flexible Pavement

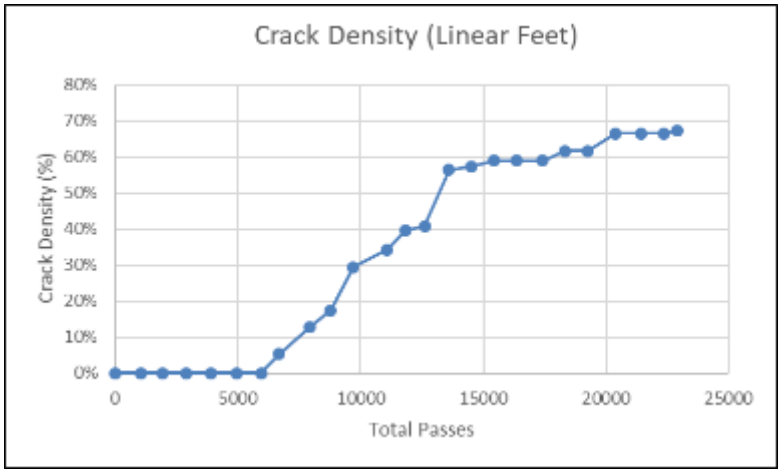
Definition of Failure New-
Flexible Pavement

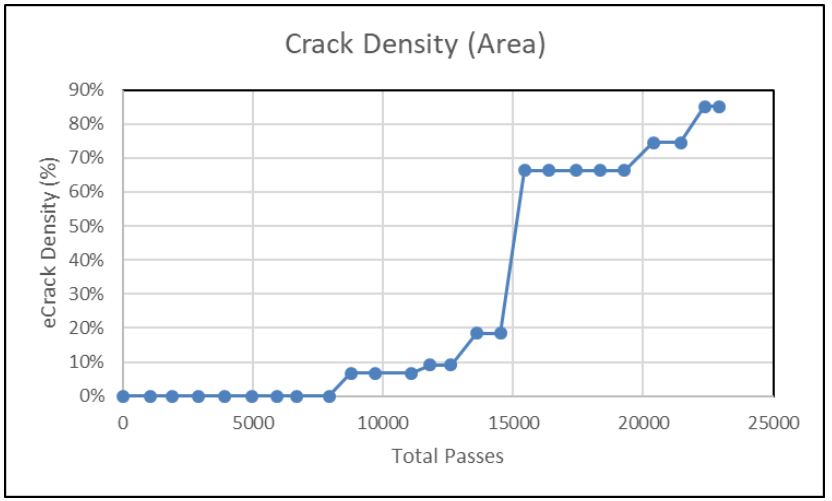
- **Crack Density**
  - Crack density is calculated by assessing the linear footage of cracks that are present per square feet of the pavement area.

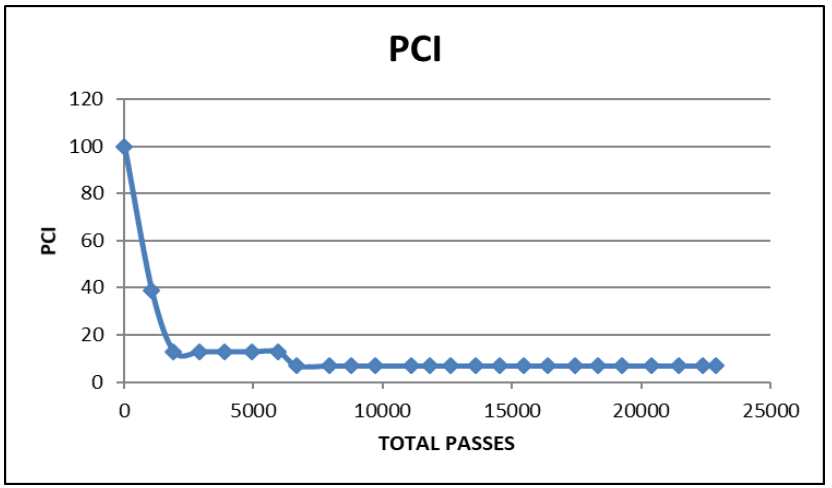
$$\text{Density} = \frac{\text{distress amount in linear feet}}{\text{sample unit area in square feet}} \times 100$$

Definition of Failure New-
Flexible Pavement

- **Crack Density**

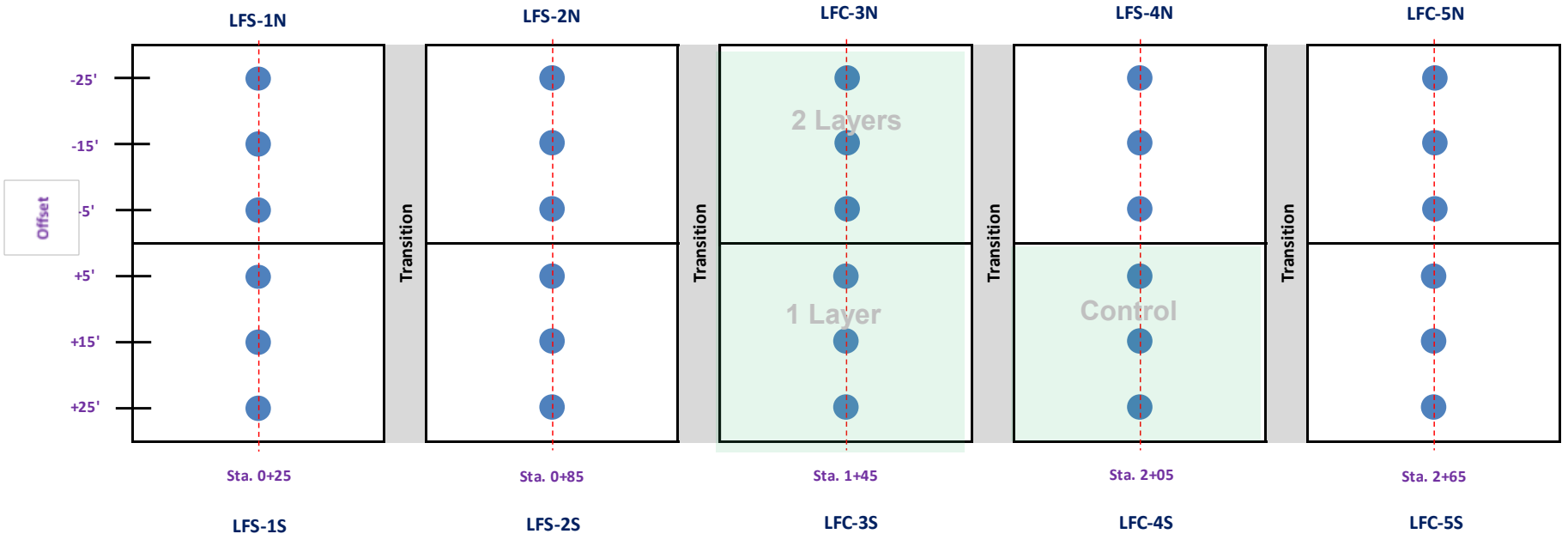






Data Analysis- Heavy Weight Deflectometer Testing

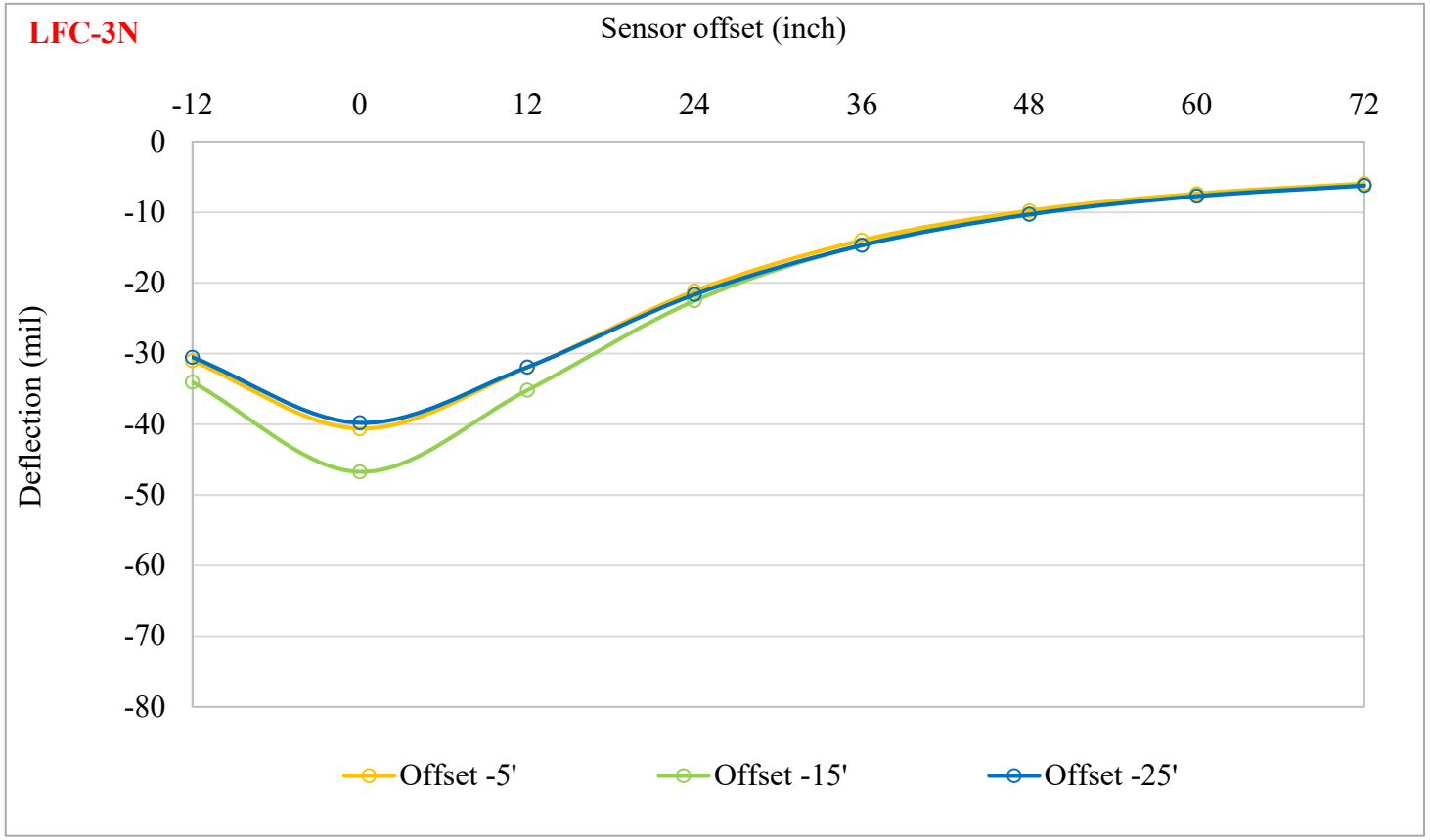
HWD Testing Layout



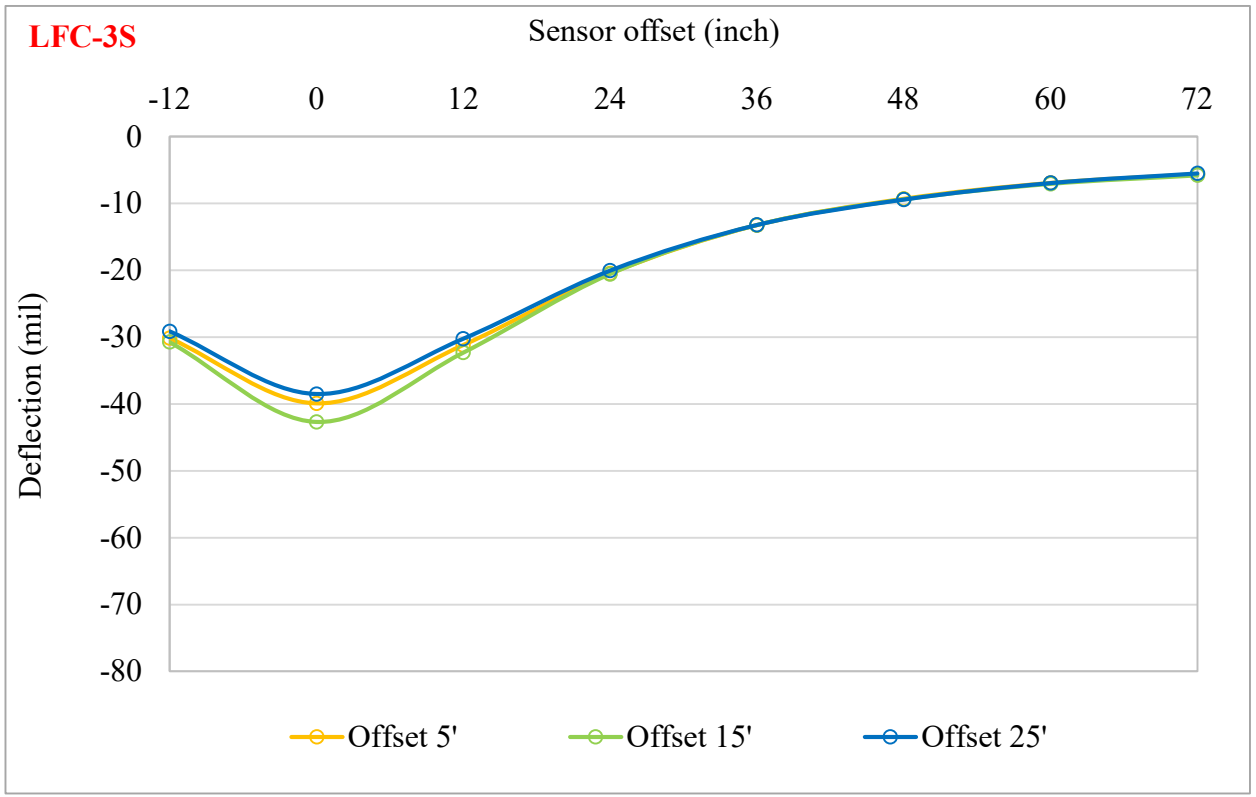
Note

1. HWD test was conducted on December 30, 2019 according to the material characterization test plan
2. On LFS-1 through LFC-4 (both North and South sides), HWD tests were conducted at 36 kips (seating), followed by 12, 24, and 36 kips load levels
3. On LFC-5 (both North and South sides), HWD tests were conducted at 20 kips (seating), followed by 10 and 20 kips load levels
4. After a preliminary review, it was observed deflections values at offset -15 and -5 feet on LFC-3N and LFC-5N were excessively high, which required re-testing on those locations

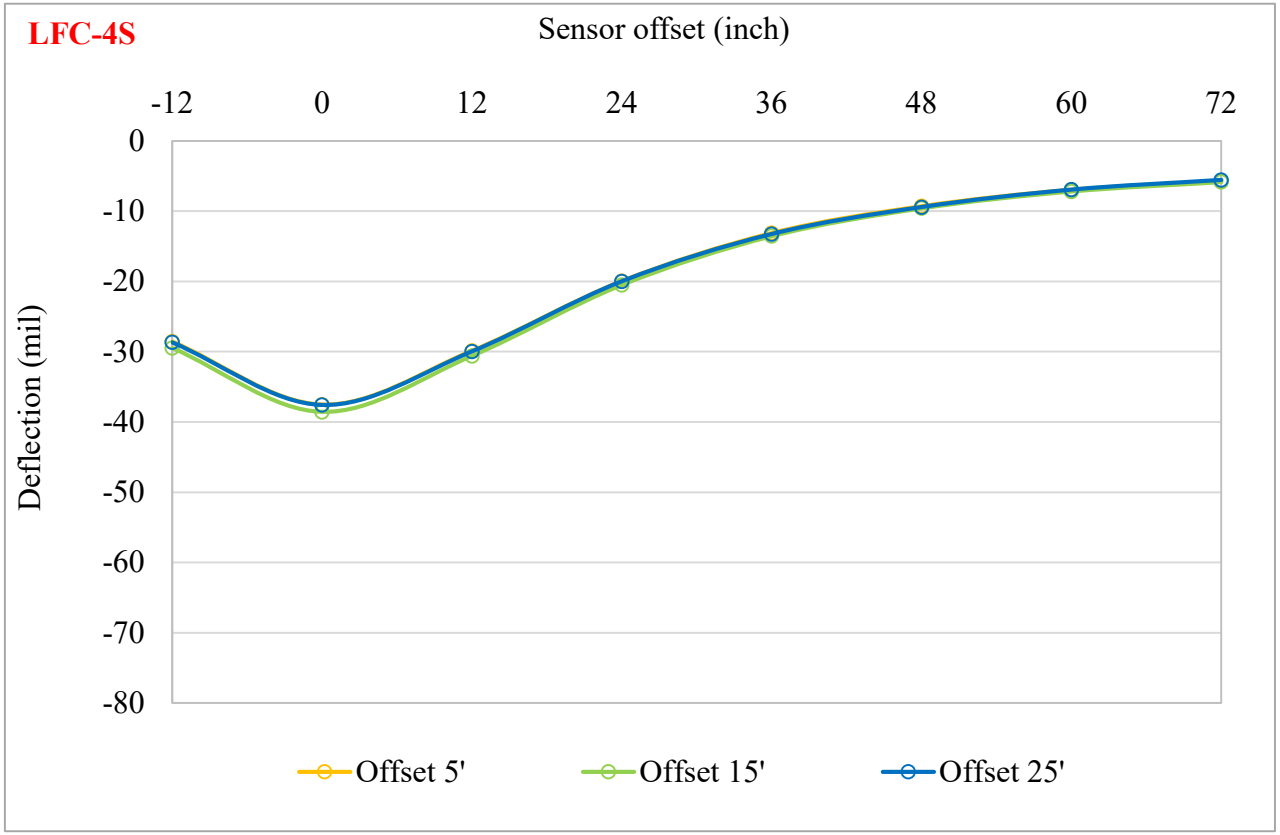
Data Analysis- Heavy Weight Deflectometer Testing-2 layers



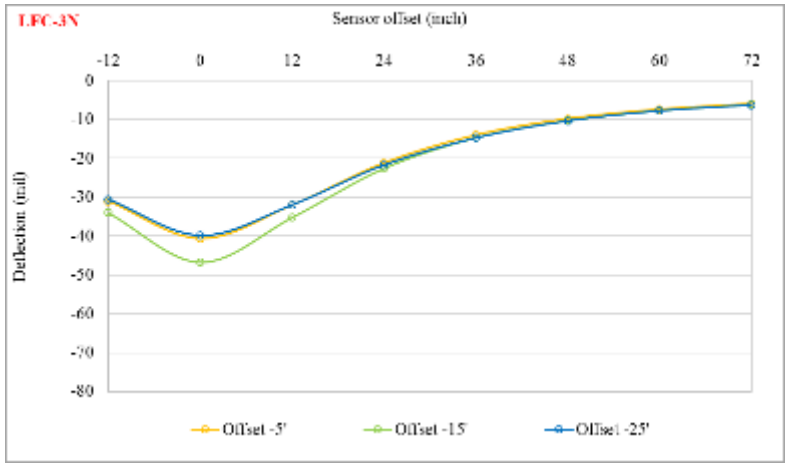
Data Analysis- Heavy Weight Deflectometer Testing-1 layer

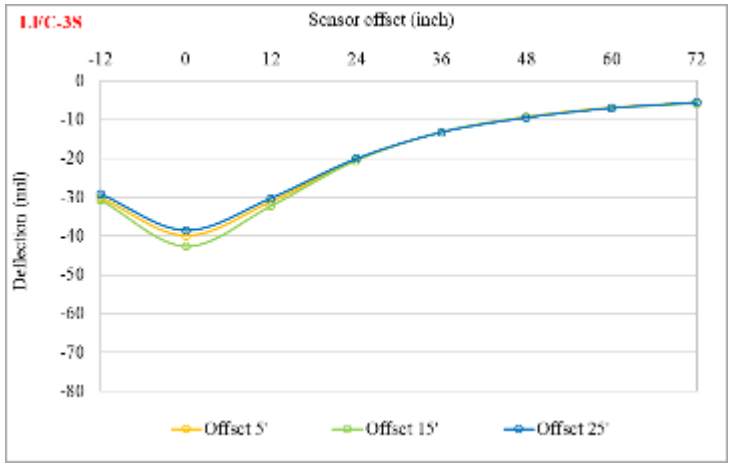


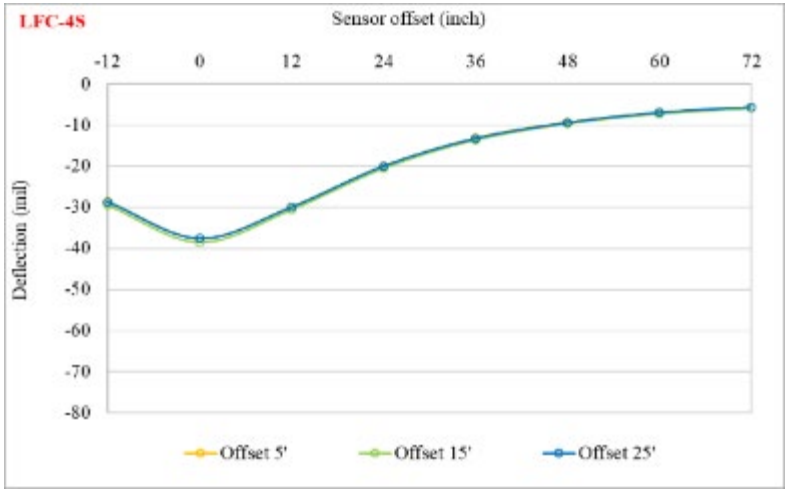
Data Analysis- Heavy Weight Deflectometer Testing- Control



Data Analysis- Heavy Weight Deflectometer Testing







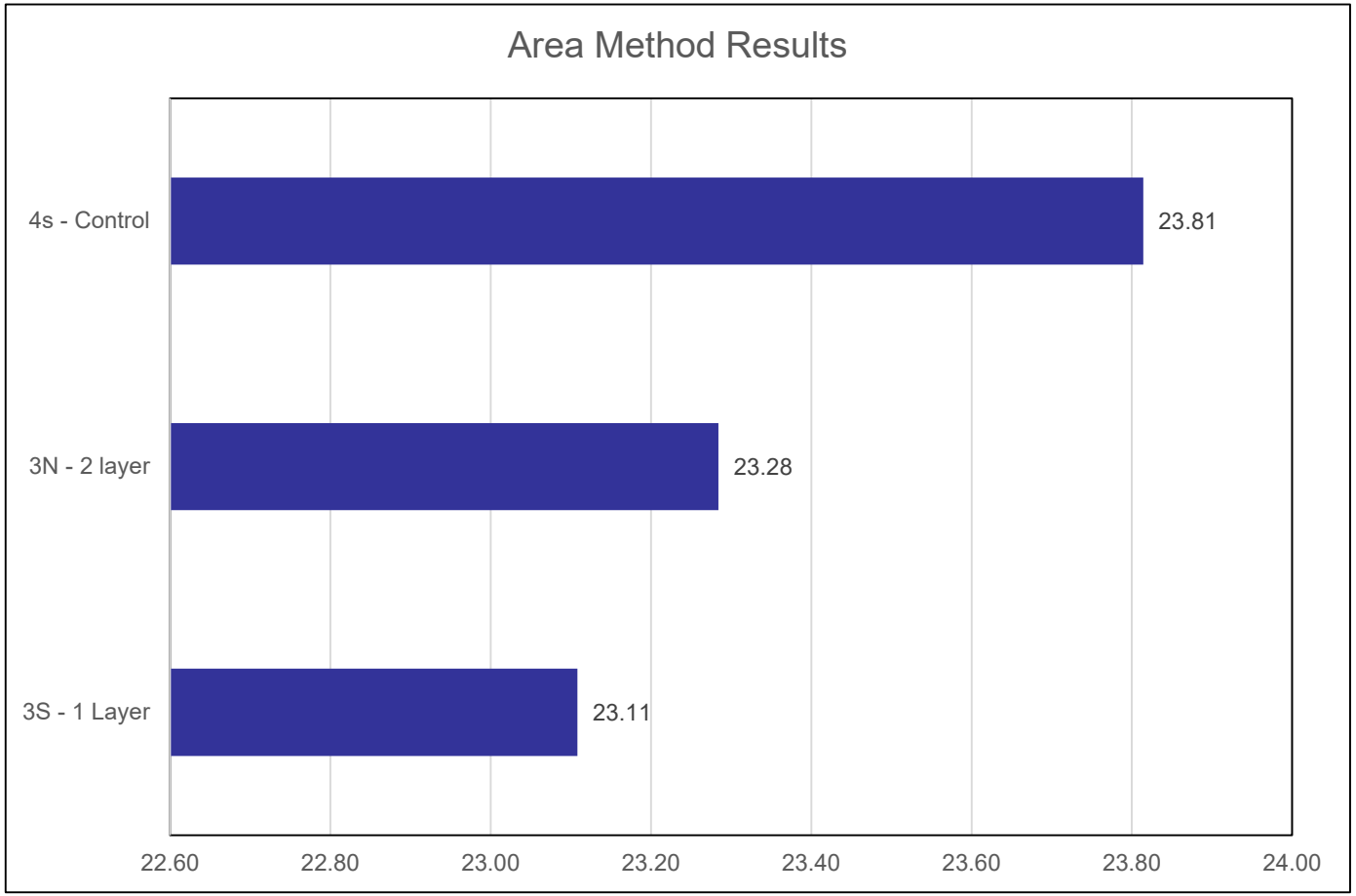
Data Analysis

Parameter	Formula	Unit	Parameter's Objective
ISM	$ISM = \frac{P}{d_0}$ *ISM* = Impulse stiffness modulus, kN/mm (lbf/inch). *P* = Applied load, kN (lbf). d_0 = Maximum deflection under the load plate, mm (inches).	lfb/mils	Characterize the stiffness of all structural layers
AREA	$AREA = 6 + 12\left(\frac{d_{12}}{d_0}\right) + 12\left(\frac{d_{24}}{d_0}\right) + 6\left(\frac{d_{36}}{d_0}\right)$	in	Reflect the structural response of the whole pavement structure
Outer Area	$Outer\ AREA = 6 \cdot \left(1 + 2 \cdot \frac{d_{24}}{d_{12}} + 2 \cdot \frac{d_{36}}{d_{12}} + 2 \cdot \frac{d_{48}}{d_{12}} + 2 \cdot \frac{d_{60}}{d_{12}} + \frac{d_{72}}{d_{12}}\right)$	in	Reflect the structural response of the whole pavement structure but adjusts for the compression effect in the asphalt layer

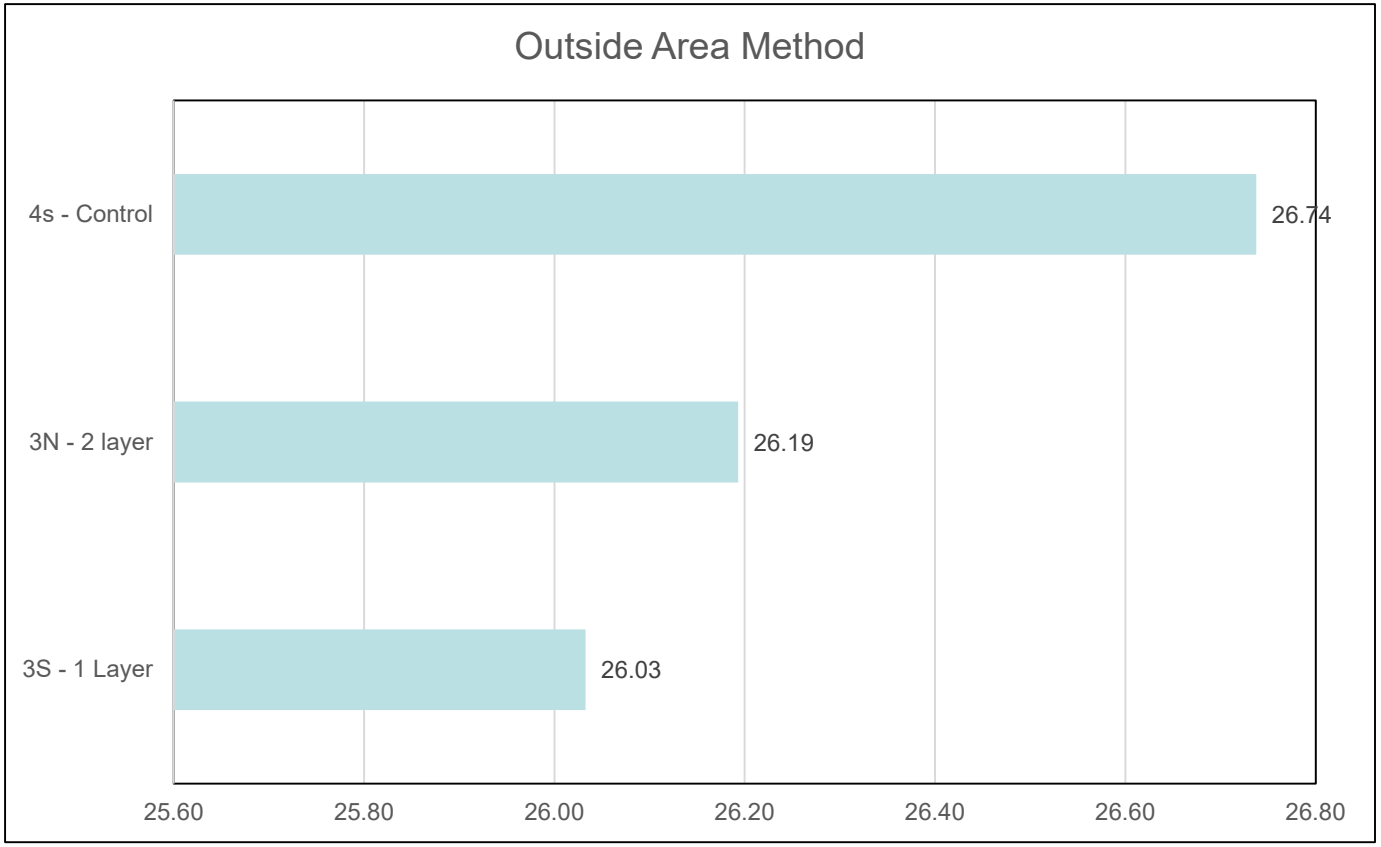
Data Analysis

Parameter	Formula	Unit	Parameter's Objective
BLI (Base layer Index)	$BLI = D_0 - D_{300}$	mils	Provides an indication of the structural condition of the base layer
MLI (Middle Layer Index)	$MLI = D_{300} - D_{600}$	mils	Provides an indication of the subbase structural condition
LLI (Lower Layer Index)	$LLI = D_{600} - D_{900}$	mils	Provides an indication of the structural condition of the subgrade layers

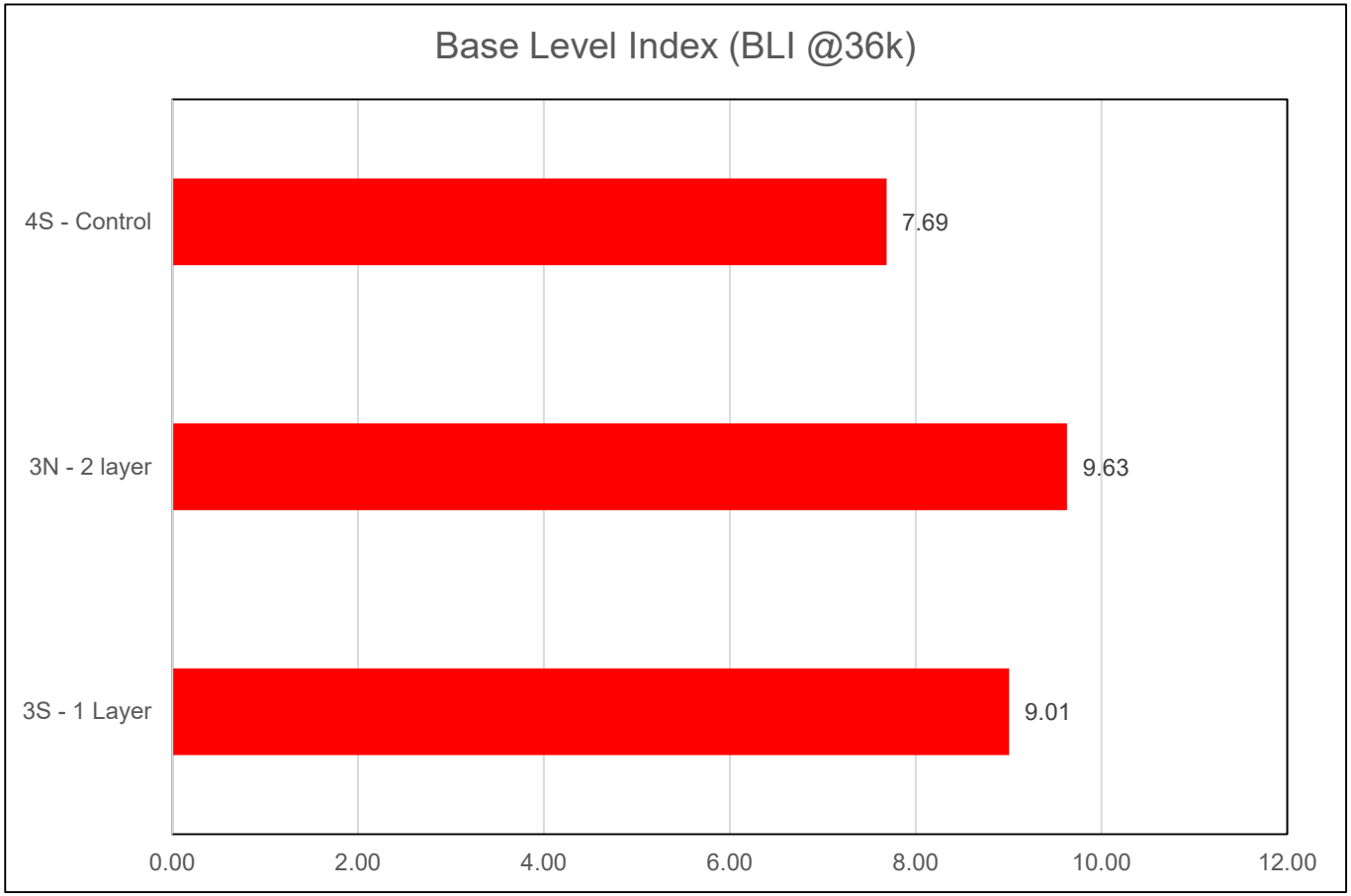
Data Analysis - Area



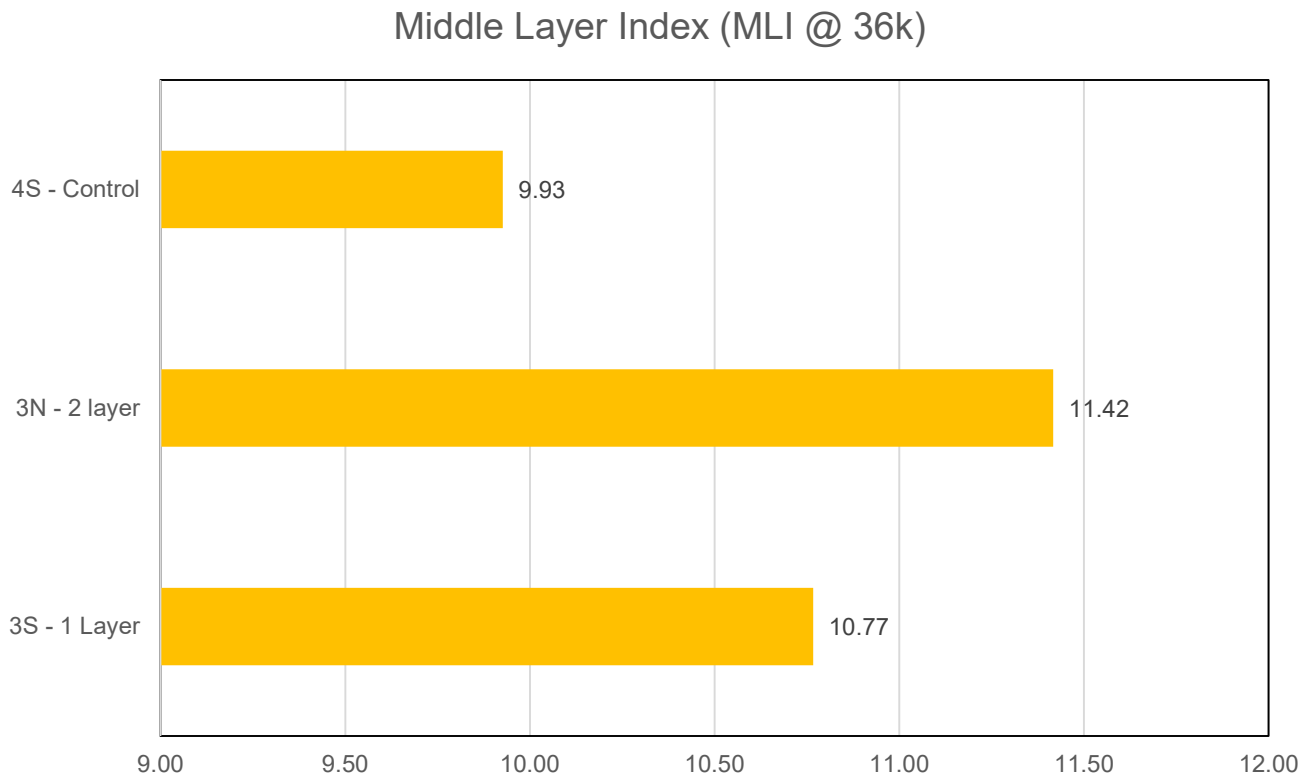
Data Analysis – Outer Area



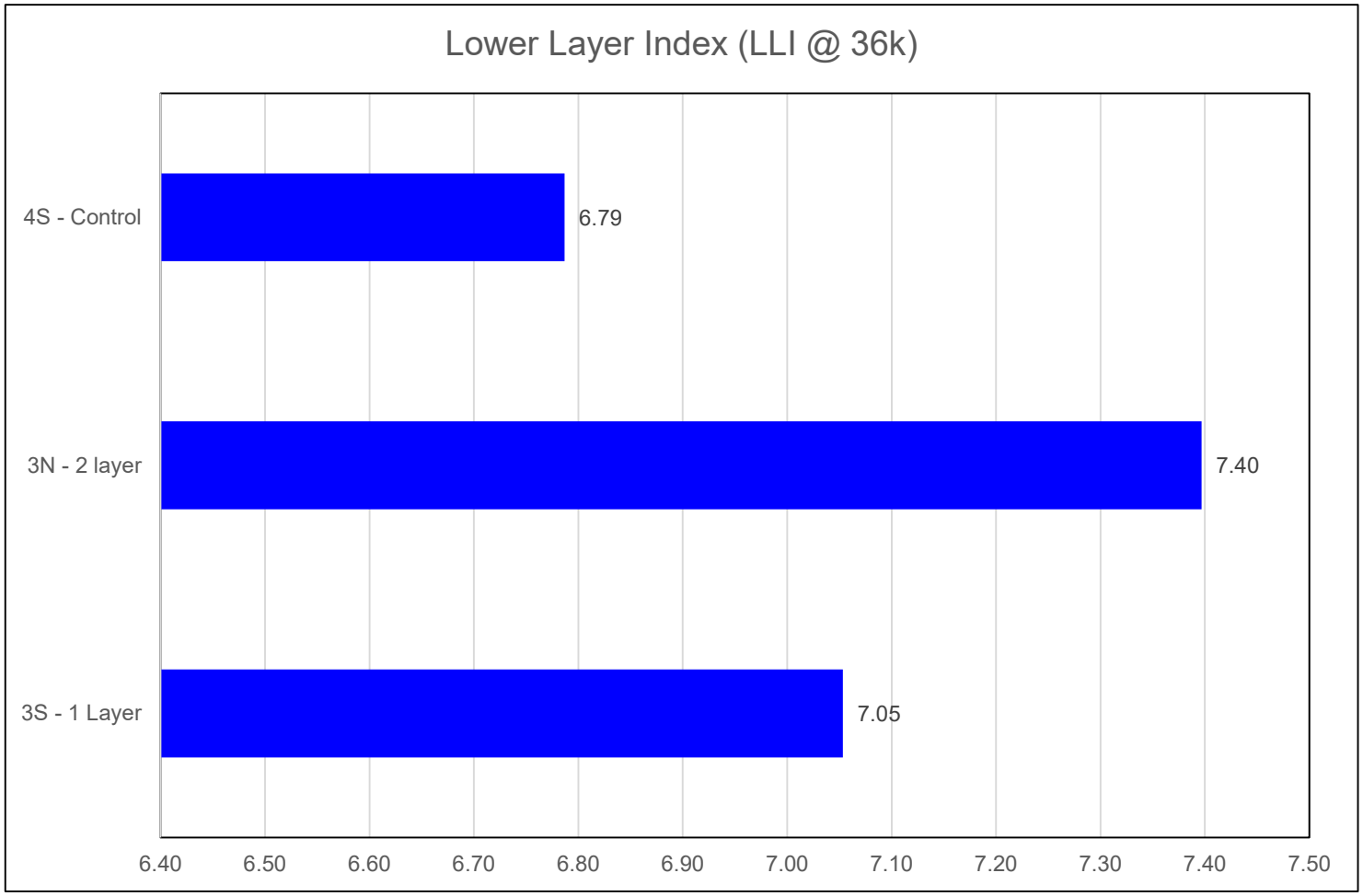
Data Analysis - BLI



Data Analysis - MLI



Data Analysis - LLI



Geosynthetic Program Overview

Goal:

Conduct research of geosynthetic applications within the pavement structure for the long-term benefit of airport pavement design and construction.

Established Partnerships:

University & Academia:

Provide quality research for the state-of-art advancement in quantifying the benefits of various Geosynthetics Applications

Geosynthetic Materials Association (GMA):

Current Industry Issues and Challenges.

Geosynthetic Definitions, Literature Reviews, Current Research, Specification Support

Interagency Collaboration (FHWA, USACE-ERDC):

Provide Validation through Full Scale Testing

PMS Field Data for Life Analysis

FAA Airport Pavement R&D Section - National Airport Pavement Test Facility

FAA Office of Airport Safety and Standards – Primary Responsibility for all Airport Program Matters Related to Standard for Airport Design, Construction, Maintenance, …

Future Geosynthetic Research

National Airport Pavement Test Facility (NAPTF)

- Separation and Stabilization
- Unbound Aggregate Reinforcement – “Quantifying the Benefit”
  - Increased Confinement
  - Reduce Vertical Stain at top of Subgrade

Benefit Goal: *Extend pavement life, potential to reduce pavement thickness, alternative cost effective subgrade improvement and/or use of lower quality materials.*

New and Innovative Sensor / Instrumentation Design to Quantify Pavement Performance

FAARFIELD Design Improvement to incorporate/quantify the modeling of geosynthetics within the pavement structure.

- Long term performance analysis
- Enhanced pavement performance models

Thank You - Questions