Airport Pavement R&D Section

ANG-E262

Federal Aviation Administration

Presented to: REDAC

By: ANG-E262

Date: August 20, 2018

Pavement Projects & Plans

- **Papers/Reports**
- **International Agreements**
- **Research Requests**
- **Technical Advisory Committee**
- **Airport Pavement R&D Project Updates**
  - NAPTF Construction Cycle 8 (CC8)
  - NAPTF Construction Cycle 9 (CC9)
  - NAPMRC Test Cycle 2 (TC2)
  - Geosynthetics

Report Publications

- **Drafts under review**
  1. DOT/FAA/AR-xx/xx: Stone Matrix Asphalt (SMA) Evaluation for the National Airport Pavement Test Facility (NAPTF) (second round of review)
  2. Analysis of National Airport Pavement Test Facility (NAPTF) Test Data for Use in Improving FAA Pavement Design Procedures: Final Report
  3. National Airport Pavement & Materials Research Center (NAPMRC): Design & Construction (Volume 1)
  4. National Airport Pavement & Materials Research Center (NAPMRC): Design & Construction (Volume 1)
  5. National Airport Pavement & Materials Research Center (NAPMRC): Instrumentation & Test Cycle 1 (TC1) Traffic Tests (Volume 2)
  6. National Airport Pavement & Materials Research Center (NAPMRC): Post Traffic Material Characterization (Volume 3)

Report Publications

- **Drafts under review**
  7. Airport Pavement Condition Monitoring Using Self-Powered Wireless Active Sensing System (TECHNICAL NOTE)
  8. Life-Cycle Assessment of Airfield Pavements and Other Airside Features: Framework, Guidelines and Case Studies

Report Publications

- **Drafts under Publication Process**
  - DOT/FAA/AR-xx/xx Sustainability Assessment of Alternative Snow Removal Methods for Airport Apron Paved Surfaces (PEGASAS) (Still in Editing and waiting to be assigned a number)
  - DOT/FAA/AR-18/8: Boeing 737-800 Final Surface Roughness Study Data Collection – Signed Final Signature
  - DOT/FAA/AR-18/13: AIRBUS A330-200 Surface Roughness Study Data Collection- Routed for Final Signatures
  - DOT/FAA/AR-xx/xx: Conductive Concrete for Airfield Heated Pavement Construction – Development and Evaluation of a Cost-effective Conductive Concrete Mix (Grant 14-G-017) Routed for Final Signatures
  - DOT/FAA/AR-xx/xx: Laboratory Performance Testing of Polymer-Modified Asphalt Mixtures for Airfields Routed for Final Signatures

Report Publications

- **Drafts under Publication Process**
  1. **DOT/FAA/AR-xx/xx: Investigating the Potential to Use Phase Change Materials (PCM) to Store Heat in Concrete Pavement Thereby Reducing the Need for Anti-Icing (PEGASAS) - Routed for Final Signatures**

  2. **DOT/FAA/AR-xx/xx: Hybrid Heated Airport Pavements: Volume 1 – Electrically Conductive Concrete for Pavement Deicing. Routed for Final Signatures**

  3. **DOT/FAA/AR-xx/xx: Hybrid Heated Airport Pavements: Volume II – Engineered Superhydrophobic Concrete Surface. Routed for Final Signatures**

Report Publications

- ## Published Reports
  1. **DOT/FAA/TC-17/28: Development of New Subgrade Failure Model for Flexible Pavements in FAARFIELD (May 2017)**
  2. **DOT/FAA/TC-16/46: Replacement of FAARFIELD Tandem Factors With Cumulative Damage Factor Methodology (October 2016)**
  3. **DOT/FAA/TC-17/47 - Energy and Financial Viability of Hydronic Heated Pavement Systems (November 2017)**
  4. **DOT/FAA/TC-18/26: Laboratory Performance Testing of Warm-Mix Asphalt Mixtures for Airport Pavements**
  5. **DOT/FAA/TC-18/27: Development of a Testing Program for the FAA's Accelerated Wheel Load Test Facility to Develop Specifications for the Use of Reclaimed Asphalt Pavement and Recycled Asphalt Shingles in new Asphalt Concrete Used on Airfield Pavements.**

International Agreements – In process

- **Ente Nazionale Per L’Aviazione Civile (ENAC)**
  – the Italian Civil Aviation Authority - was established on 25th July 1997 by Legislative Decree no.250/97 as the National Authority committed to oversee the technical regulation, the surveillance and the control in the civil aviation field.

- **Council for Scientific and Industrial Research (CSIR)**
  – world-class South African research and development organization established through an Act of Parliament in 1945.

Research Requests

1. Performance tests for asphalt pavements

Federal Aviation Administration

Memorandum

Date:

To: Michel Hovan, Ph. D.
Manager, Airport Technology R&D Team, ANG-E26

From: John R. Dermody, Director of Airport Safety and Standards, AAS-1

Prepared by: Khalil Kodsi, Manager, Airport Engineering Division, AAS-100

Subject: Request for Research and Development Support Performance of Pavements Constructed following State Specifications for Highway Materials

Background:

Under the current Airport Improvement Program and in proposed reauthorization to the program provisions are included for the use of State highway specifications on airports serving aircraft less than 60,000 lbs. Aircraft loads require that asphalt pavements at airports be constructed to more stringent standards than highways. Currently, there are no performance related specifications to quickly evaluate what changes need to be made to specifications following highway specifications to insure that the pavements constructed following State highway specifications will perform under airport aircraft loads.

Scope of Work:

Make recommendations for critical properties for materials, construction, and acceptance of airport asphalt mixtures for runways, taxiways, and aprons for aircraft < 60,000 pounds, to assure equivalent performance to the Federal Aviation Administration (FAA) specifications P154, P208, P209, P401, and P403, located in Advisory Circular 150/5370-10G

Research Requests

2. Alternate methods of acceptance of unbound materials

Federal Aviation Administration

Memorandum

Date:

To: Michel Hovan, Ph. D.
Manager, Airport Technology R&D Team, ANG-E26

From: John R. Dermody, Director of Airport Safety and Standards, AAS-1

Prepared by: Khalil Kodsi, Manager, Airport Engineering Division, AAS-100

Subject: Request for Research and Development Support FAA pavement Design, Construction, and Evaluation

Background:

The Federal Aviation Administration currently requires the use of nuclear density machines for the determination of in placed density of unbound pavement materials. There have been improvements in other means of evaluation of the in place properties of unbound paving materials, for example Light Falling Weight Deflectometers (LFWD) or Portable Seismic Pavement Analyzer (PSPA).

Scope of Work:

- Investigate alternative ways of acceptance of unbound pavement materials (subgrade, subbase, and base).
- Recommend how FAA could incorporate use of other devices into our construction specifications

Final Report:

At a minimum, the final report should include:

- Evaluation of alternatives to utilizing nuclear density testing for acceptance of unbound pavement materials

Research Requests

3. Stabilized Bases

Federal Aviation Administration

Memorandum

Date:

To: Michel Hovan, Ph. D.
Manager, Airport Technology R&D Team, ANG-E26

From: John R. Dermody, Director of Airport Safety and Standards, AAS-1

Prepared by: Khalil Kodsi, Manager, Airport Engineering Division, AAS-100

Subject: Request for Research and Development Support FAA Pavement Design, Pavement Materials, Construction and Evaluation

Background:

In the late 1960's the FAA adopted the requirement for the use of stabilized bases when aircraft greater than 200,000 lbs. gross weight were included in the aircraft traffic. At some point in time, the FAA reduced this requirement to when aircraft greater than 100,000 lbs. gross weight were included in the aircraft traffic to require stabilized bases. In both the FAA pavement design criteria and in the FAA construction specifications and aggregate exhibiting a California Bearing Ratio > 100 has been considered to be equivalent to providing a stabilized base.

Scope of Work:

There is a need to determine:

- When is a stabilized base required?
- When is a stabilized base recommended?
- What are the minimum requirements for a material to be considered a stabilized base (must it be chemically stabilized or are there other criteria, e.g. minimum strength and/or modulus of elasticity that it must provide.

Research Requests

4. Pavement Roughness

Federal Aviation Administration

Memorandum

Date:

To: Michel Hovan, Ph. D. Manager, Airport Technology R&D Team, ANG-E260

From: John R. Dermody, Director of Airport Safety and Standards, AAS-1

Prepared by: Khalil Kodsi, P.E., Manager, Airport Engineering Division, AAS-100

Subject: Request for Research and Development Support for FAA Pavement Design, Construction, and Evaluation

Background:

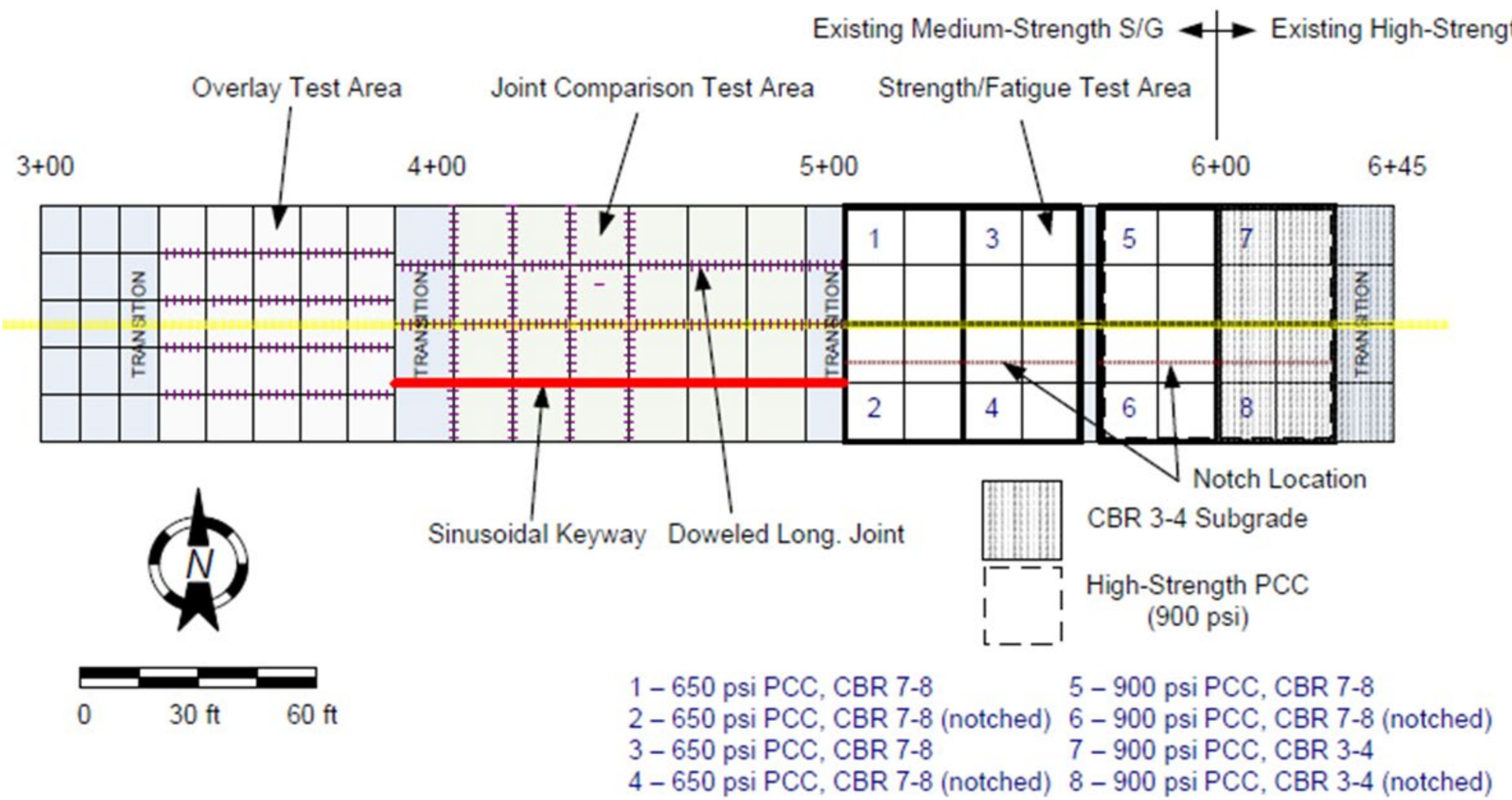
The Federal Aviation Administration (FAA) currently recommends that airports check the smoothness of pavements when being constructed; and then once pavements are put into service, the FAA recommends the airports periodically check in service pavement roughness. Technical procedures and evaluation for pavement roughness is provided in Advisory Circular (AC) 150/5380-9 Guidelines and Procedures for Measuring Airfield Pavement Roughness, which references the Boeing Bump Index (BBI) for evaluation. The BBI was developed and is currently structured around the point that pavement gets so rough that it may damage the aircraft operating on the pavement. Technology for measuring pavement roughness has progressed since AC 150/5380-9 was last updated in 2009. In support of the technical content in this AC, it is necessary to investigate the index-evaluating runway (RW) roughness as well as the methods available to measure roughness. Boeing is currently initiating a research initiative with Tongji University. The FAA should consider working with Boeing in evaluation of any updates to the measurement of pavement roughness as it affects the safe operation of aircraft on runways.

Technical Advisory Comittee

Construction Cycle 8 (CC8) Update - Concrete

- **Primary Objectives**
  - PCC-on-Rigid Overlay Test: Test PCC overlay on existing PCC with target SCI 80 (Follow-on to CC4 overlay tests)
  - Evaluate Comparative Joint Performance:
    - Longitudinal Joint: doweled versus alternate sinusoidal key
    - Transverse Joint: doweled versus undoweled (dummy)
  - Improve FAARFIELD Failure Model: Test full-scale slab strength & fatigue strength for different concrete strength and foundation conditions
- **Secondary Objectives**
  - Develop overload criteria for rigid pavements
  - Effect of *k*-value vs. CBR in characterizing rigid subgrade

CC8 Test Layout



CC8 – Test Status

- **Phase 1, Rigid Overload Test – COMPLETED**
- **Phase 2, Overlay Test – COMPLETED**
- **Phase 3, Joint Comparison Test – IN PROGRESS**
- **Phase 4, Strength/Fatigue Test –**
  - Test plan completed.
  - Testing will commence following completion of Phase 3.

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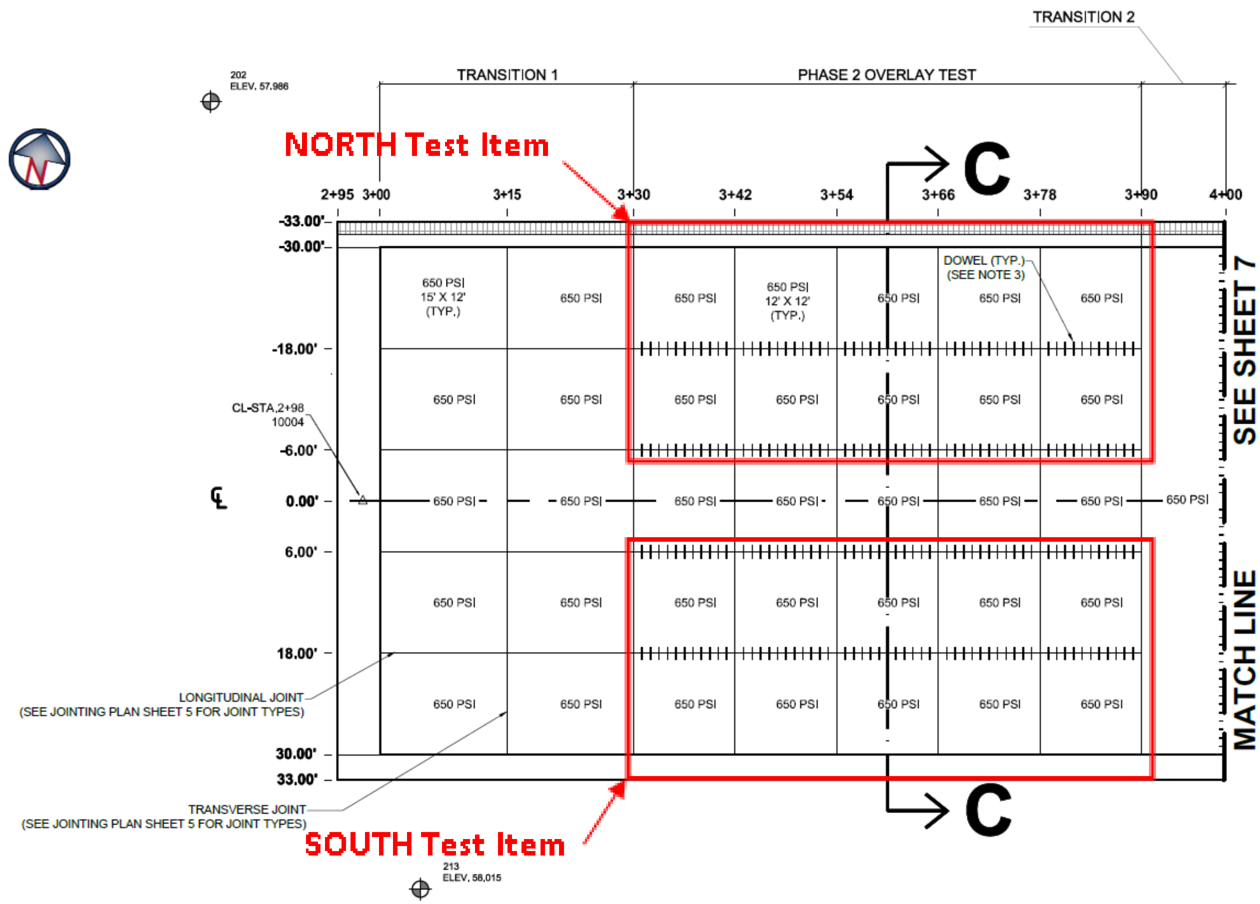
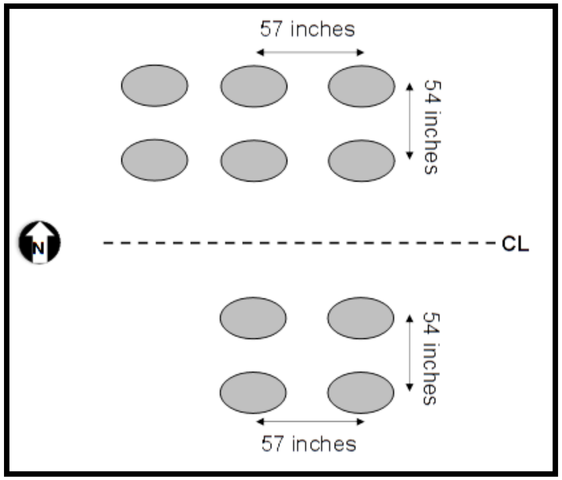
NAPTF Vehicle Trafficking CC8 Overlay Test Items, October 2017

CC8 Overlay Test: Plan View

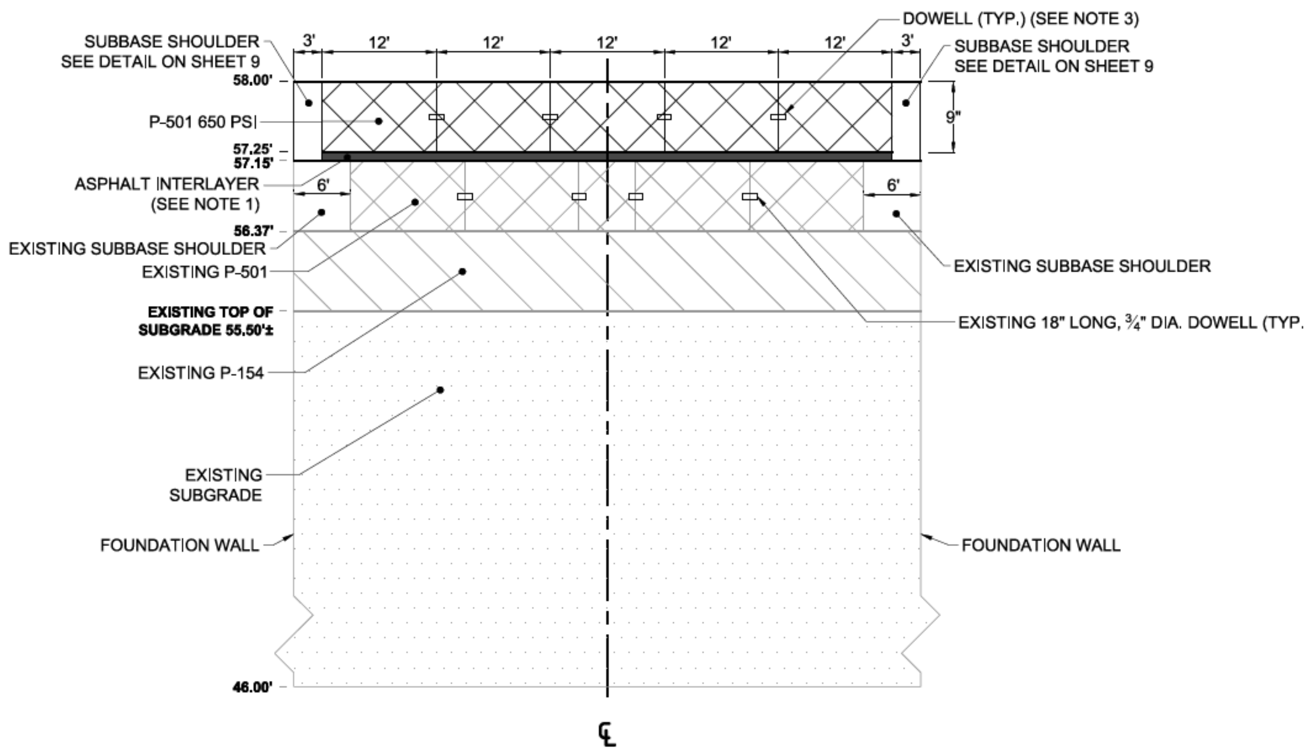




Load Configurations

CC8 Overlay Cross-Section

Showing Longitudinal Joint Staggering

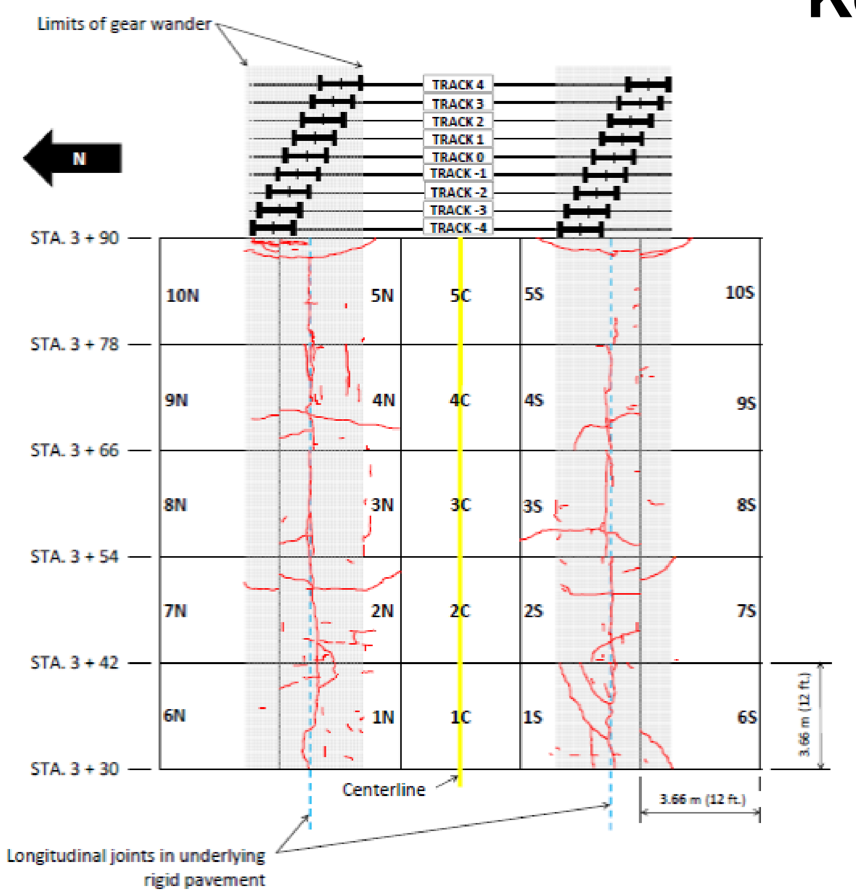


SECTION C-C

HORIZONTAL SCALE: 1"=10'

VERTICAL SCALE: 1"=1'

CC8 Overlay Test:
Crack Pattern After Week 11



Key Observations:

– Notwithstanding 50% higher gear load on the north, the south test item exhibited cracking earlier, and failed earlier, than the north test item.

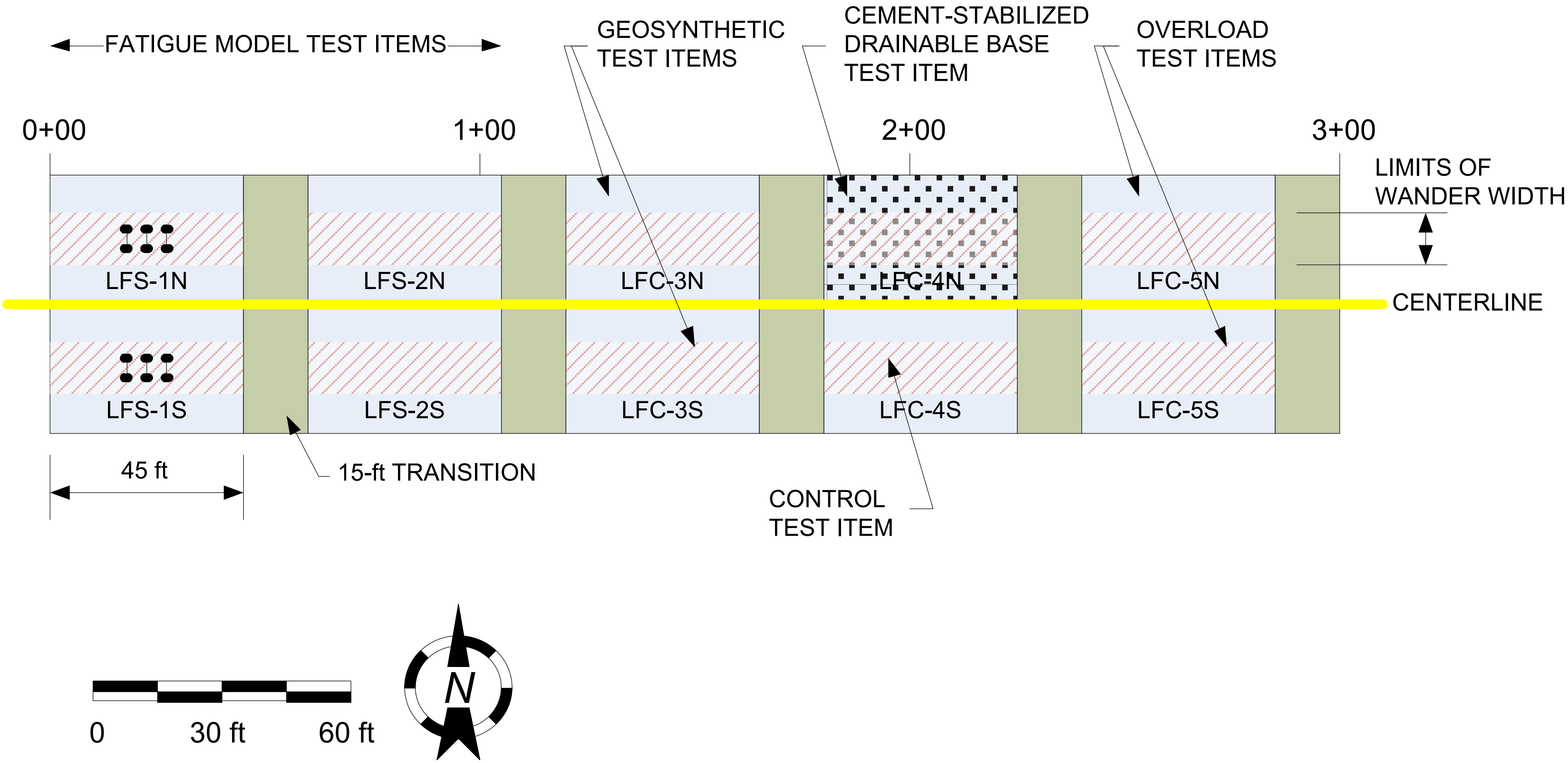
– Distresses were a combination of corner breaks, and linear cracks reflected up from the joint in the underlying pavement.

– Transverse cracks and diagonal cracks largely formed as secondary cracks connecting joints to longitudinal reflection cracks.

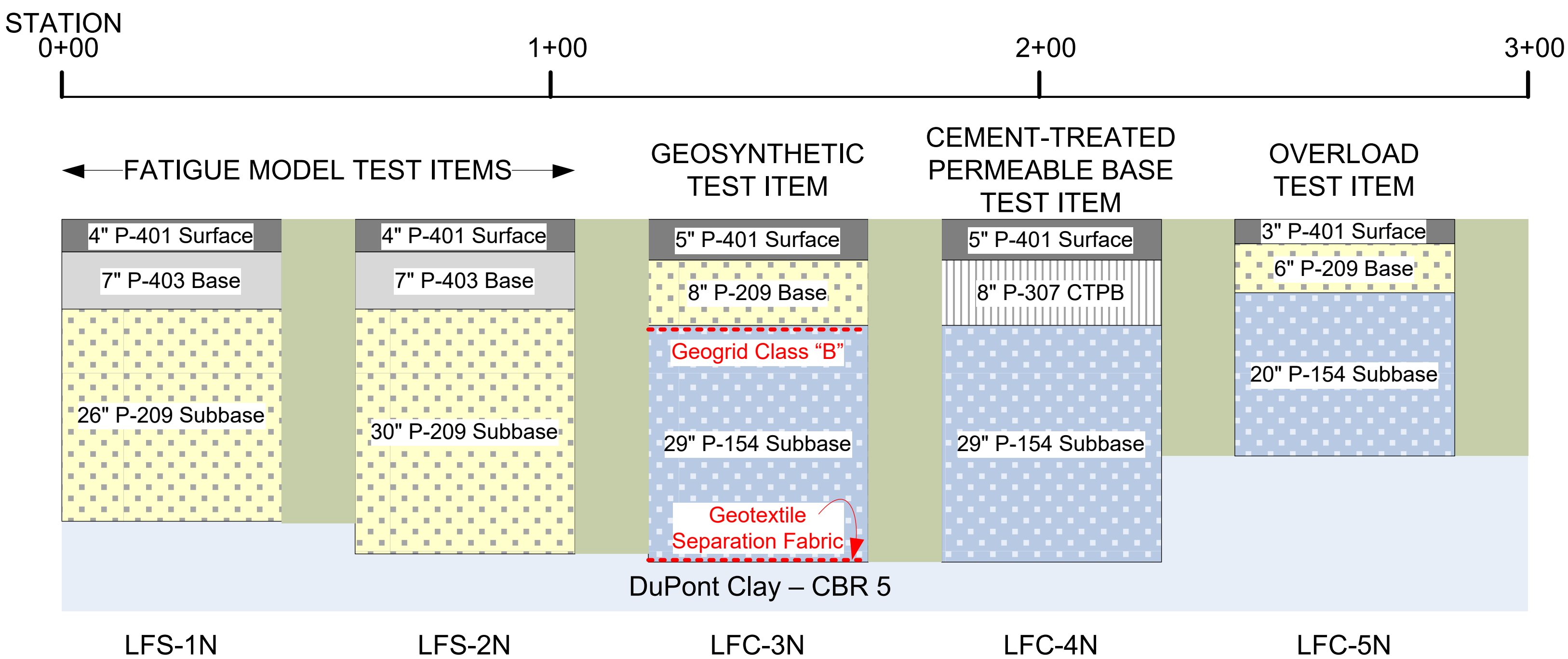
Construction Cycle 9 - Asphalt

- **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 geogrids on flexible pavement performance
  - Cement Treated Drainable base performance
  - Strain criterion for allowable overload

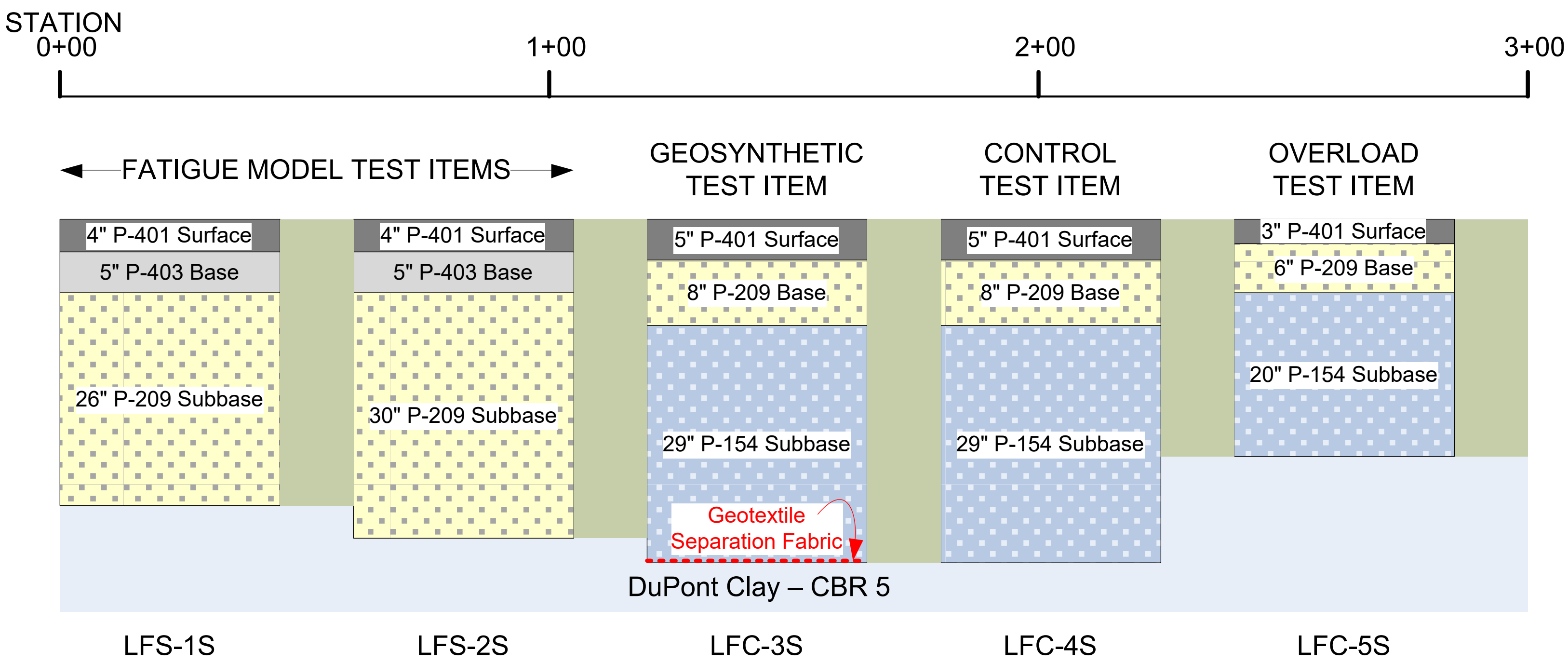
CC9 Layout


FATIGUE MODEL TEST ITEMS
GEOSYNTHETIC TEST ITEMS
CEMENT-STABILIZED DRAINABLE BASE TEST ITEM
OVERLOAD TEST ITEMS
0+00
1+00
2+00
3+00
LIMITS OF WANDER WIDTH
LFS-1N
LFS-2N
LFC-3N
LFC-4N
LFC-5N
CENTERLINE
LFS-1S
LFS-2S
LFC-3S
LFC-4S
LFC-5S
45 ft
15-ft TRANSITION
CONTROL TEST ITEM
0
30 ft
60 ft
N

CC9 North
Longitudinal Cross Section



CC9 South
Longitudinal Cross Section

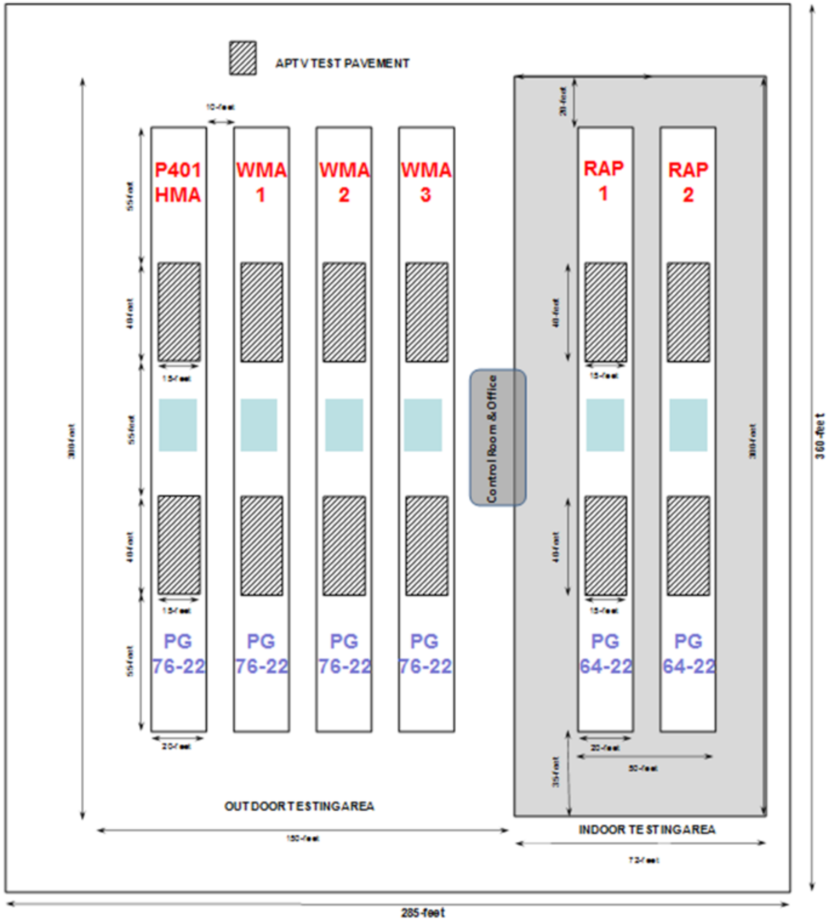


Design Failure Passes
(FAARFIELD 1.4)

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

NAPMRC – Test Cycle 2 Layout

- **Design complete**
- **Construction Summer 2018**
- **Material**
  - P-401 HMA
  - WMA (3)
  - RAP (2)
- **Tire pressure 254 psi**
- **Failure criterion: cracking & rutting**



Pavement Cross Section: TC-2

P-401 HMA/WMA SURFACE
9 inches (229 mm)

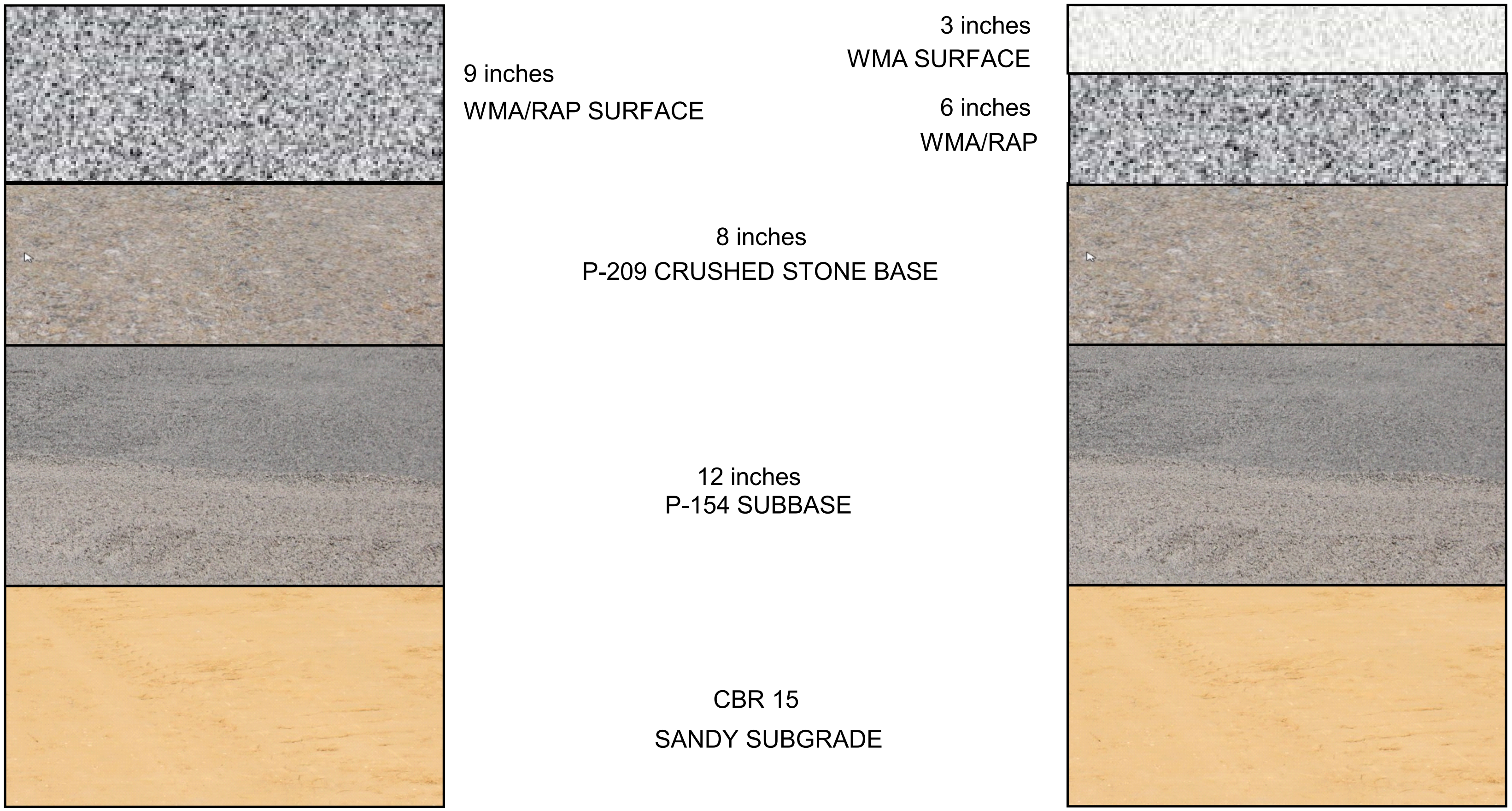
P-209 CRUSHED STONE BASE
8 inches (203 mm)

P-154 SUBBASE
12 inches (305 mm)

SANDY SUBGRADE
CBR 15

NAPMRC TC-2 PAVEMENT CROSS SECTION

Pavement Cross Sections



NAPMRC TC-2 PAVEMENT CROSS SECTION – INDOOR LANES

Geosynthetics Research

- **Goal: Include geotextile/geogrid material properties into design software/standards.**
- **Partner with Geosynthetics Materials Association (GMA).**
- **Timeline:**
  - Literature review completed October 2016.
    - Soil Stabilization
    - Unbound Aggregate Layer Reinforcement
  - Incorporated draft specifications in AC 150/5370-10H (November 2017)
  - Obtain/Analyze data through full scale testing
    - Cyclic box testing at ERDC GSL, Vicksburg, MS. Draft report June 2018.
    - CC9 will include two test items with geotextiles/geogrids (2018).
  - Modify FAA specifications for pavement design/construction based on full scale test results.

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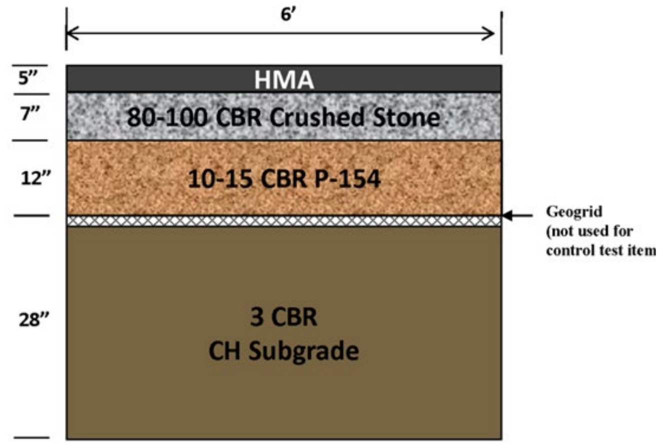
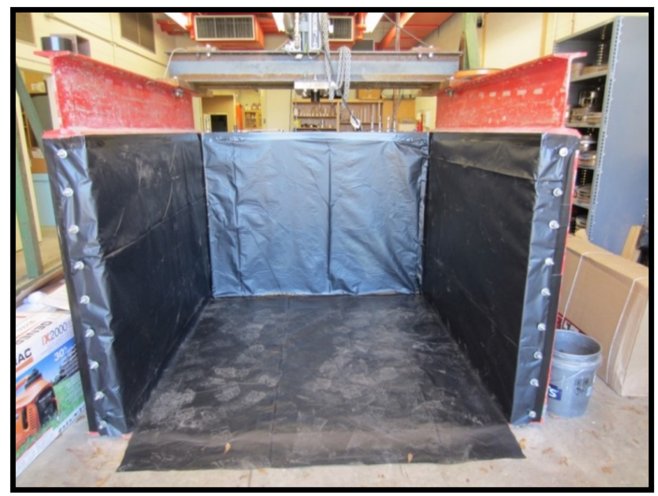
Geosynthetics Research
Cyclic Plate Load Box Tests

- **Work performed at ERDC GSL.**
  - PI Greg Norwood.
  - Phase 1 test – base/subbase interface
  - Phase 2 test – subbase/subgrade interface. Draft report June 2018.
- **Geosynthetic materials tested:**
  - Tensar BX1200
  - Tensar TX 140
  - Huesker Fornit 40/40
  - Tencate RS580i
- **Quantify benefit using Traffic Benefit Ratio (TBR)**
  - AASHTO R 50-09
- **Predictive models**
- **Recommend specification**

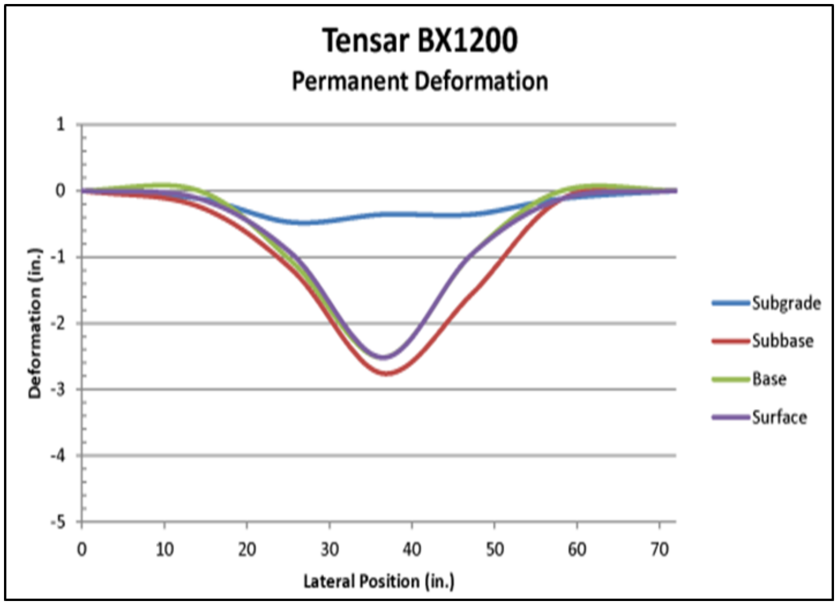




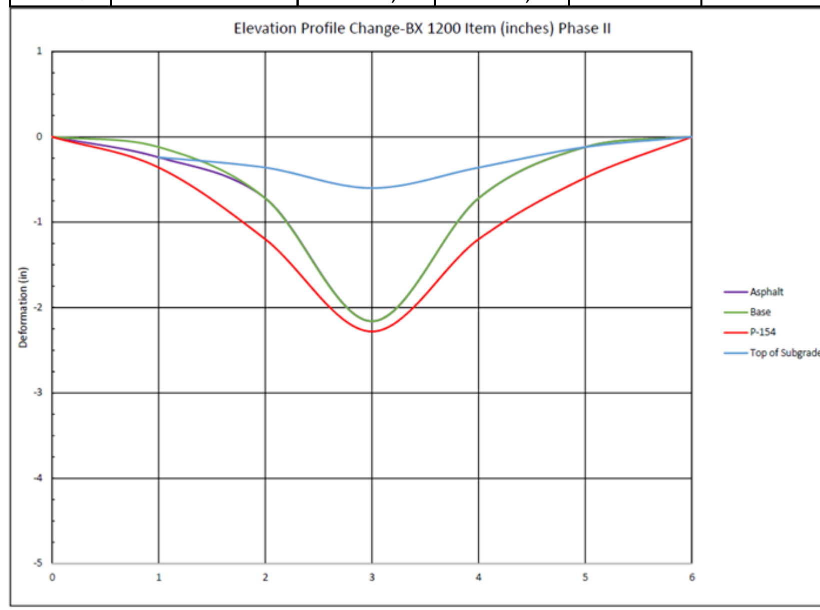
Geosynthetics Research

Phase 1	Test Item	Cycles @ 1" Deformation	Cycles @ 2" Deformation	TBR @1" Deformation	TBR @2" Deformation
Geosynthetic on subbase	*Control w/Sand*	304	1,278	1	1
	BX1200	6,322	25,960	20.8	20.3
	TX140	1,000	4,304	3.3	3.4
	Fornit 30	9,024	34,901	29.7	27.3

Phase 2	Test Item	Cycles @ 1" Deformation	Cycles @ 2" Deformation	TBR @1" Deformation	TBR @2" Deformation
Geosynthetic on subgrade	*Control w/Sand*	304	1,278	1	1
	Control w/LMS	150,720			
	BX1200	9,720	44,960	32.0	35.2
	TX140	1,460	9,890	4.8	7.7
	Fornit 40	4,100	17,600	13.5	13.8
	RS580i	2,575	20,830	8.5	16.3



Phase I – Base/Subbase Interface
Deformation to 2.25 inches: 30,000 Cycles



Phase II – Subbase/Subgrade Interface
Deformation to 2.25 inches: 50,900 Cycles

QUESTIONS