Florida Institute of Technology

Ground Tire Rubber (GTR) as a Stabilizer for Subgrade Soils

FDOT Contract Number: BDK81 977-03

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Problem Statement

- GTR supplies may increase when not used in Hot Mix
- Are other highway applications possible?

Outline

- Objectives
- Task overview
- Progress

Objectives

- Determine the key pavement engineering properties of GTR and stabilized Florida subgrade soil blends

Tasks

- Task 1 Literature Search
- Task 2 Determine GTR Sources
- Task 3 Determine Subgrade Sources
- Task 4 Test Program Development
- Task 5 Database Development
- Task 6 Sampling
- Task 7 Testing
- Task 8 Data Reduction
- Task 9 Data Analysis
- Task 10 Technology Transfer

Literature Search

- Speir and Witczak
  - Density decreased with increase of GTR
- Papp Jr., Maher, and Baker
  - LBR decreased with increase of GTR
  - Resilient Modulus decreased with increase of GTR
- Viyanant
  - Minimum failure strain at ~3%

Test Plan

- Three soil types (FDOT selecting)
  - A-3 - Low LBR (20)
  - A-2-4 – Medium LBR (40)
  - A-2-4 – High LBR (80)
- FDOT approved GTR supplier with three different sizes
  - 1 inch (1-inch to 3/8-inch)
  - 3/8 inch (1/2-inch to #4 sieve)
  - #40

Global Tire Recycling Plant Site Visit

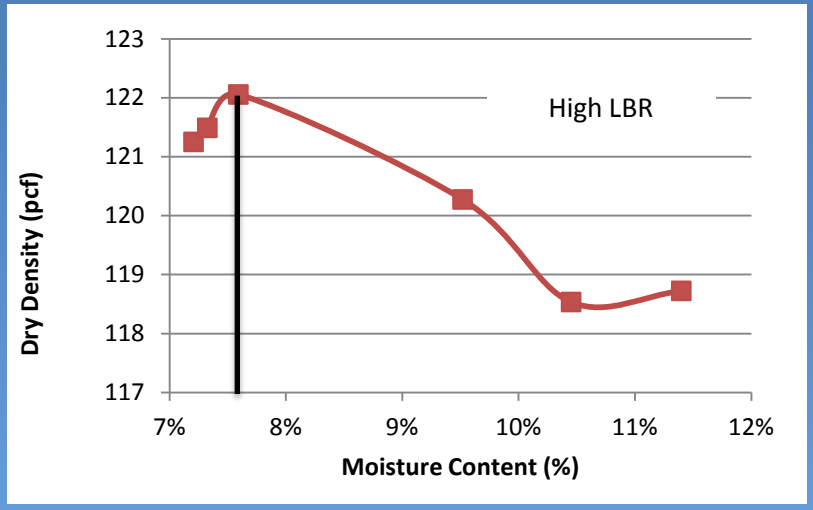
Test Program

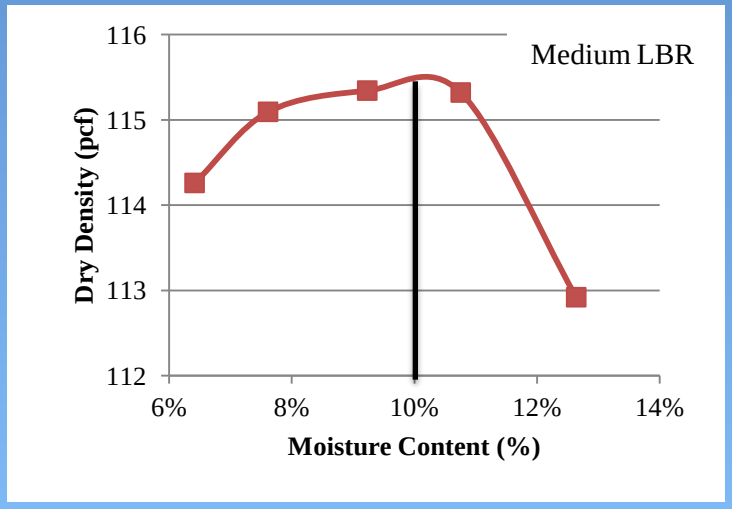
1. Atterberg Limits
2. Optimum Moisture Content
3. Sieve Analysis
4. Volumetric Mixing
5. LBR
6. Resilient Modulus
7. Creep
8. Permeability
9. Consolidation

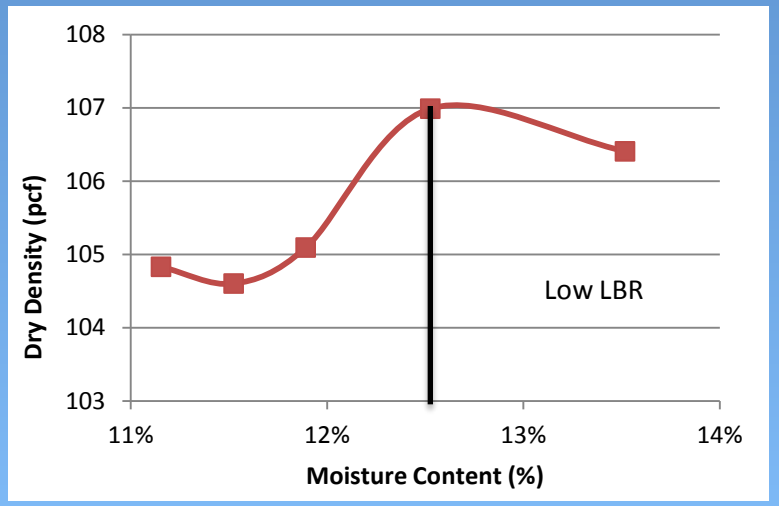
Atterberg limits

- Low LBR Material
  - No fines
- Medium and High LBR Material
  - No plastic fines

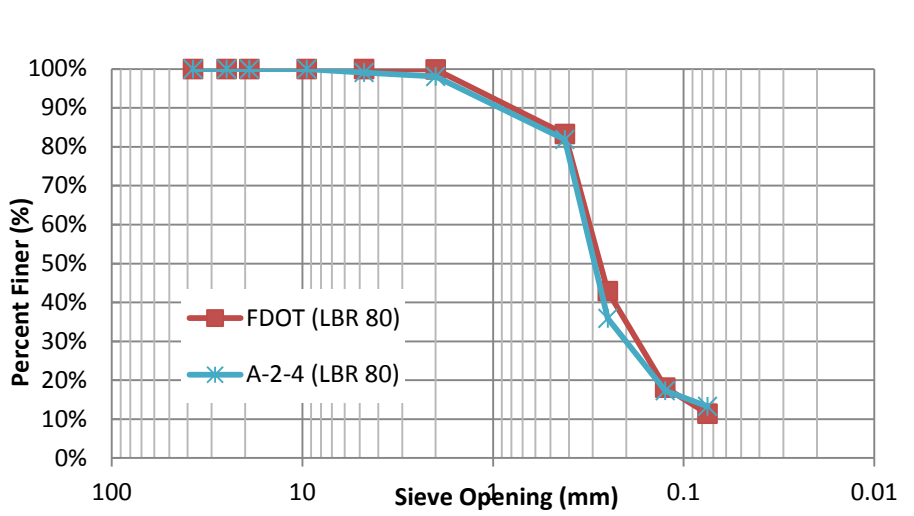
Optimum Moisture Content

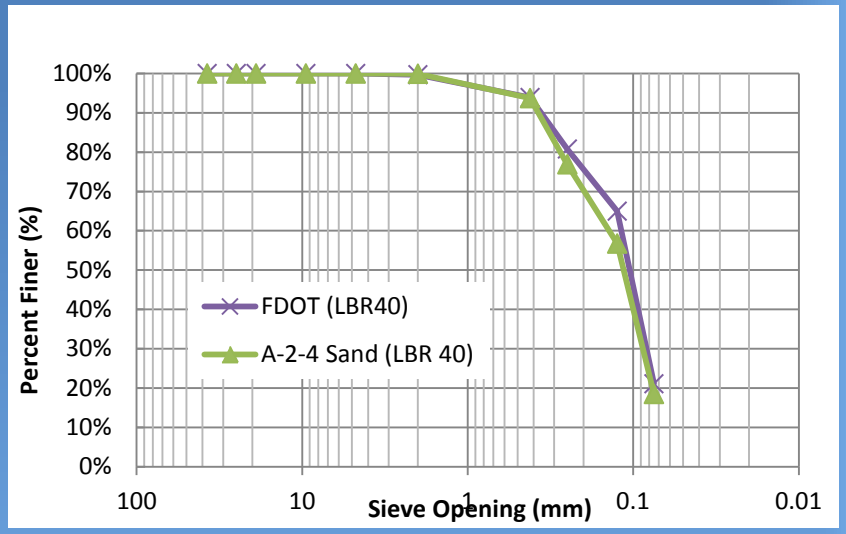


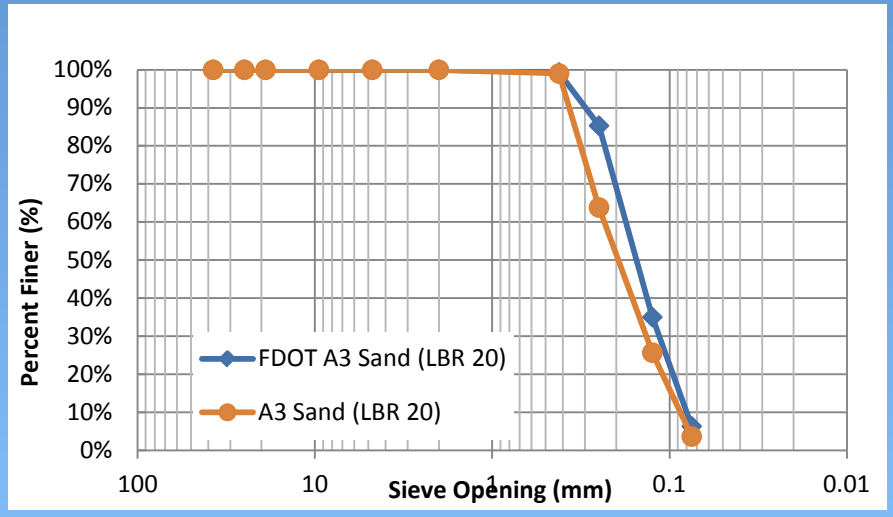




Sieve Analysis







Sieve Analysis (cont.)

Grain Size Characteristic	Low LBR Material	Medium LBR Material	High LBR Material
C_u	2.2	2.0	4.1
C_c	0.007	0.01	0.02
Passing # 200	5%	20%	12%
AASHTO Classification	A-3	A-2-4	A-2-4

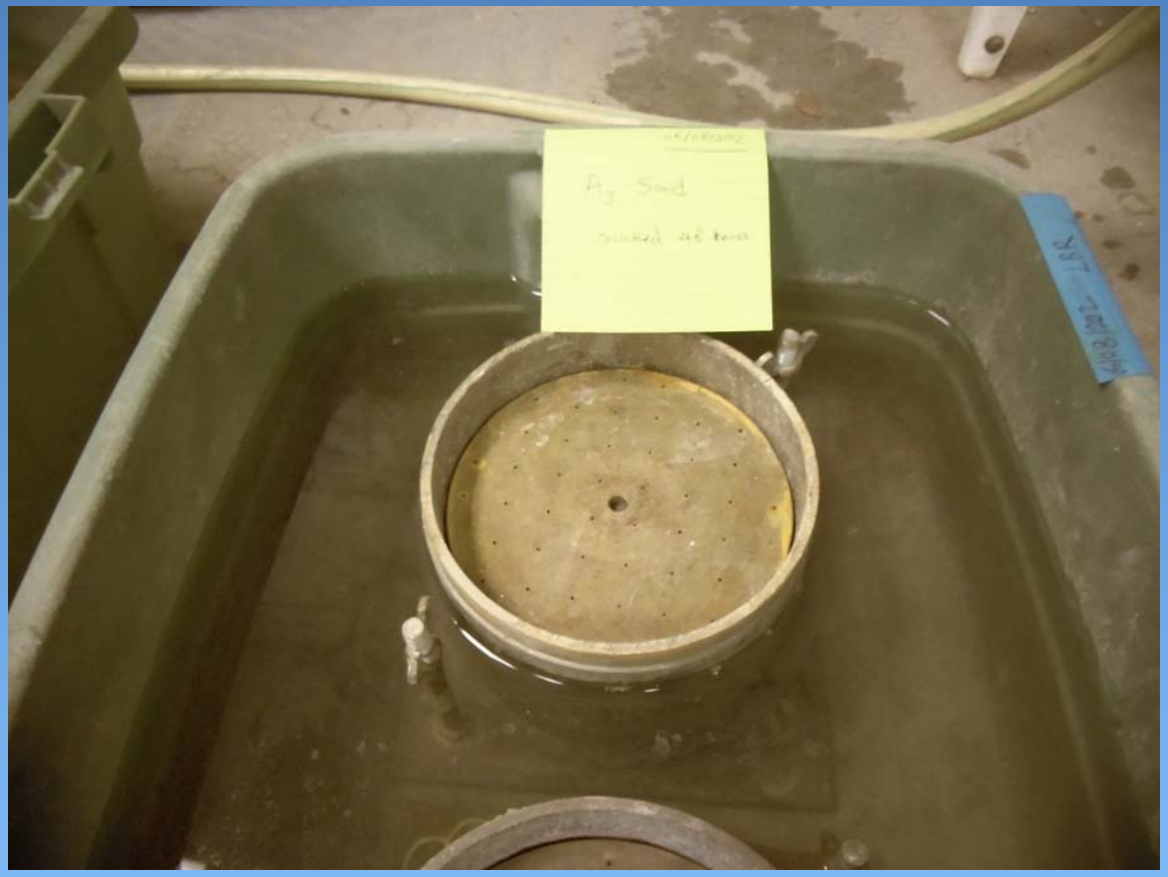
Volumetric Mixing

- Mixing by volume used in the field
- 4%, 8%, 16%, 24%, 32% GTR by volume
- Correspond to 1/2”, 1”, 2”, 3” and 4” GTR layers in a 12” lift

Volumetric Mixing (cont.)

LBR

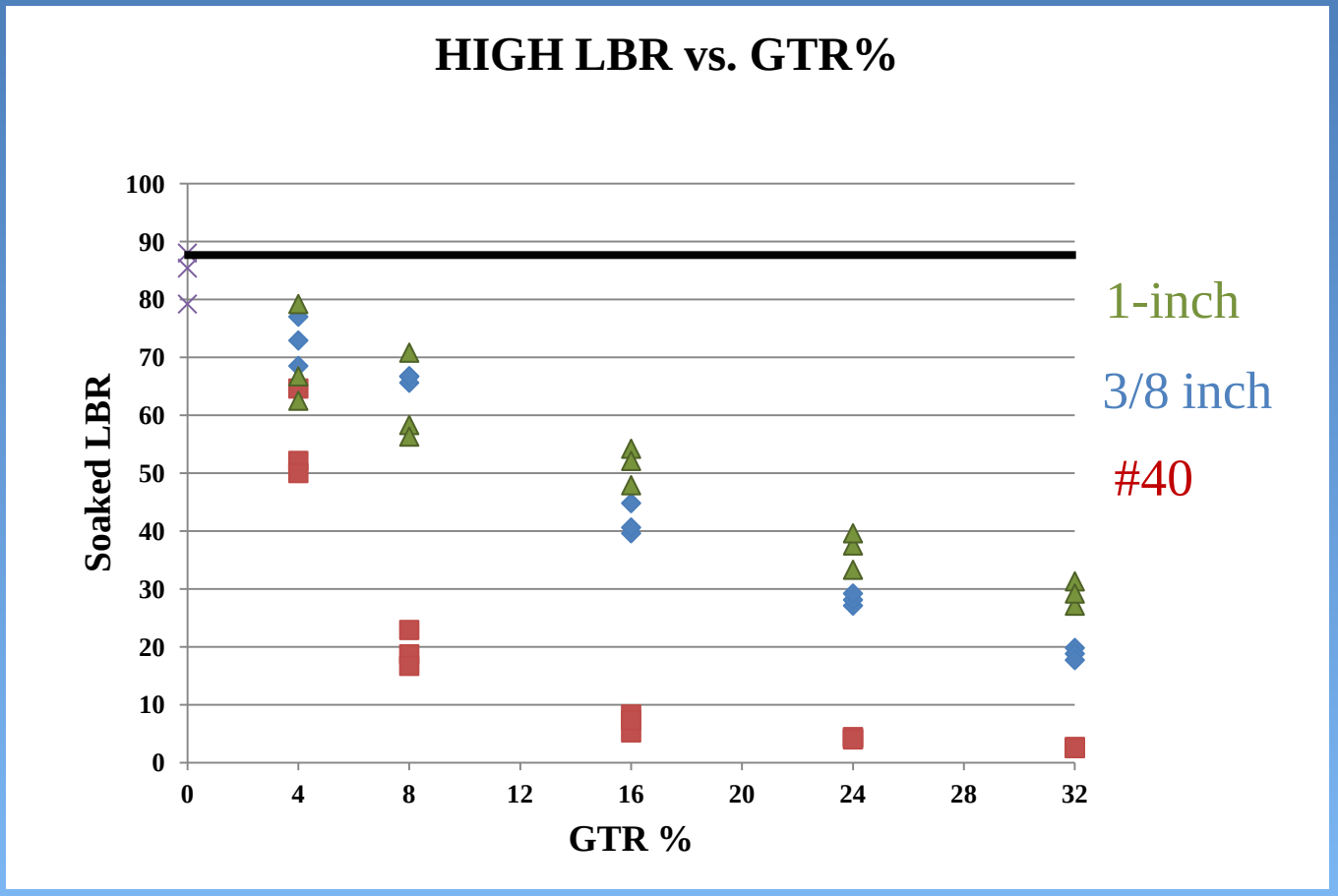
LBR (cont.)



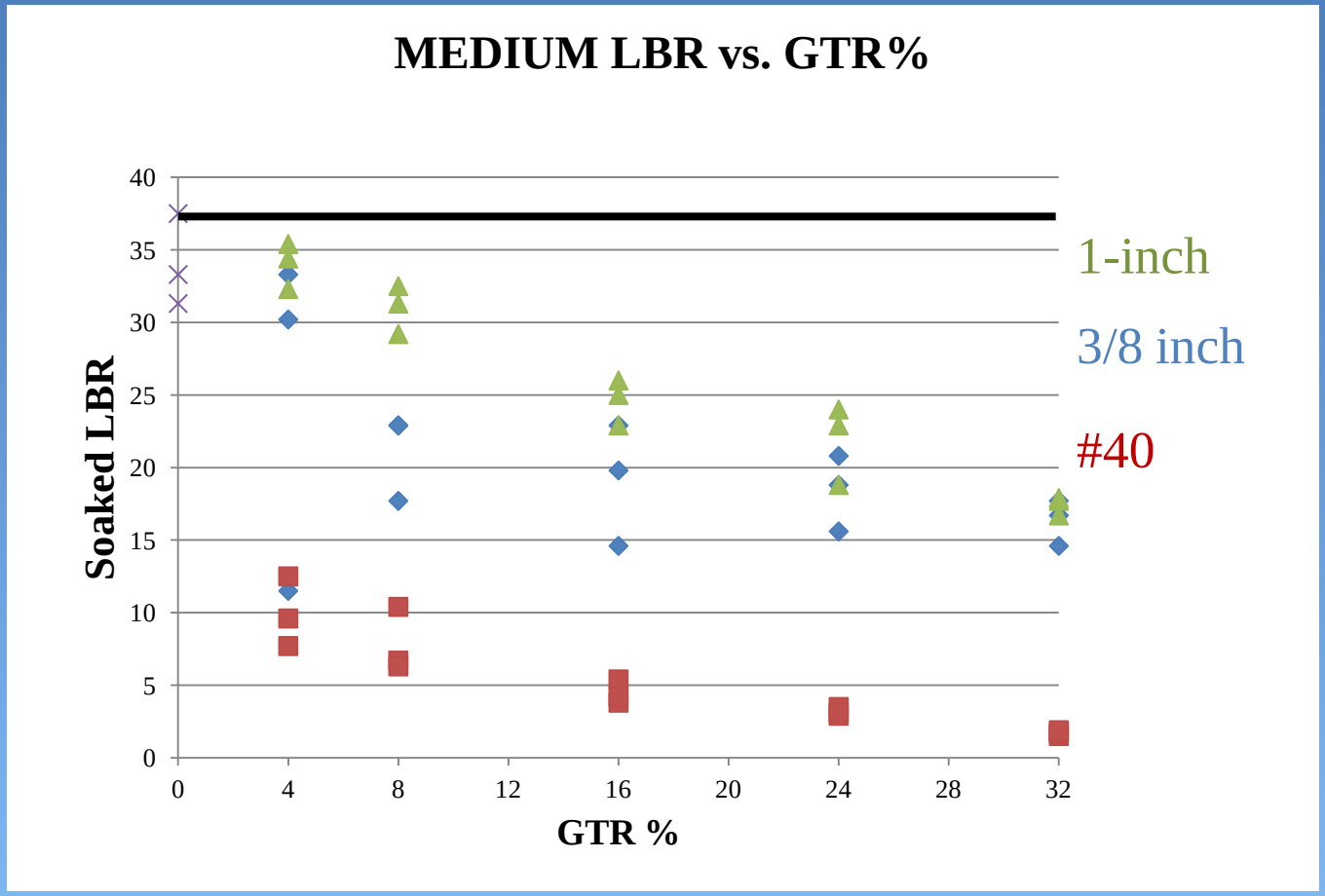
LBR (cont.)

- Limerock Bearing Ratio
  - 15lb surcharge for subgrade

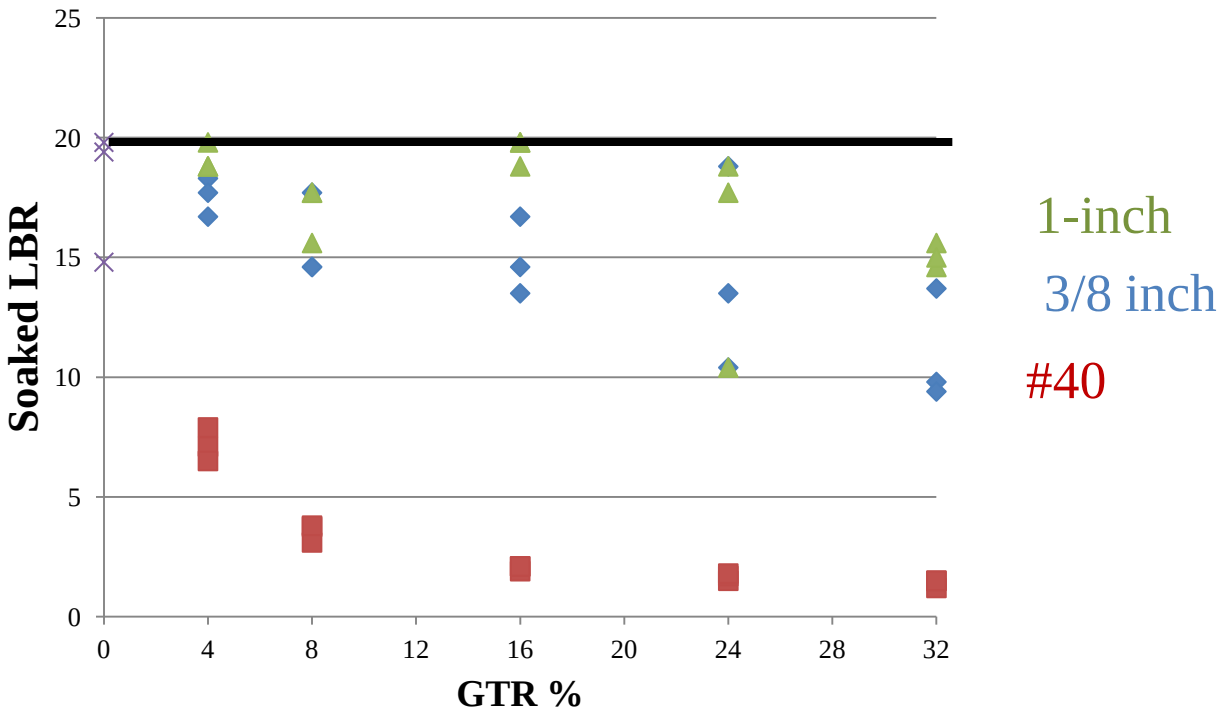
LBR Results


HIGH LBR vs. GTR%
Soaked LBR
100
90
80
70
60
50
40
30
20
10
0
0
4
8
12
16
20
24
28
32
GTR %
1-inch
3/8 inch
#40

LBR Results (cont.)



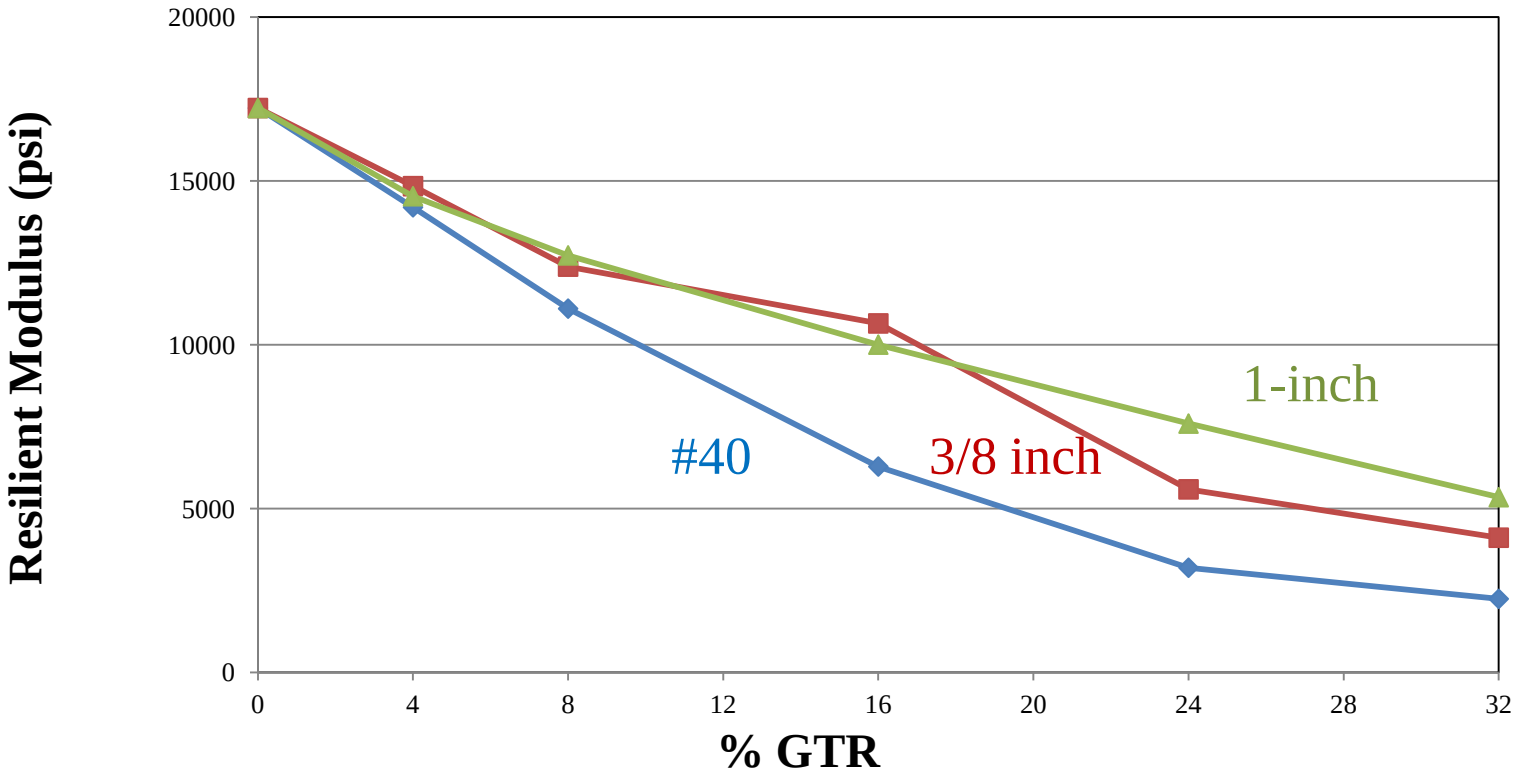
LBR Results (cont.)



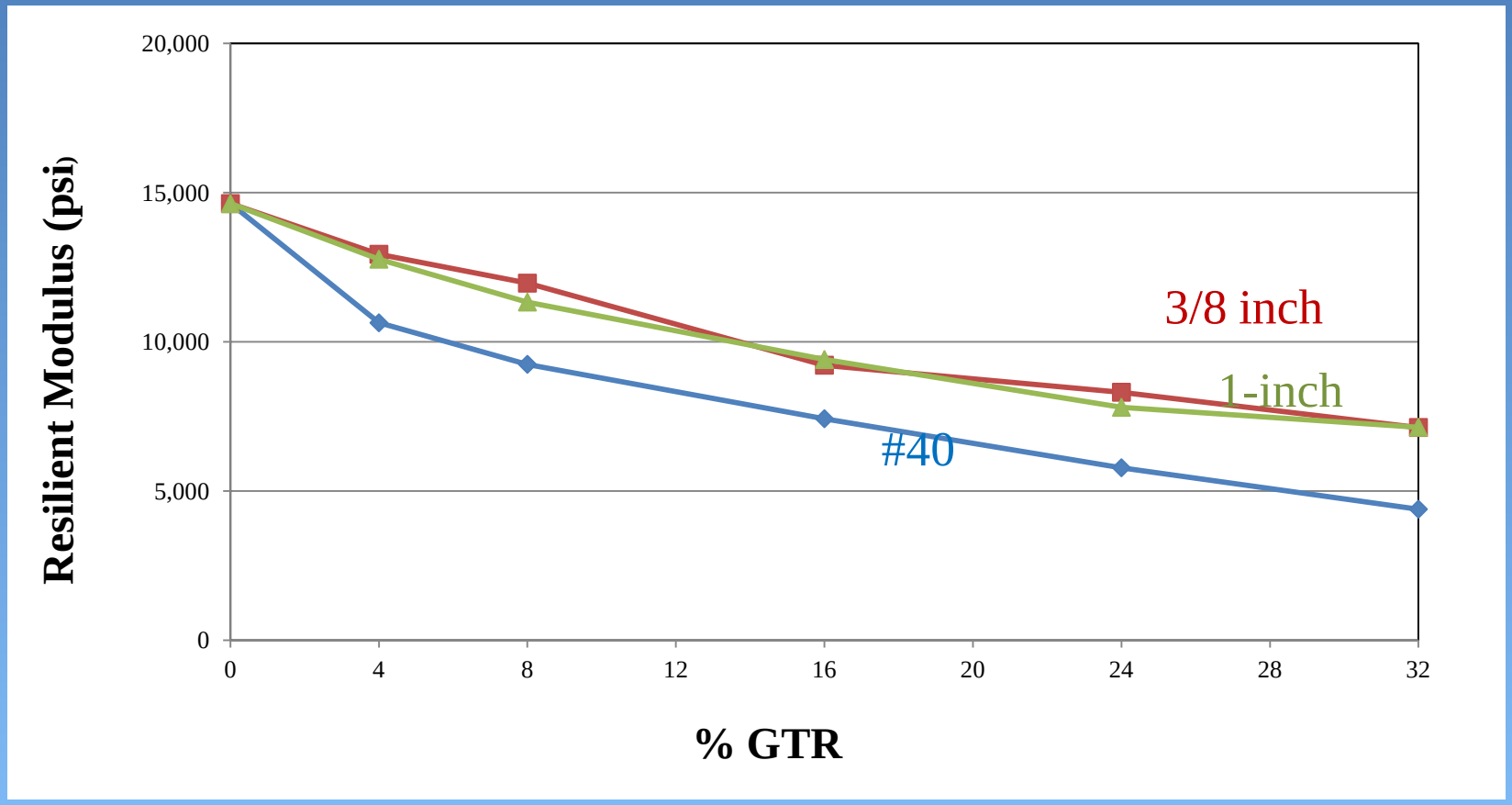
Resilient Modulus

- Tests performed at the State Materials Office (SMO)

% GTR vs. Resilient Modulus for High Soil Blends



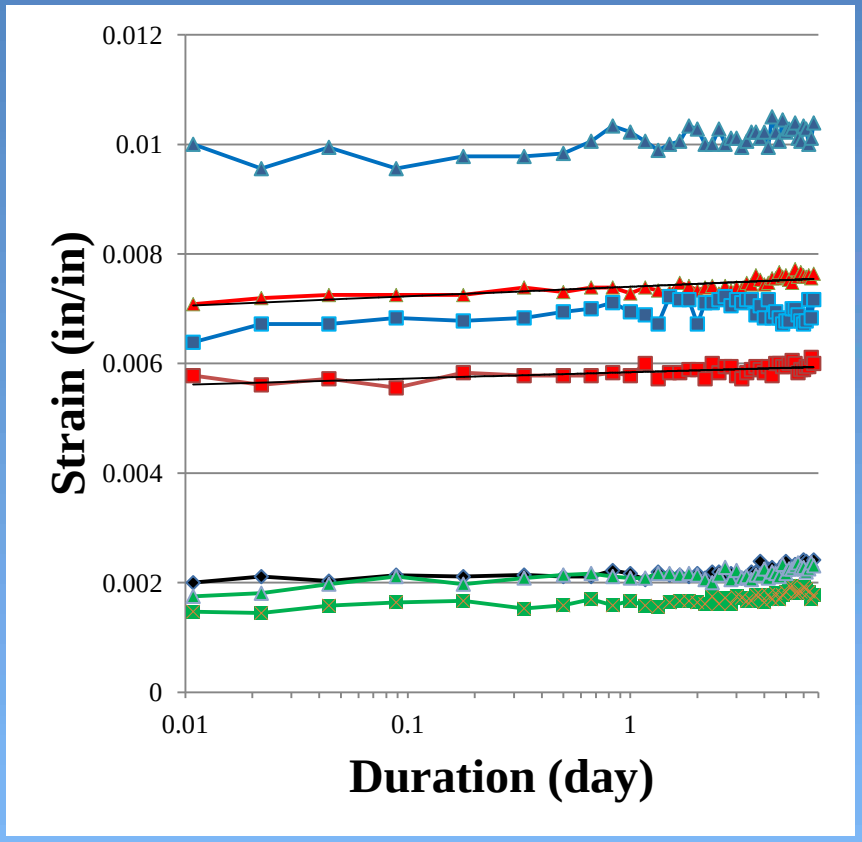
% GTR vs. Resilient Modulus for Medium Soil Blends



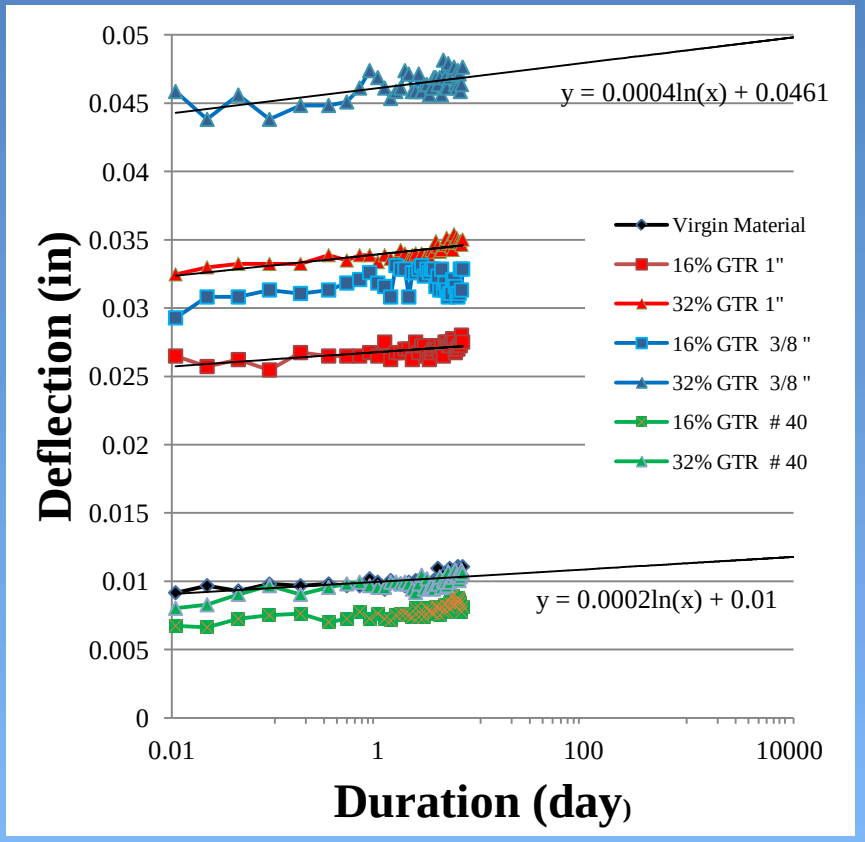
Creep

High LBR Material

Strain vs. Duration for High LBR Material

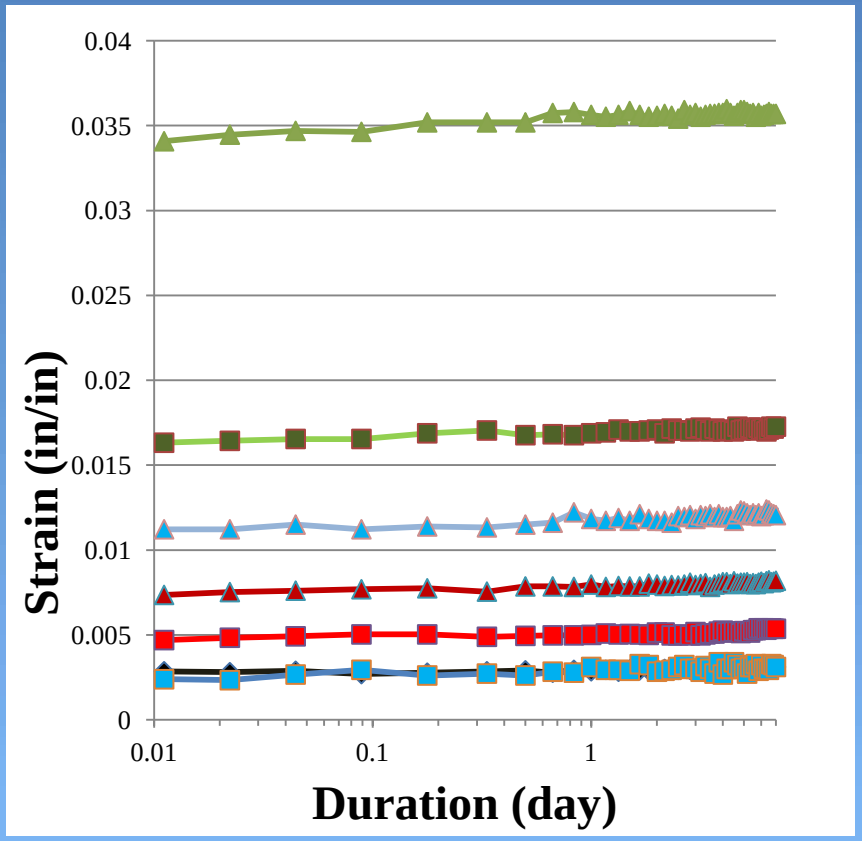


30-Year Deflection Projection for High LBR Material

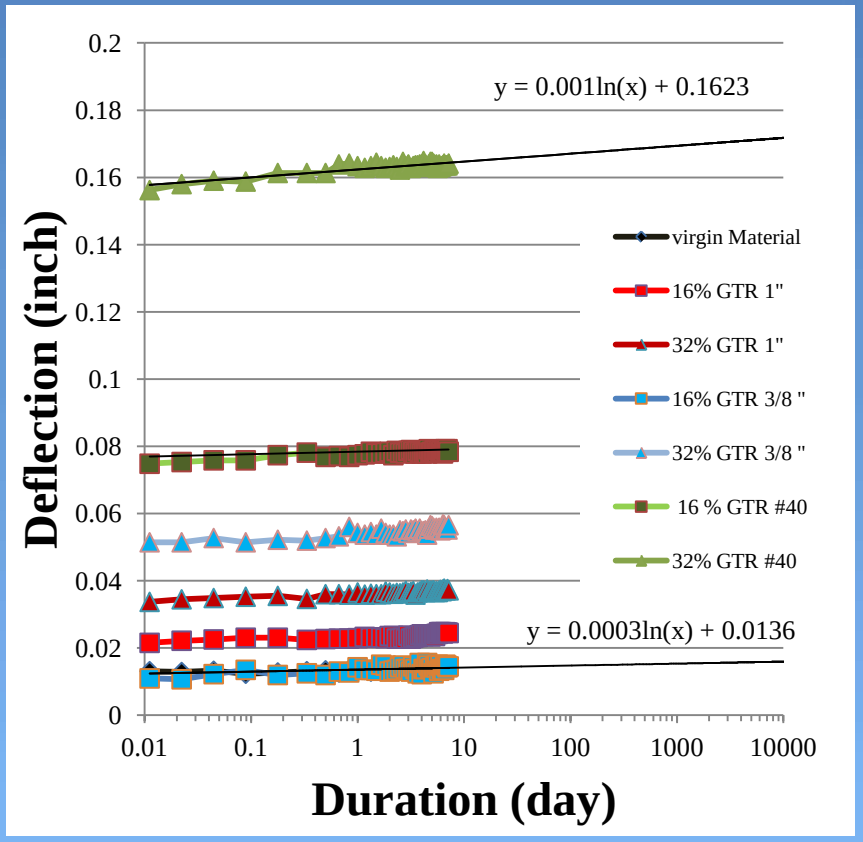


Medium LBR Material

Strain vs. Duration for Medium LBR Material

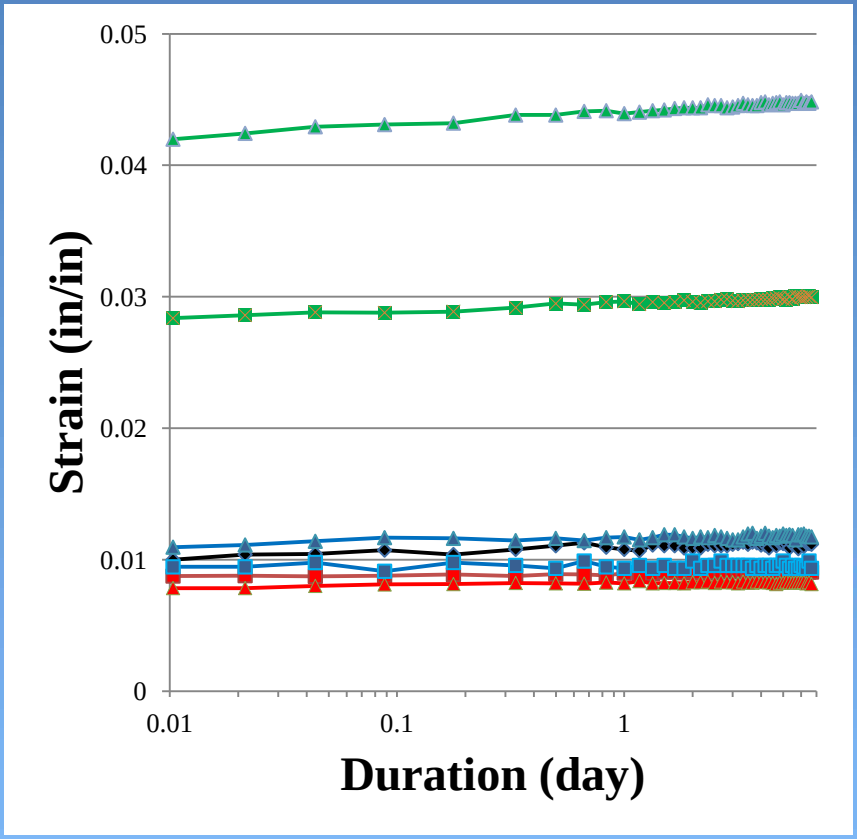


30-Year Deflection Projection for Medium LBR Material

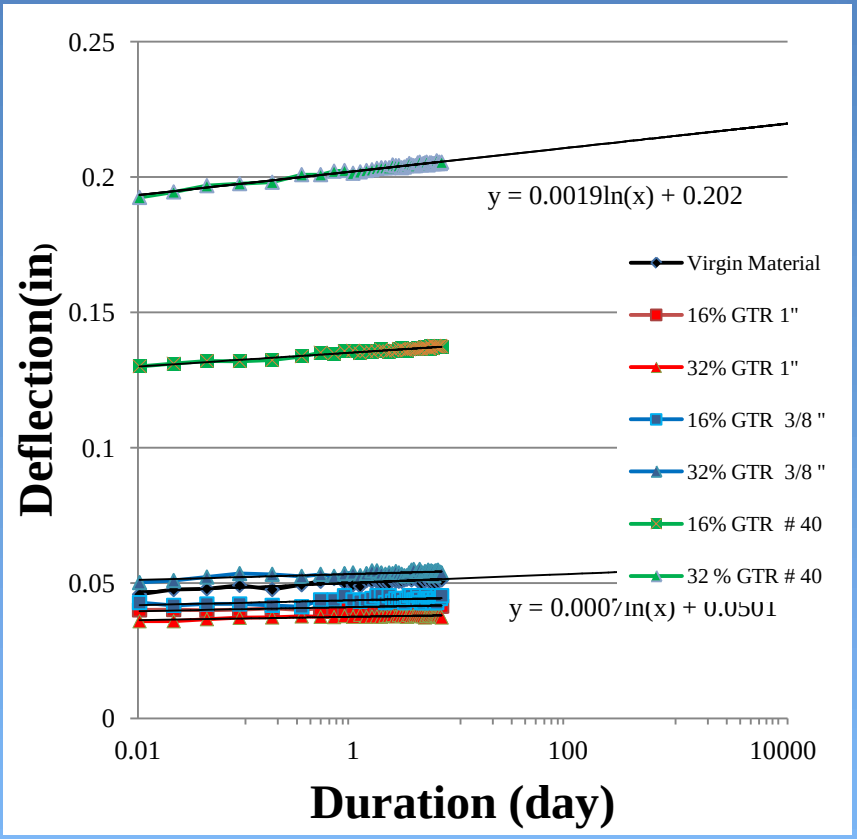


Low LBR Material

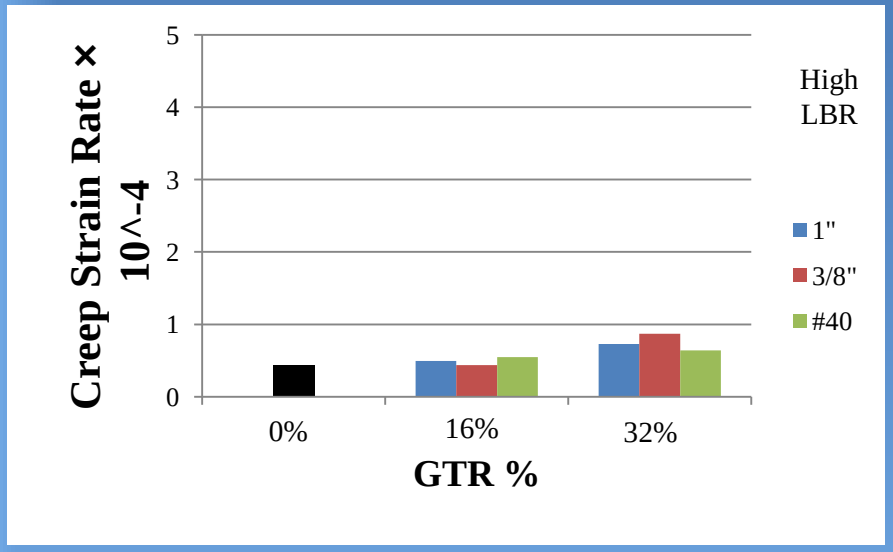
Strain vs. Duration for Low LBR Material

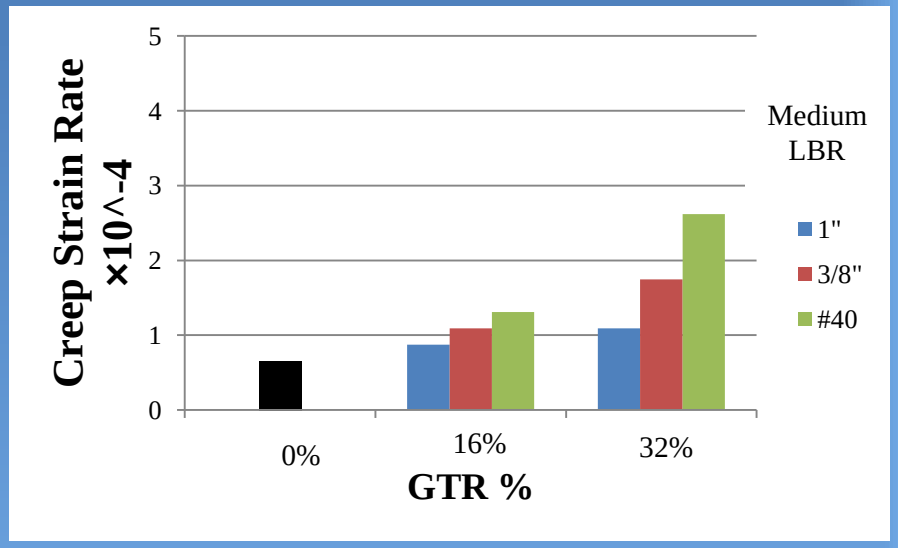


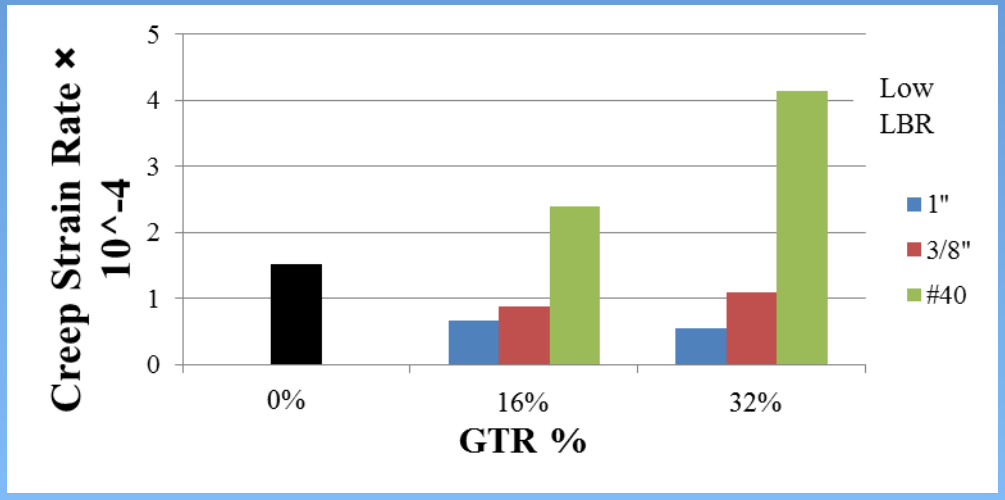
30-Year Deflection Projection for Low LBR Material



Strain Rate vs. GTR % for each Soil Type



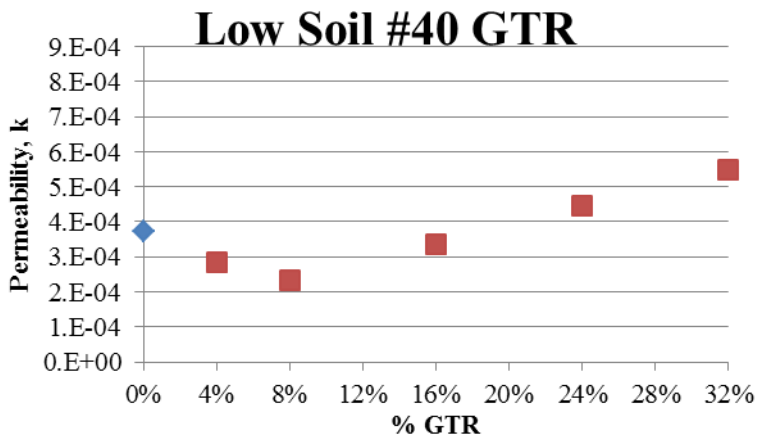




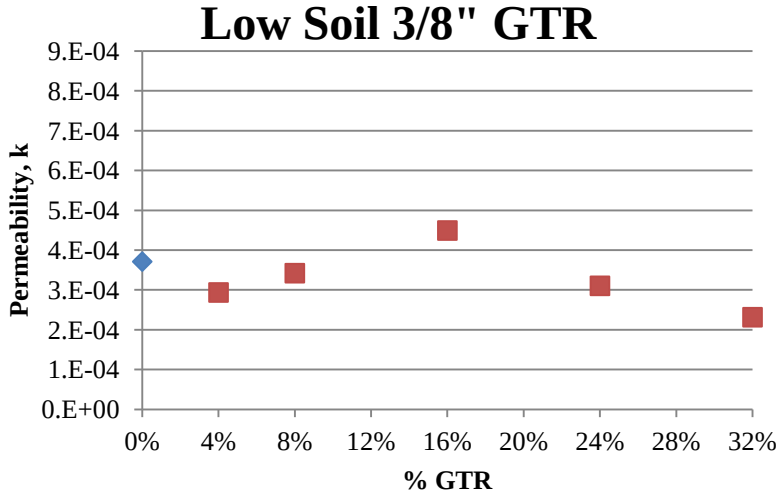
Permeability

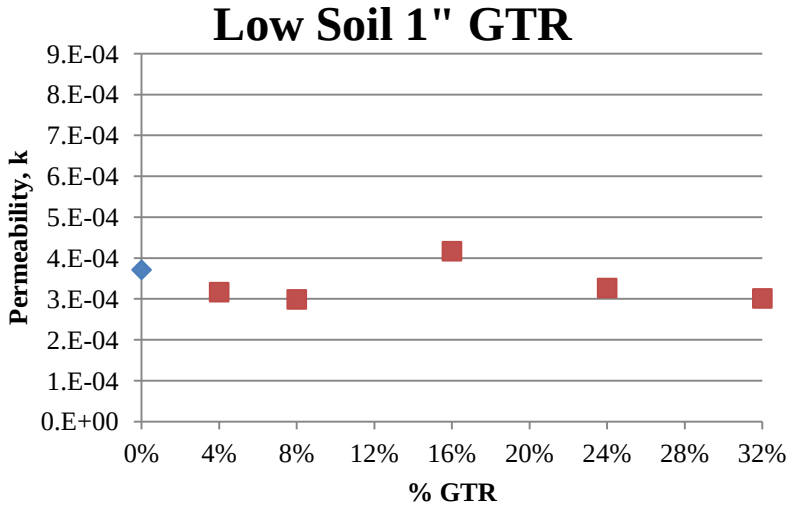
Constant Head Permeability
Test Set-up

Low LBR Material



Soil	GTR	k (cm/sec)
Low LBR	0	3.7E-04
Med LBR	0	4.2E-06
High LBR	0	6.3E-06





Consolidation

Custom 4-inch Consolidation Molds

Summary

- With increasing GTR %:
  - Density decreases
  - LBR decreases
  - Resilient Modulus decreases
  - No significant Creep
  - No significant change in Permeability

Questions