

Performance of Reinforced Test Sections

3 Years Later

**FDOT Project BD 546-7
(completed)**

**Khaled Sobhan
Florida Atlantic University**

Surface distress on SR 15 / US 98 prior to reconstruction in 2008



Site Conditions

Organic Soil

- Depth of 1.5 – 3.0m
- Black with shell fragments
- No visible organic material



Peat

- Depth of 3.0 ~ 6.0m
- Light to dark brown
- Low cohesion/plasticity
- Significant amount of decomposed vegetation

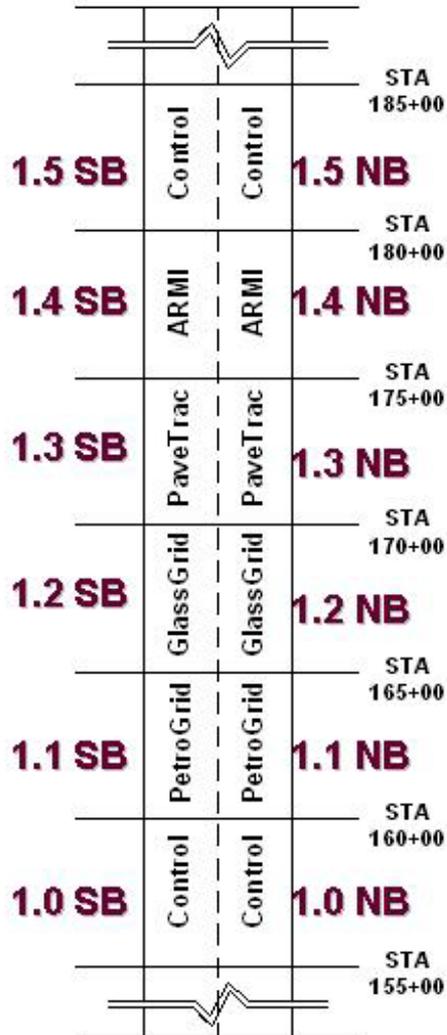


Summary of Properties

Attribute	Silty Muck		Fibrous Peat	
	Range	Mean	Range	Mean
Void Ratio	3.2 - 5.6	3.8	5.7 - 13.9	9.4
Moisture Content, (%)	160 - 330	205	300 - 650	475
Organic Content, (%)	22 - 60	35	25 - 92	76
Unit Weight, (kN/m^3)	10.9 - 11.7	11.4	9.7 - 10.9	10.4
c_u , (kPa)	17 - 23	20	29 - 40	33

LOCATION 1

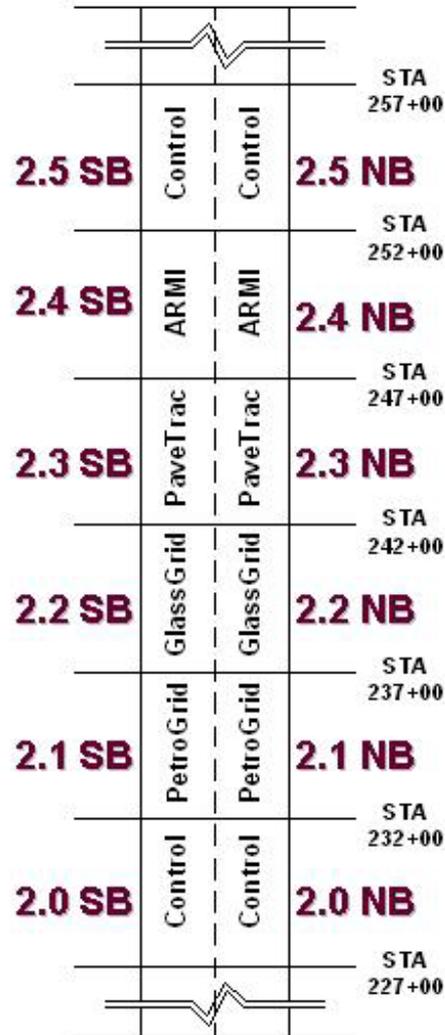
Palm Beach/Martin County Line
(MP 26.519)



Palm Beach Canal Bridge
(MP 19.674)

LOCATION 2

Palm Beach/Martin County Line
(MP 26.519)



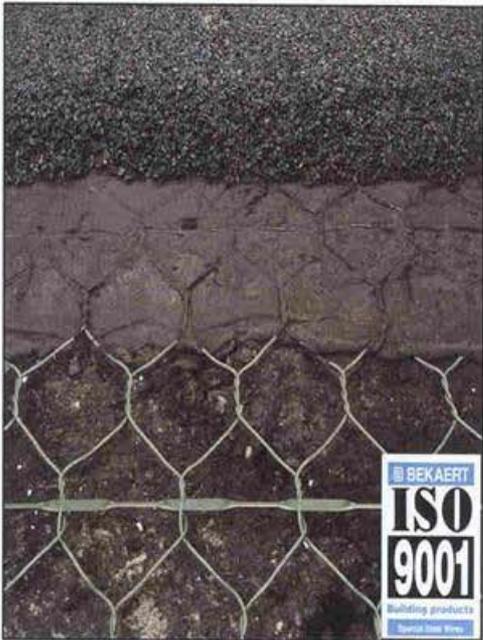
Palm Beach Canal Bridge
(MP 19.674)

Test Project Overview

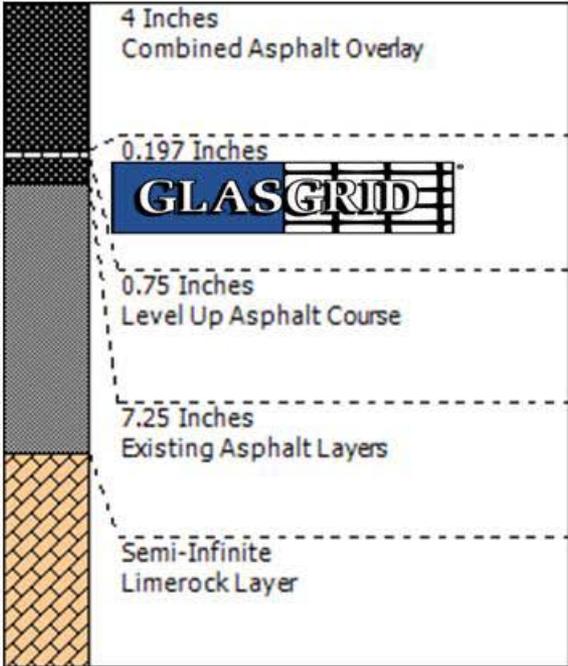
- Two test locations
- Each 3000 ft. long, separated by 4200 ft.
- Four reinforced test sections and two control sections per lane direction, each 500 ft.
- Three reinforcement materials plus ARMI
- Test sections replicated in northbound and southbound lanes

Reinforcing Materials

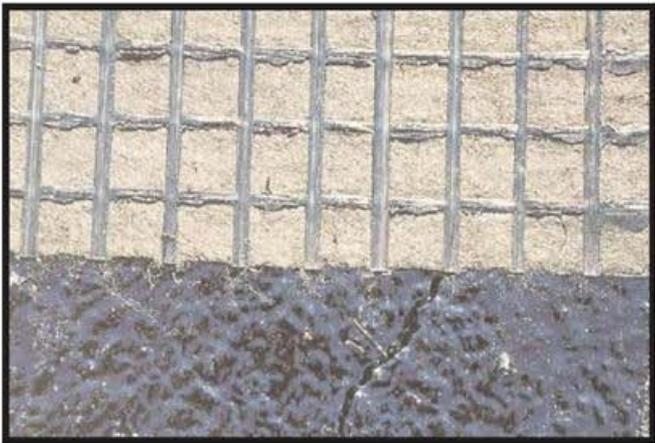
PAVE TRAC MT-1



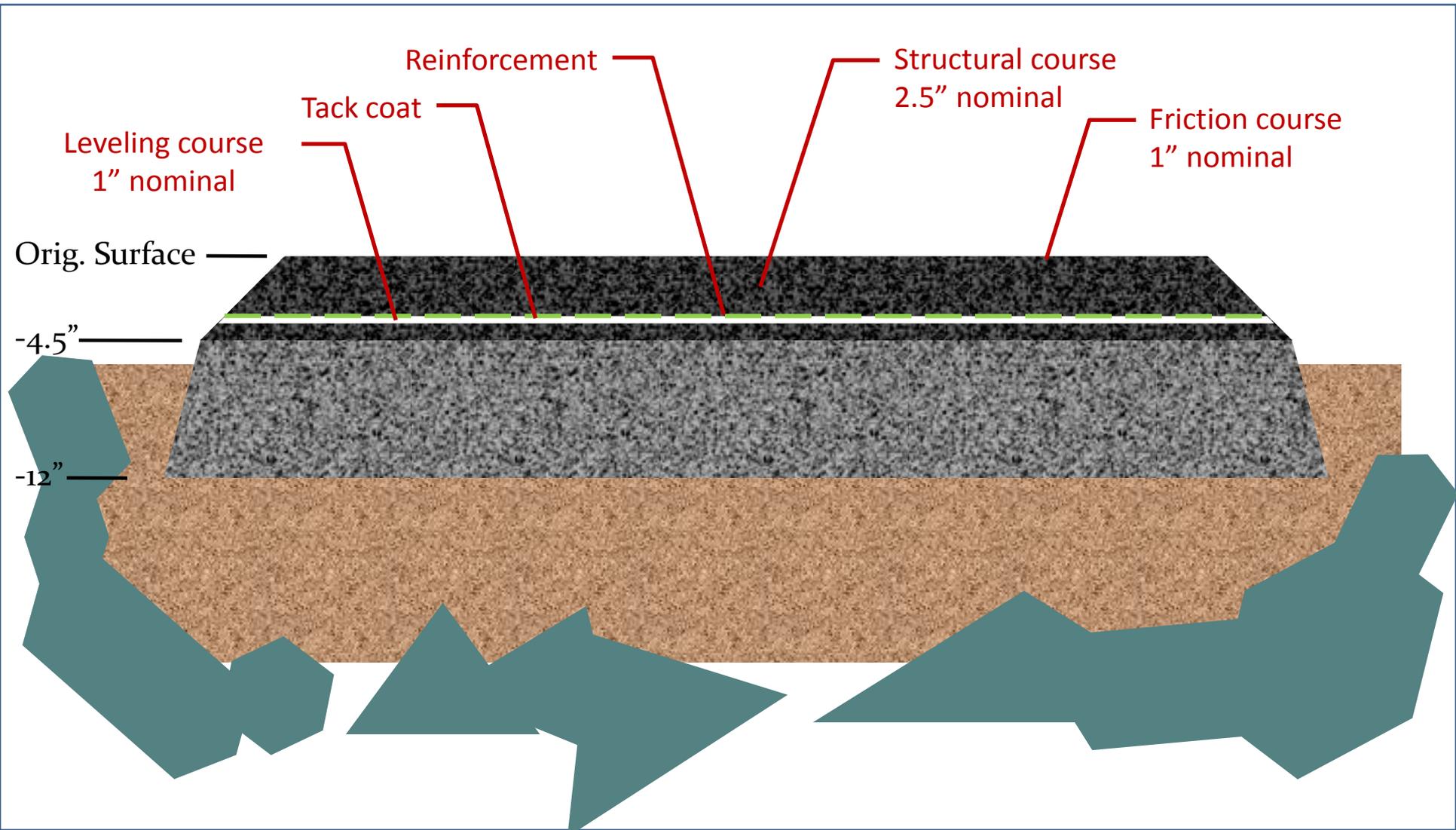
GLASGRID 8501



PETRO GRID 4582

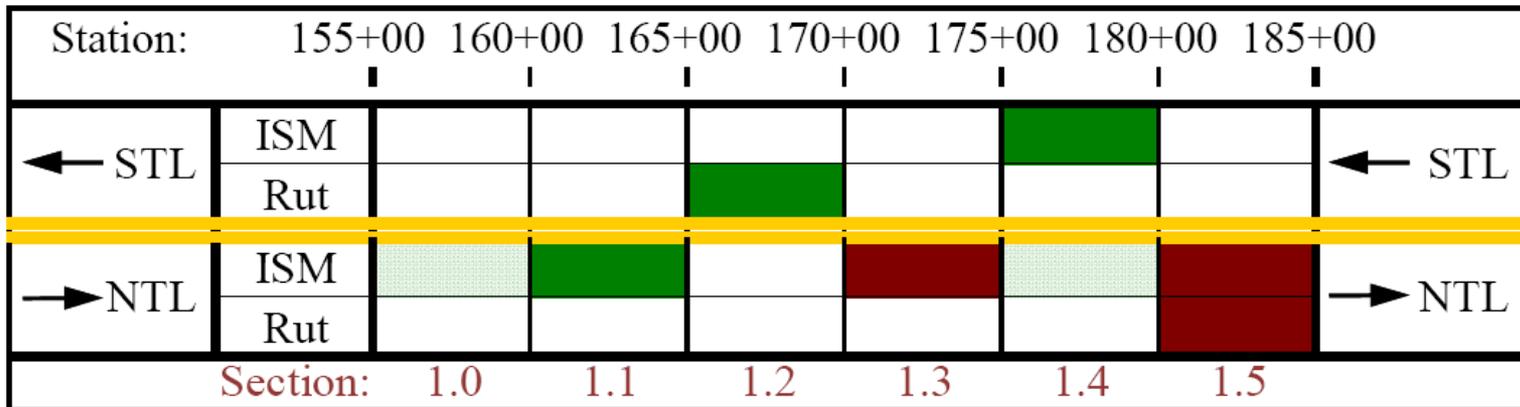


Construction Sequence

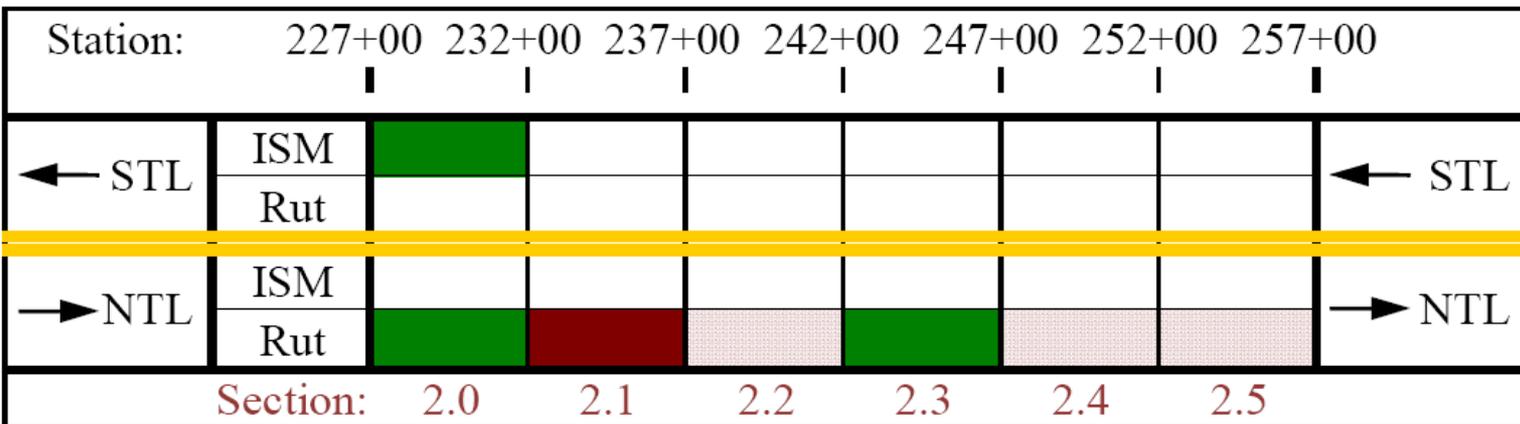


SR-15 Summary Charts: Pre-construction Conditions

Test Location 1



Test Location 2



Key

-  Section is statistically dissimilar to not more than one other section
-  Section is stiffer or less rutted than two other sections
-  Section is stiffer or less rutted than three or more other sections
-  Section is softer or more rutted than two other sections
-  Section is softer or more rutted than three or more other sections

Note: All comparisons are between sections in the same lane and location

Summary of Pre-construction Analysis

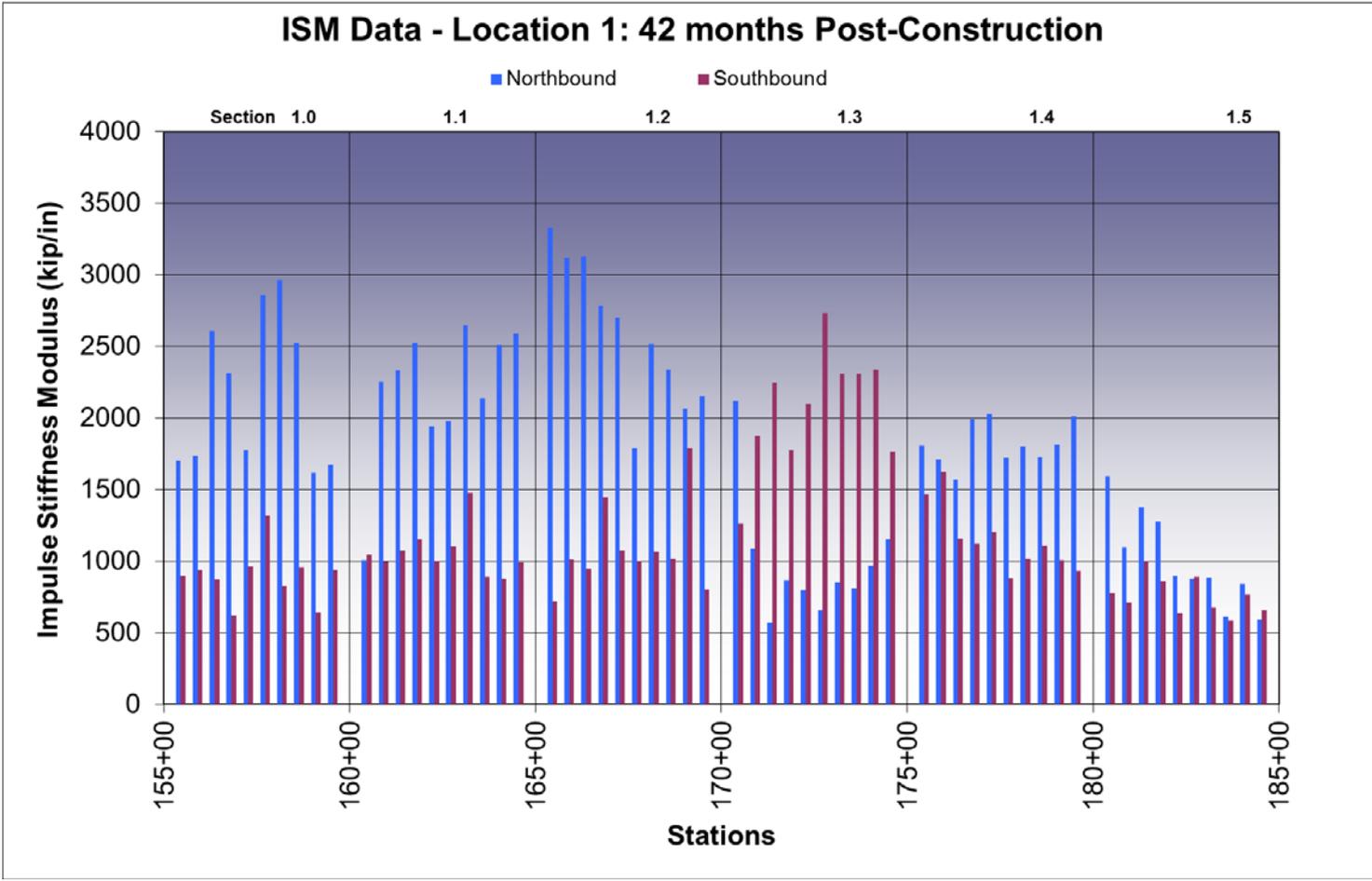
A sufficient number of test sections are statistically similar for valid future comparisons of pavement performance.

Post-construction Tests and Analysis

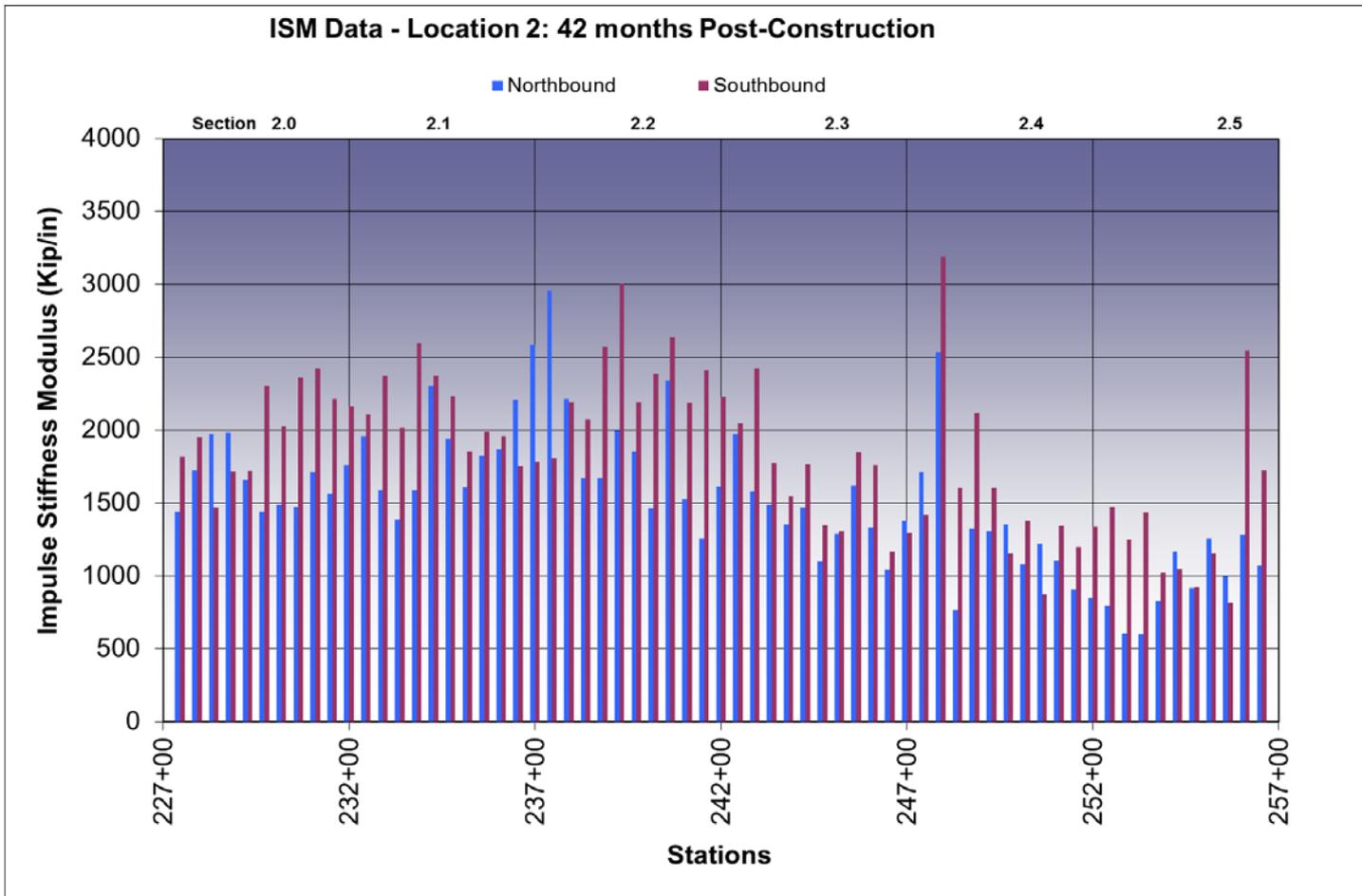
- Conducted March , 2009; April 2010; April 2011, April 2012
- Falling Weight Deflectometer (FWD) Tests
- Rut measurements
- Cracking
- Measurements made at same points as pre-construction tests

Post-construction 42 months ISM Data

Test Location 1

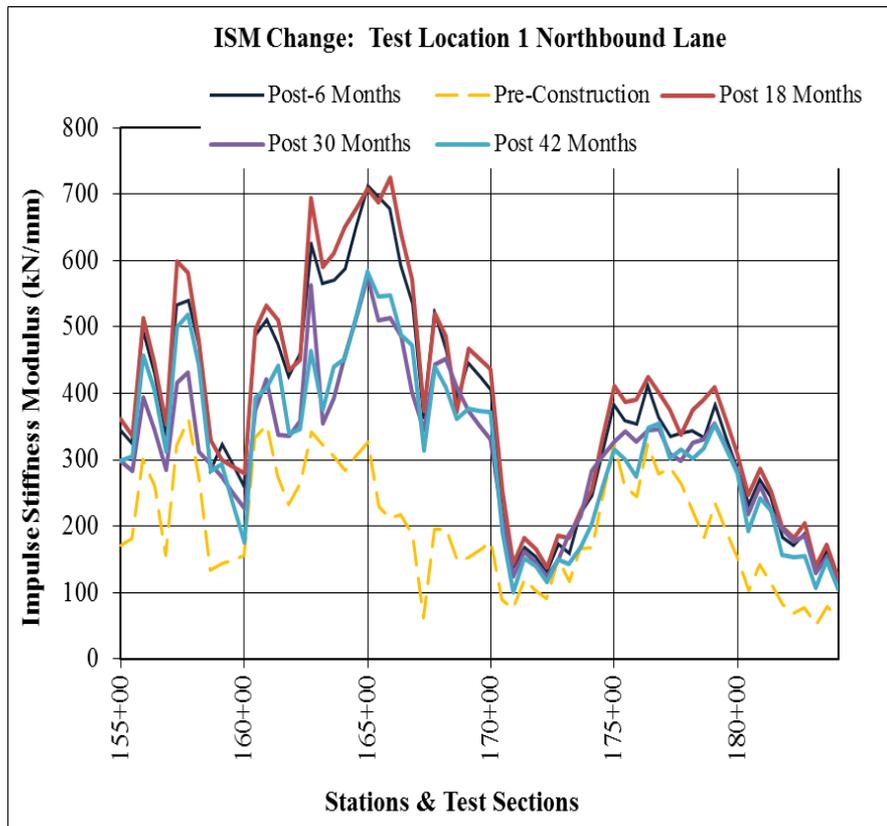


Post-construction 42 months ISM Data Test Location 2

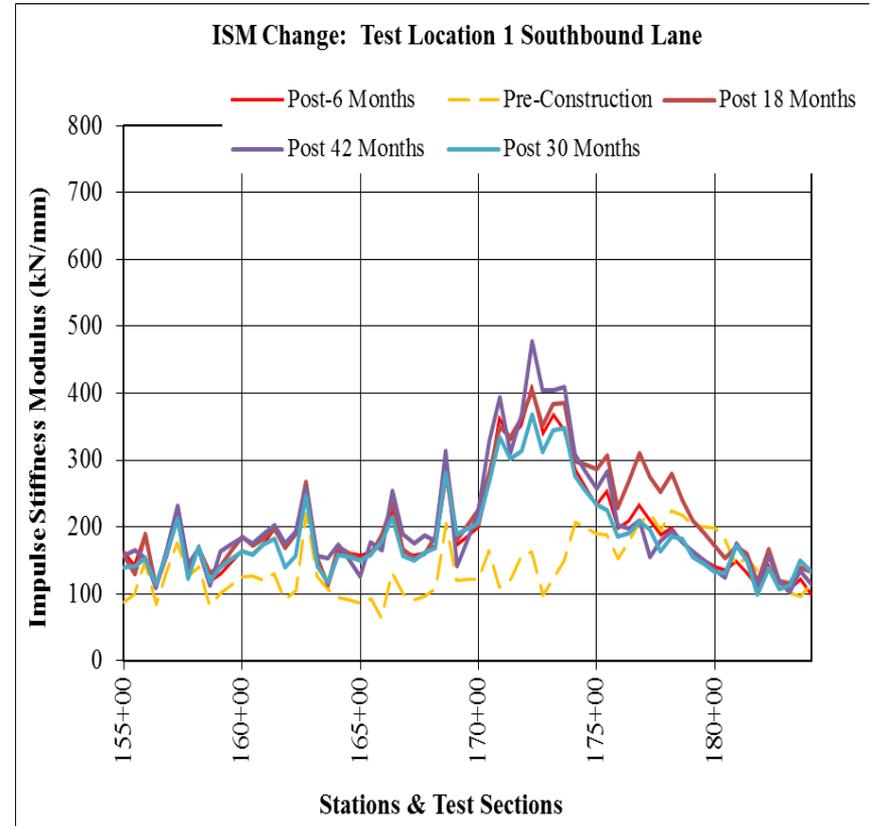


ISM Data Post-construction vs Pre-construction Location 1

Location 1 Northbound

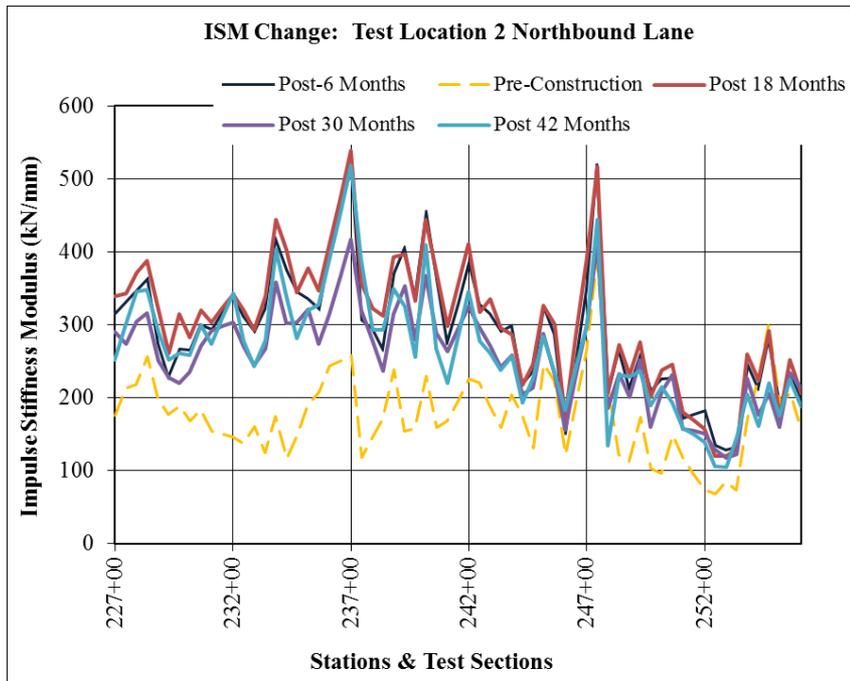


Location1 Southbound

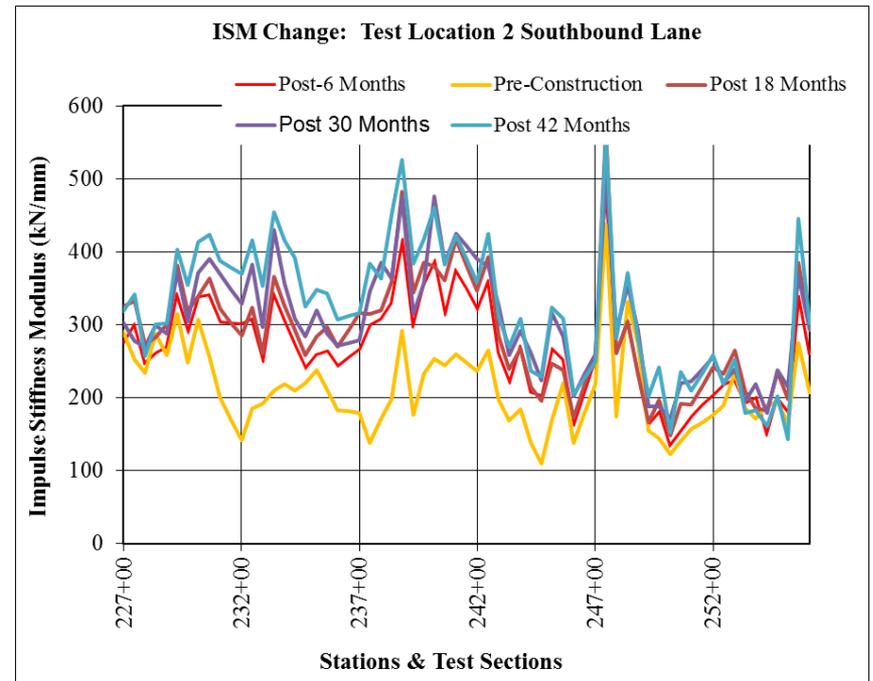


ISM Data Post-construction vs Pre-construction Location 2

Location 2 Northbound

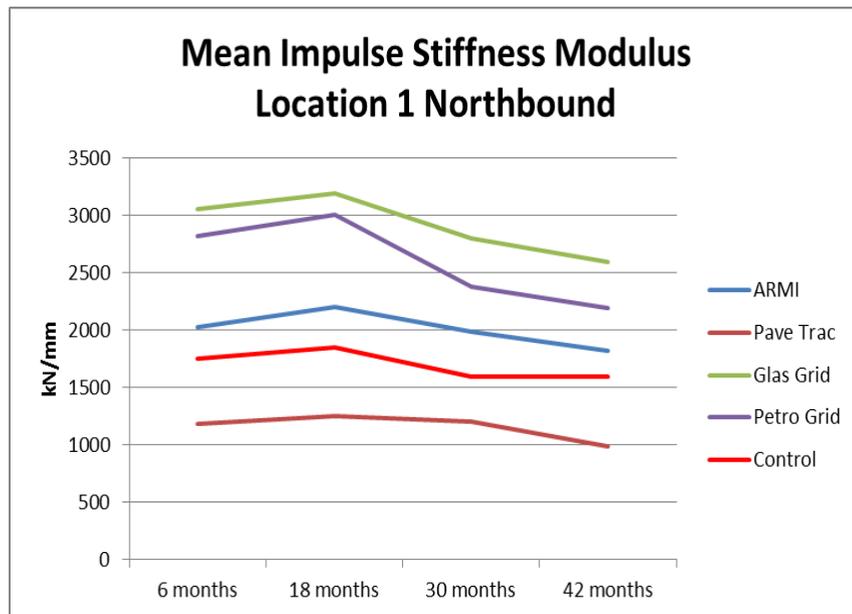


Location 2 Southbound

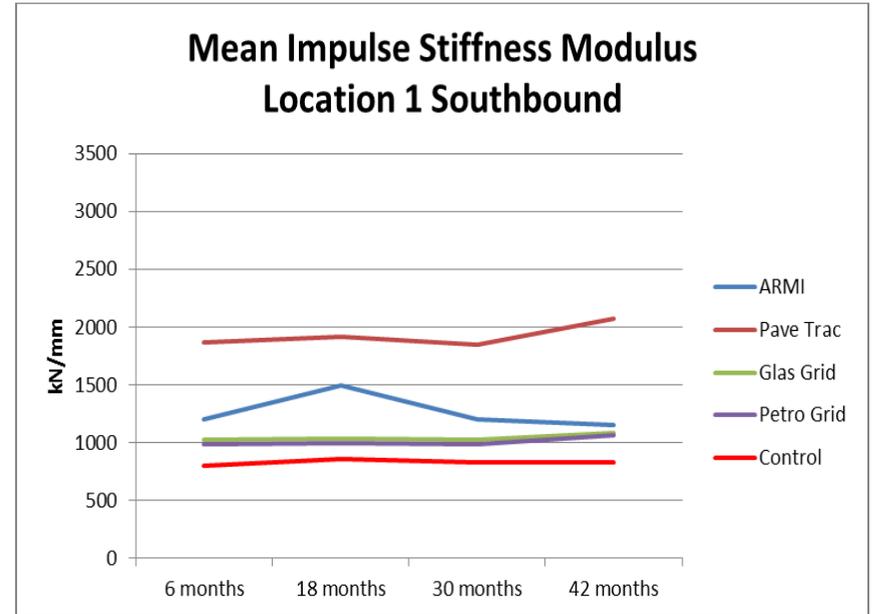


Mean Impulse Stiffness Modulus Location 1

Location 1 Northbound



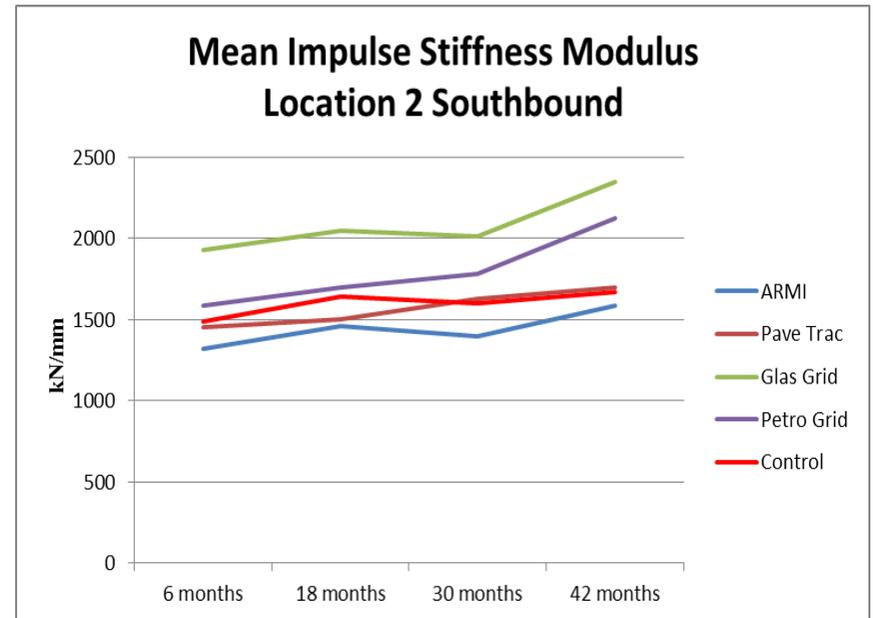
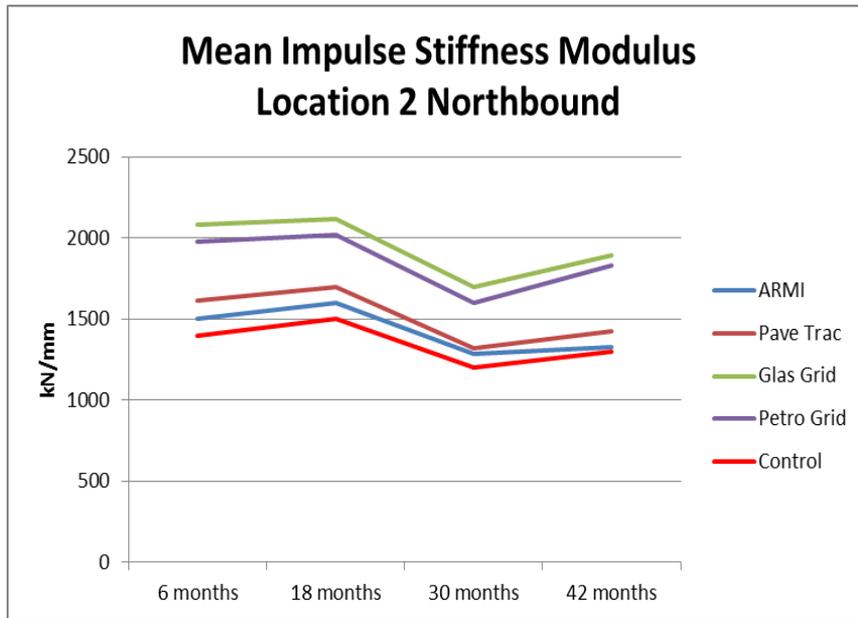
Location 1 Southbound



Mean Impulse Stiffness Modulus Location 2

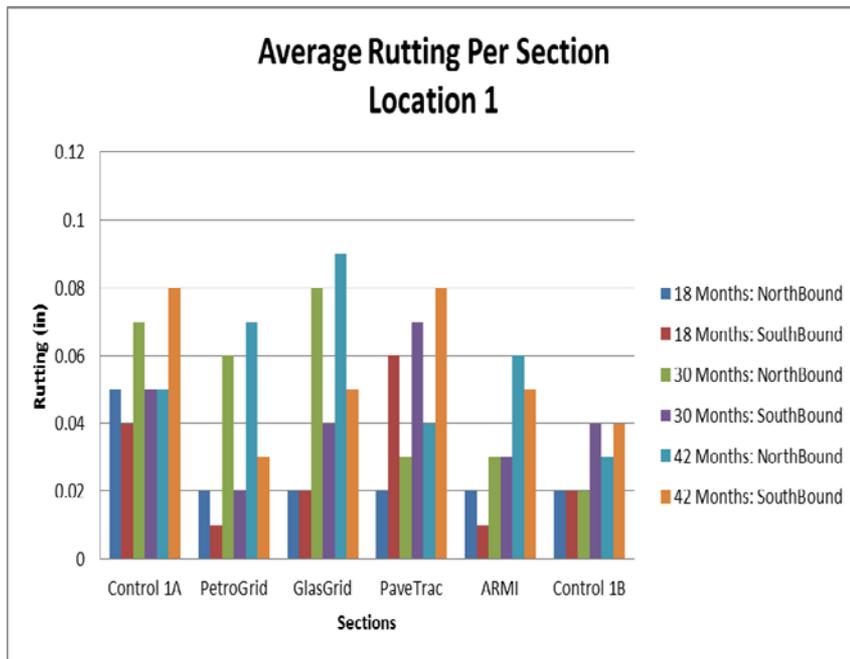
Location 2 Northbound

Location 2 Southbound

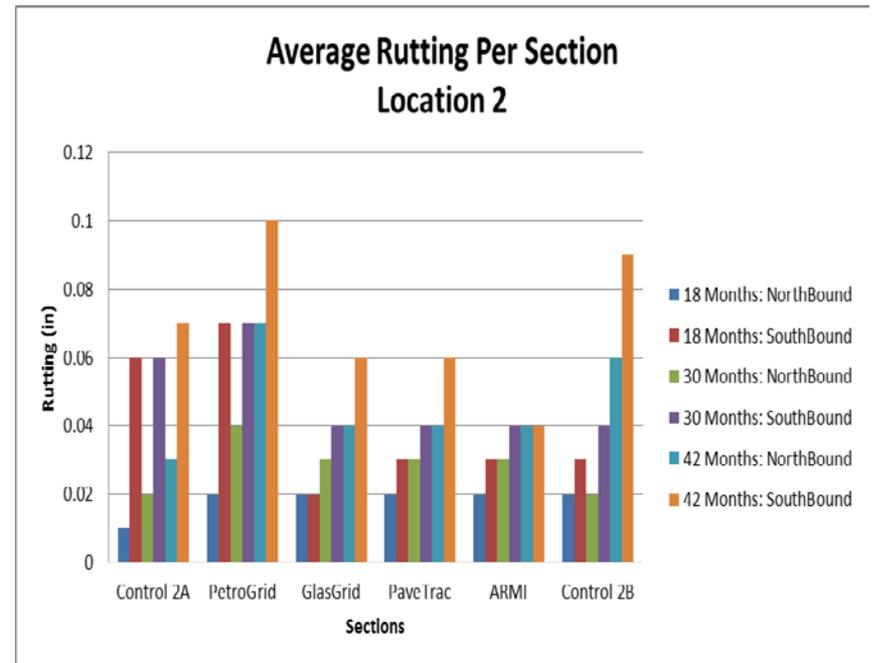


Average Rutting Per Section

Location 1

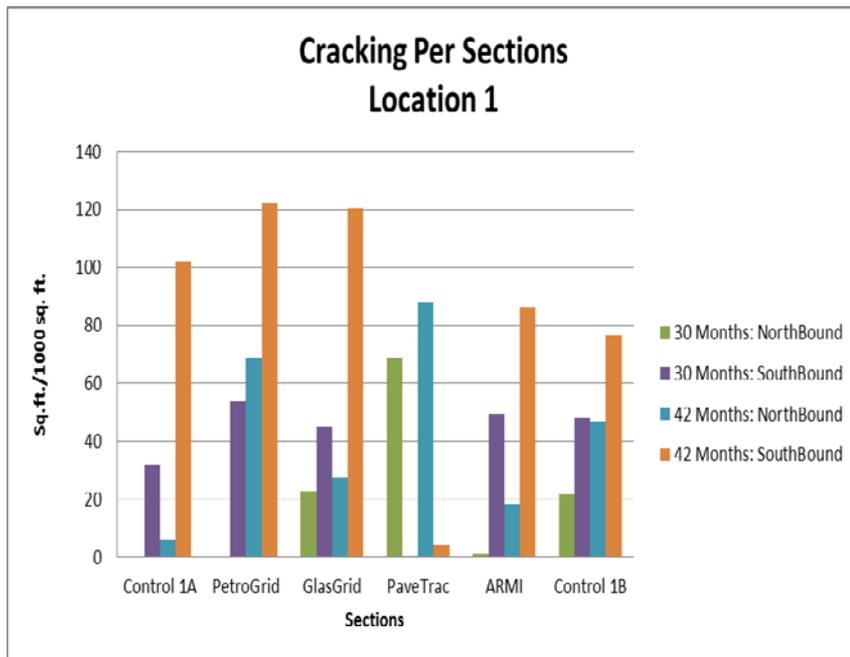


Location 2

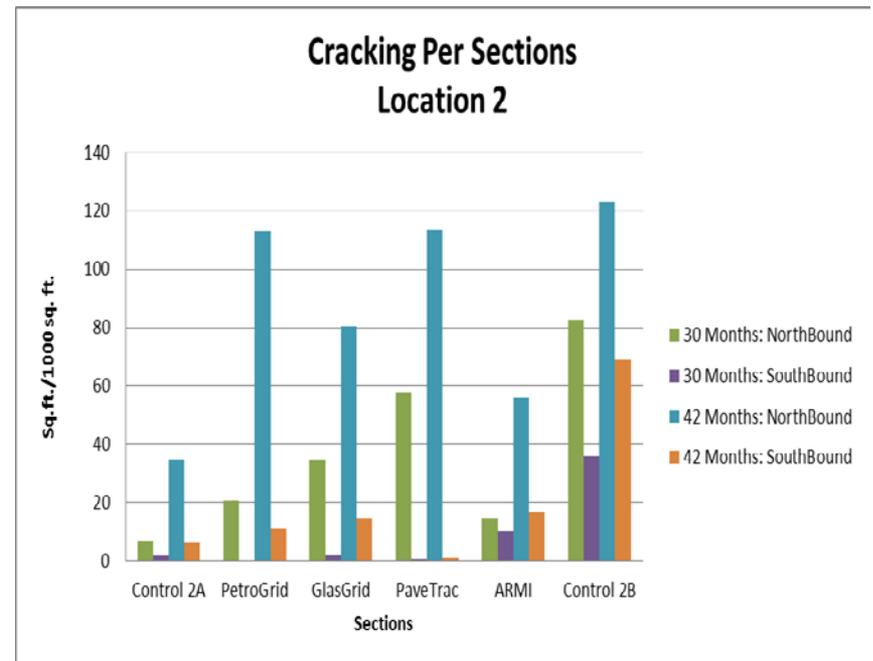


Average Cracking Per Section

Location 1



Location 2



Contribution from reinforcements

For every section:

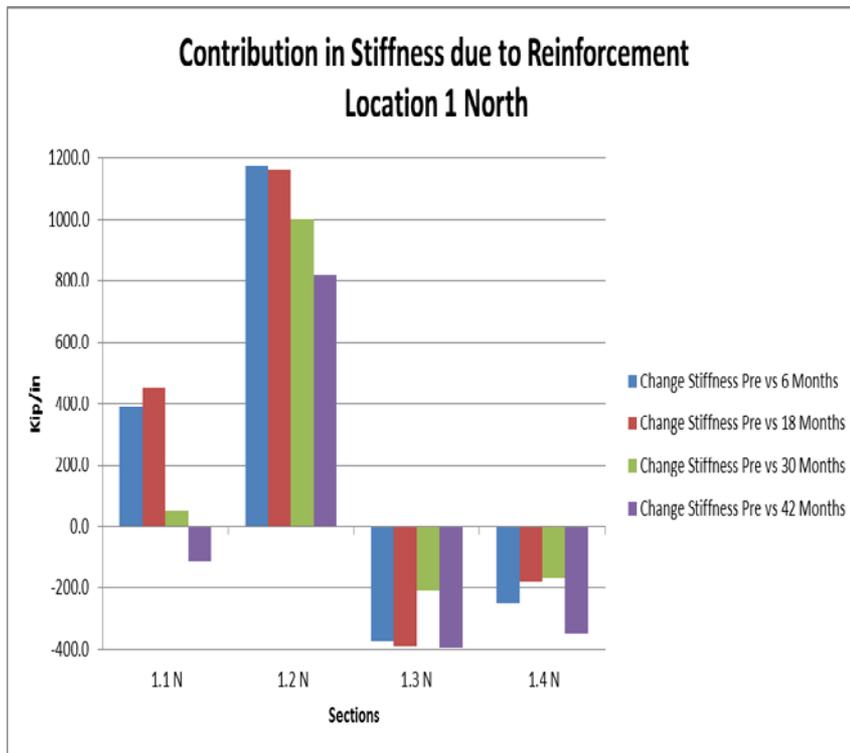
□ The difference in the stiffness increase was compared with the average increase of the control sections in the same lane and test location:

Gain in stiffness due to reinforcement ,

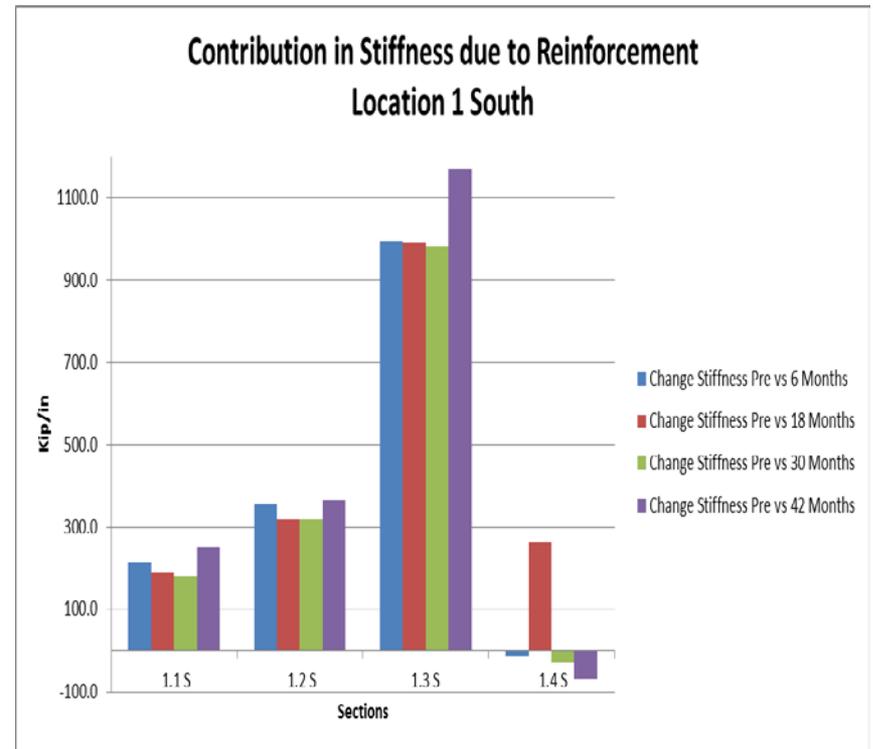
$$G_R = \Delta ISM_{M-R} - \Delta ISM_{M-C}$$

Contribution of Reinforcement

Location 1 Northbound: G_R

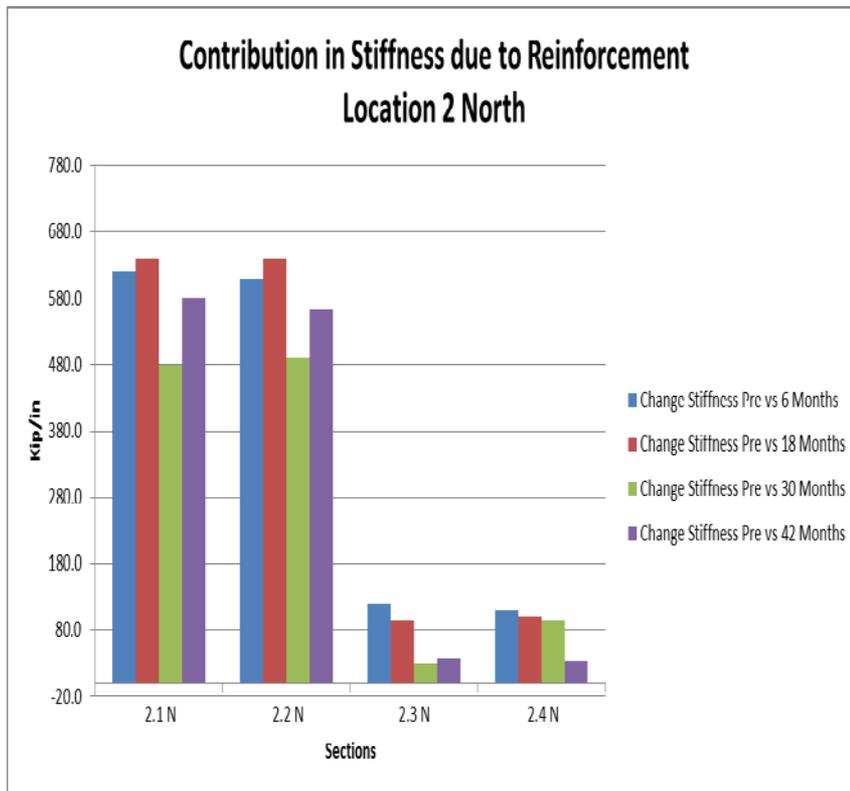


Location 1 Southbound: G_R



Contribution of Reinforcement

Location 2 Northbound: G_R



Location 2 Southbound: G_R



Conclusions (3 Years Later)

- PetroGrid, GlasGrid and PaveTrac embedded sections are maintaining higher pavement stiffness in 11 out of 12 test sections, compared to control sections. 9 sections are performing better than the ARMI sections. 3 out of 4 ARMI sections are performing better than the control sections.
- Rutting is increasing with age in all test sections. Most reinforced sections showing lower rutting than at least one control section; mixed performance

- Cracking significantly increased between 30 and 42 months. Most reinforced sections showing lower cracking than at least one control section; mixed performance
- The concept of *Gain in Stiffness*, G_R , was developed to delineate the contribution of the individual reinforcing materials from the overall improvement in stiffness. The reinforcements continue to maintain their effectiveness over control sections in 11/12 reinforced sections and 2/4 ARMI sections.