LTRC On-Going Project:
ROLLER COMPACTED CONCRETE OVER SOIL CEMENT UNDER ACCELERATED LOADING

Preliminary Test Section Results

Zhong Wu, Ph.D., P.E.

July 8, 2014

LTRC RCC Showcase, Baton Rouge, LA

Outline

- In Situ Testing during the Construction
- Monitoring and Accelerated Loading of RCC Pavement Sections – Section 4 Results

Introduction

- Six full-scale, RCC-surfaced pavement test sections were constructed at the PRF of LTRC
  - Each section: 71.7-ft long and 13-ft wide
- The RCC sections will be accelerated-loaded to a failure by a vehicle load simulator device called *ATLaS 30*, under a natural, southern Louisiana weather and subgrade condition.

Constructed RCC Test Sections

8 " RCC
12” Cement Treated Base
6.5" new soil subgrade
Existing Subgrade

Section 1

6 " RCC
12” Cement Treated Base
6.5" new soil subgrade
Existing Subgrade

Section 2

4"RCC
12” Cement Treated Base
6.5"new subgrade soil
Existing Subgrade

Section 3

8 " RCC
8.5” Soli Cement Base
10" Cement Treated Subgrade
Existing Subgrade

Section 4

6 " RCC
8.5” Soli Cement Base
10" Cement Treated Subgrade
Existing Subgrade

Section 5

4"RCC
8.5” Soli Cement Base
10" Cement Treated Subgrade
Existing Subgrade

Section 6

RESEARCH CENTER

Objectives

(1) to determine the structural performance and load carrying capacity of thin RCC surfaced pavements

(2) to determine the applicability of using a thin RCC surfaced pavement structure (with cement treated or stabilized base) as a design option for low- and high-volume pavement design in Louisiana

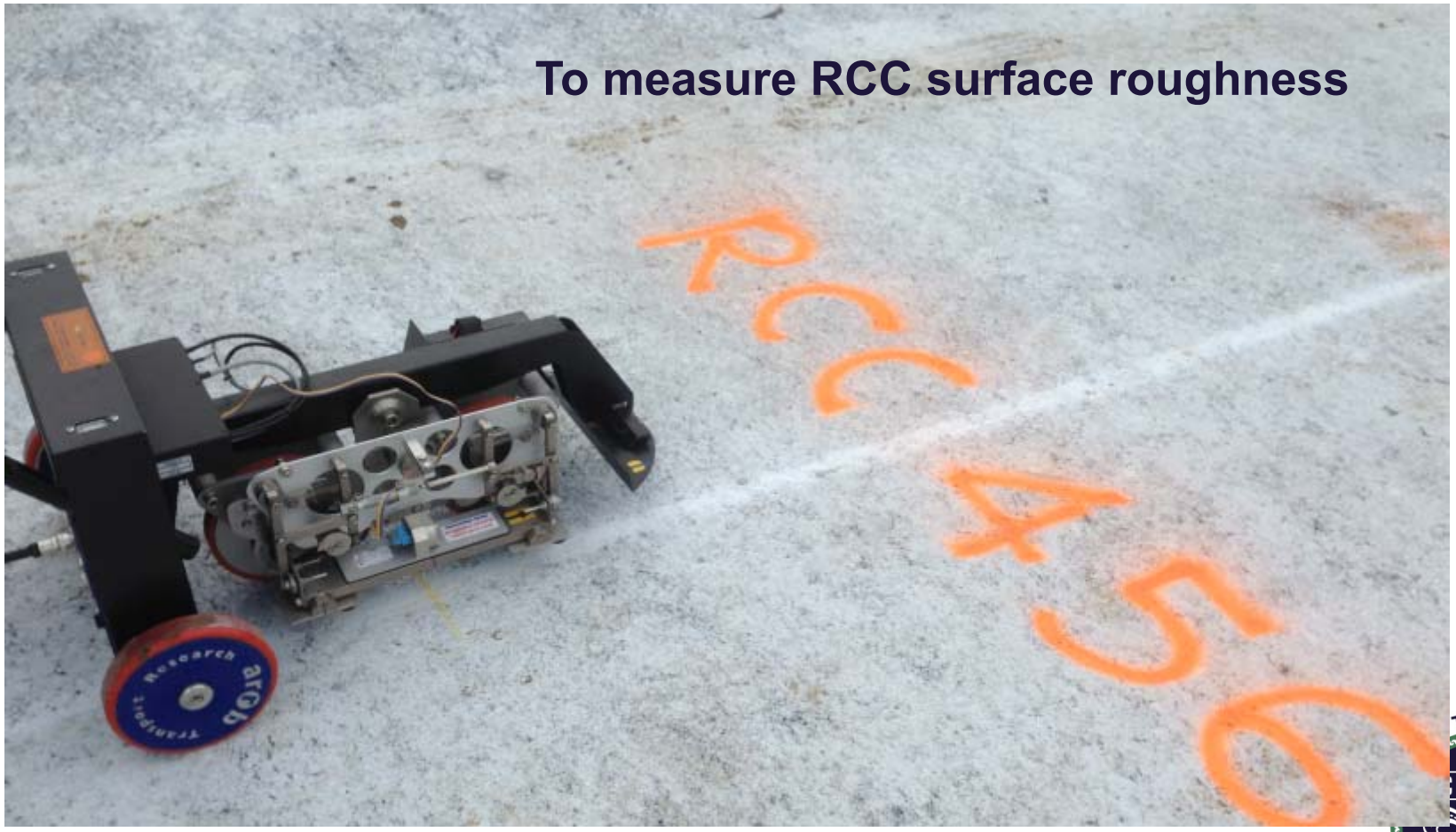
RCC Sections 1-3 (with 12” cement treated base)
- Design alternative for those low-volume roads having significantly heavy truck traffic

RCC Sections 4-6 (8.5” soil cement+ treated subgrade)
- Design alternative for high-volume roads using a treated subgrade layer

Saw-Cutting Joints

- 1.5” deep, 20-ft interval for 8”RCC
- 1” deep, 15-ft interval for 6”RCC
- 0.5” deep, 10-ft interval for 4”RCC

Walking Profiler



RCC Surface Texture and Friction

Sand Patch Test for Macro-texture

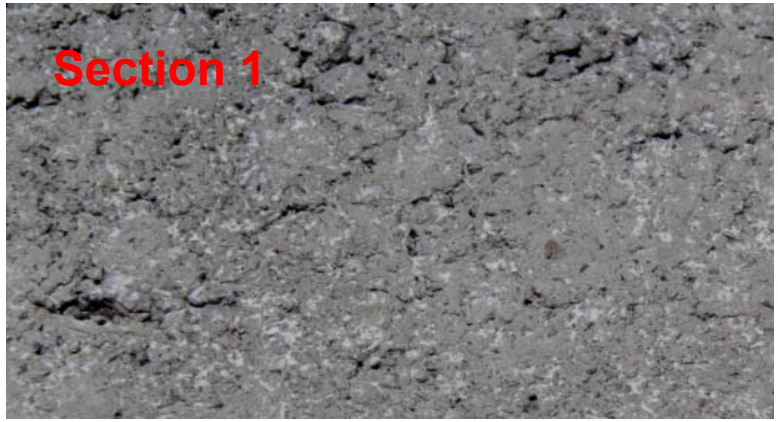
Dynamic friction Tester for Friction


Section 3

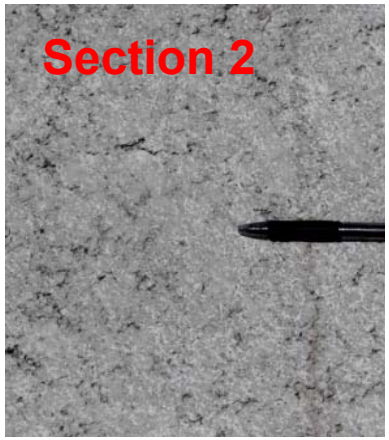

Section 6


Section 2

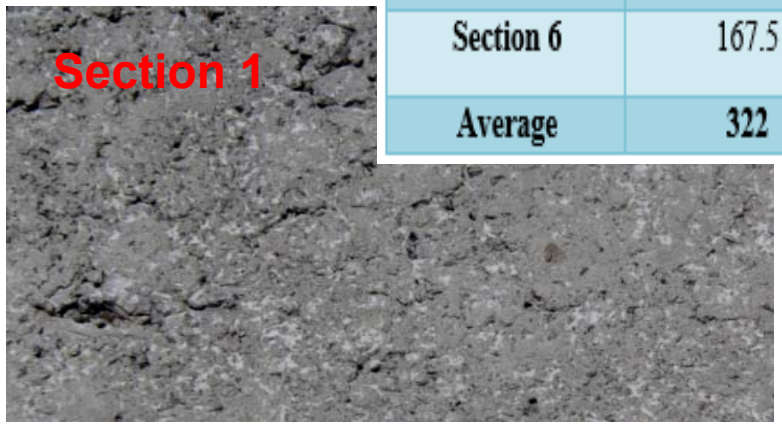

Section 5

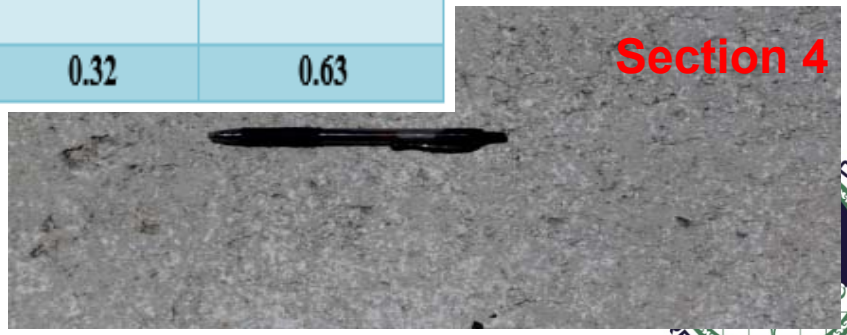

Section 1


Section 4



Sections	IRI (in/mile)	DFT20	MTD (mm)
Section 1	359.5	0.3	0.99
Section 2	469.7	0.4	0.72
Section 3	622.7	0.22	0.89
Section 4	190.1	0.3	0.36
Section 5	122.2	0.42	0.39
Section 6	167.5	0.28	0.43
Average	**322**	**0.32**	**0.63**





Finished RCC Surfaces (FWD Tests)

FWD to determine the as-built RCC pavements structure properties, eg. Layer moduli, structure number/layer coefficient.

FWD Backcalculated Layer Moduli

8”RCC+12CT E_{RCC}=3587ksi E_{base}=258ksi E_{sub} = 27ksi	6”RCC+12CT E_{RCC}=2361ksi E_{base}=181ksi E_{sub} = 24ksi	4”RCC+12CT E_{RCC}=2904ksi E_{base}=139ksi E_{sub} = 22ksi
Section 1	Section 2	Section 3
8”RCC+8.5SC E_{RCC}=3767ksi E_{base}=418ksi E_{sub} = 31ksi	6”RCC+8.5SC E_{RCC}=3763ksi E_{base}=352ksi E_{sub} = 28ksi	4”RCC+8.5SC E_{RCC}=4384ksi E_{base}=305ksi E_{sub} = 26ksi
Section 4	Section 5	Section 6

Those backcalculated results consistent with FWD deflections obtained from individual layers

Prediction of Structural Number (SN)

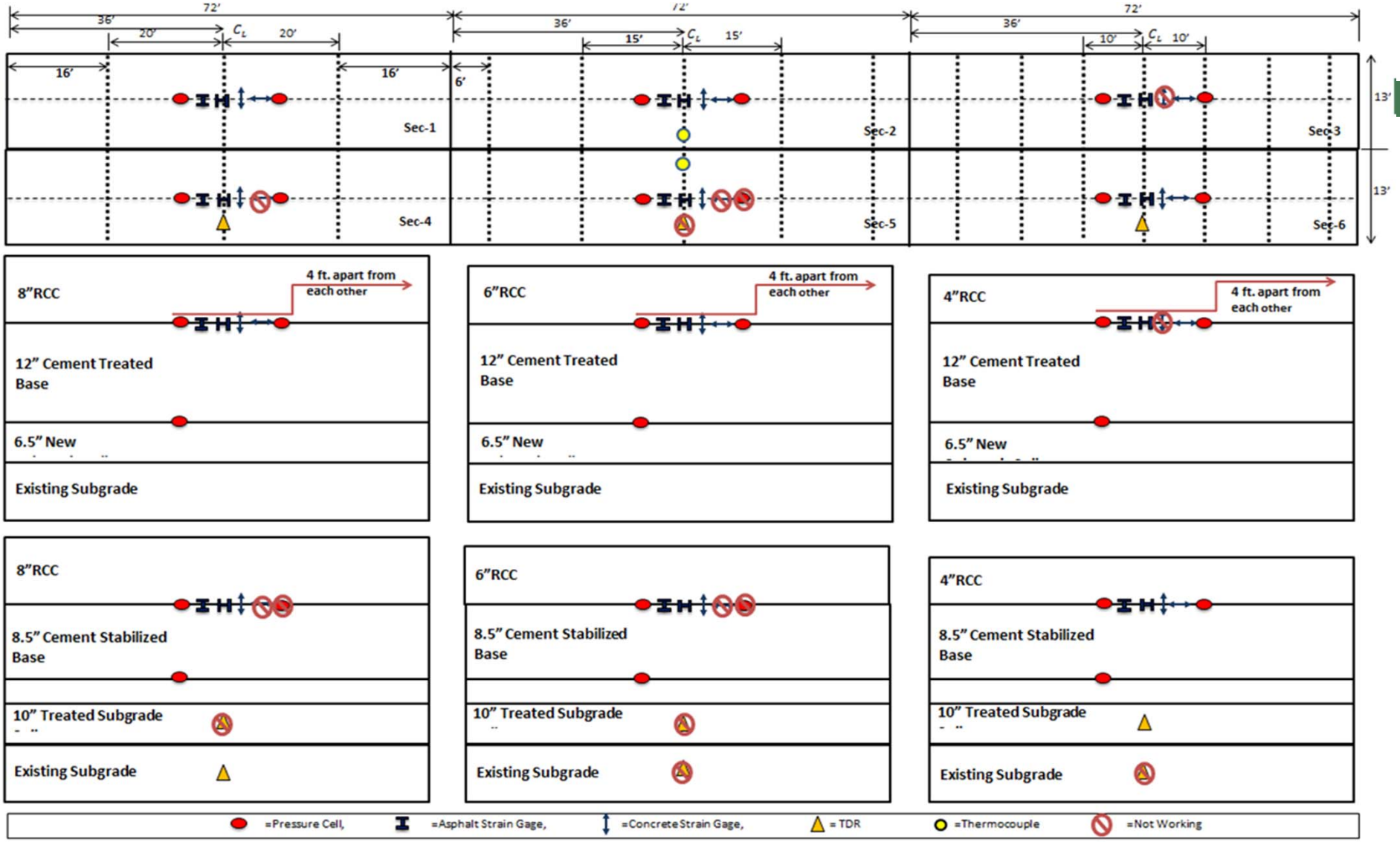
8”RCC+12CT	6”RCC+12CT	4”RCC+12CT
SN= 5.4	SN= 4.4	SN= 3.3
Section 1	Section 2	Section 3

8”RCC+8.5SC	6”RCC+8.5SC	4”RCC+8.5SC
SN=6.0	SN= 5.1	SN= 4.0
Section 4	Section 5	Section 6

Estimated $a_{RCC} \approx 0.48$

Monitoring and Accelerated Loading of RCC Pavement Sections

Instrumentation Layout



JDMDs will be used over edges of transverse saw-cut joints

- Instrumentation Installation

Pressure Cell & Asphalt Strain gage

Asphalt Strain gage & Concrete Strain Gage

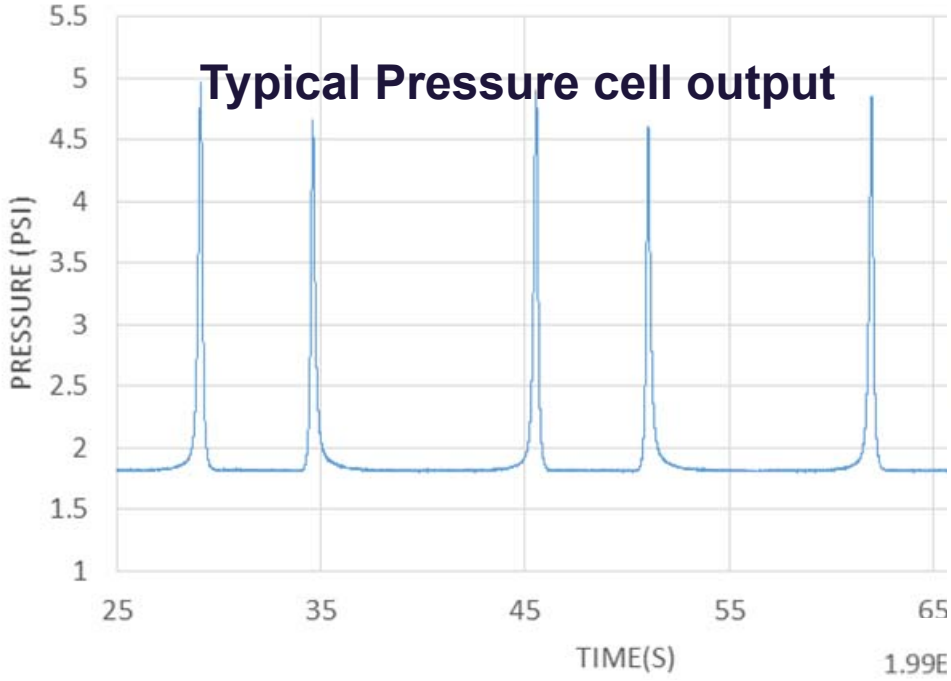
Protecting the Cables

Levelling Pressure Cell

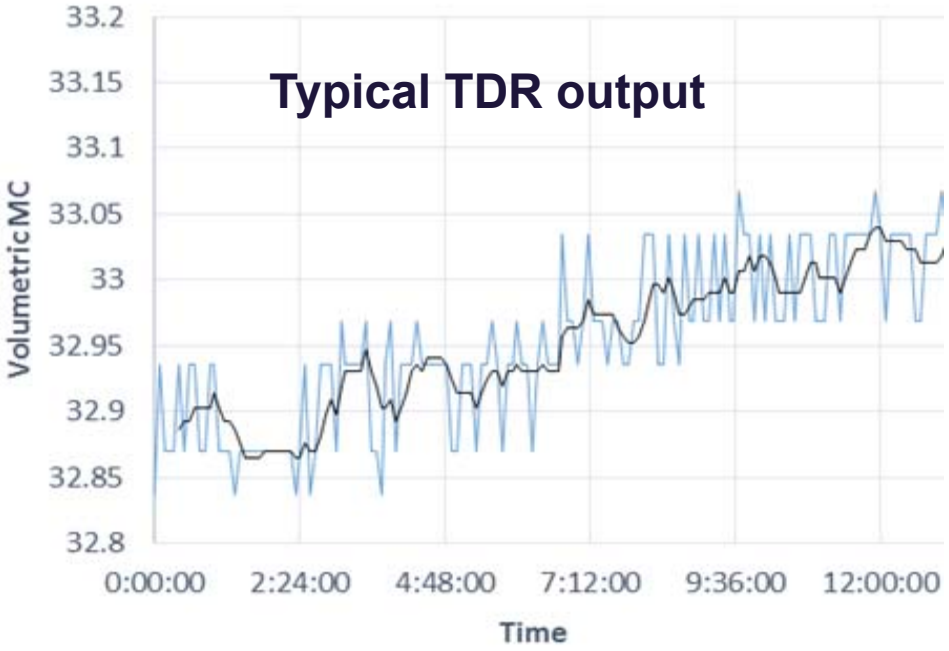
Installation of Moisture gage

Installation of Thermo-probe

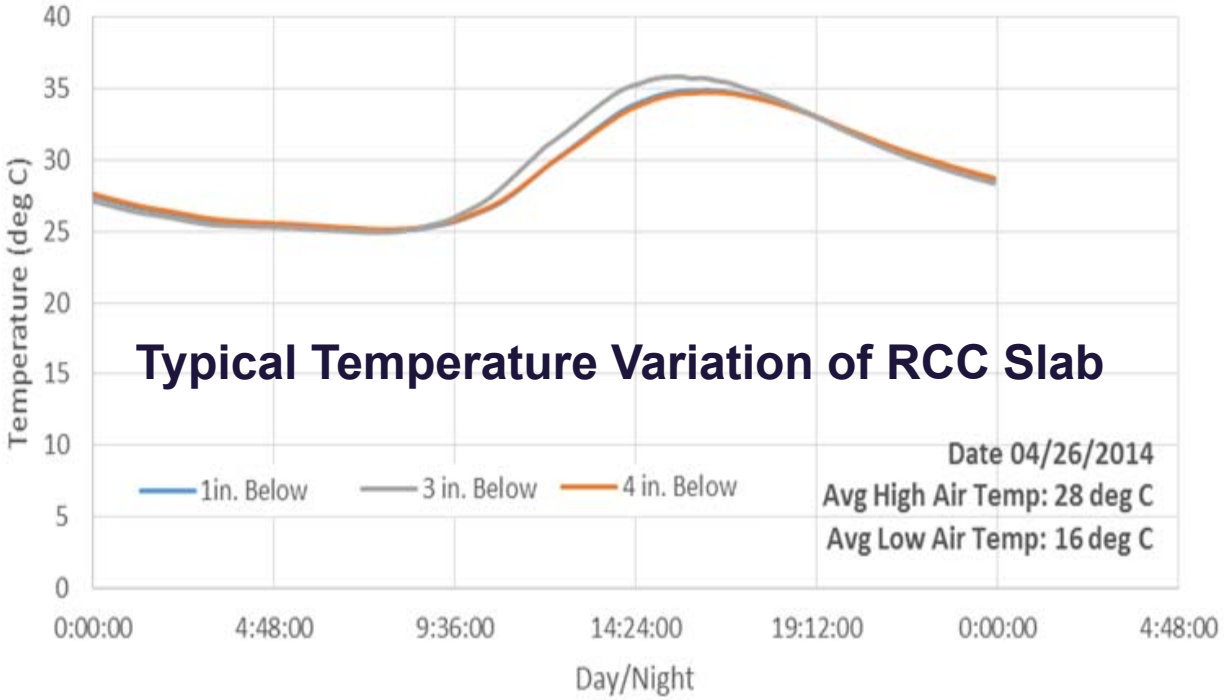
Typical Pressure cell output



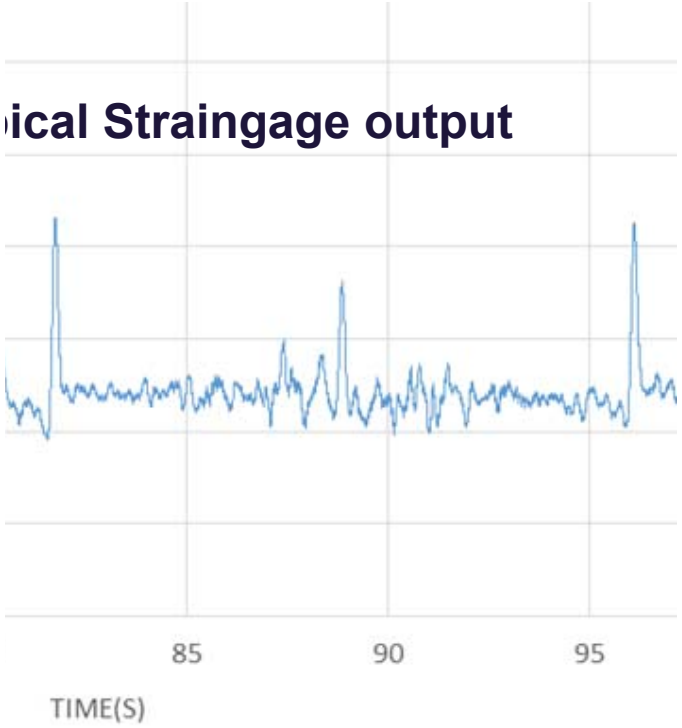
Typical TDR output



Typical Temperature Variation of RCC Slab



ical Straingage output



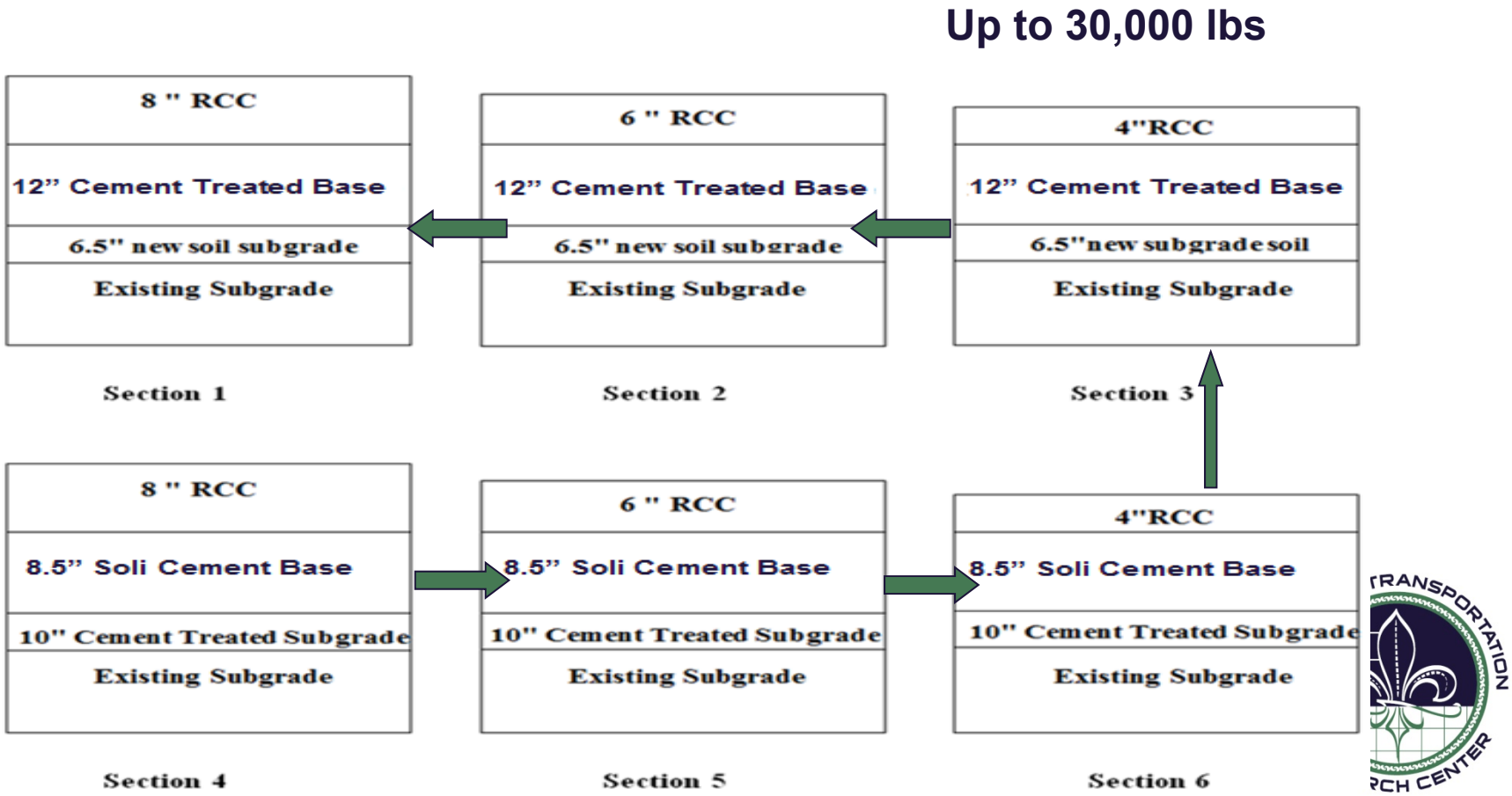
Accelerated Pavement Testing - ATLaS30

Dual-tire load, 130psi
Load: up to 30 kips
Speed: 4~6 mph
Bi-directional loading
Effective length: 42-ft
About 10,000 passes/day

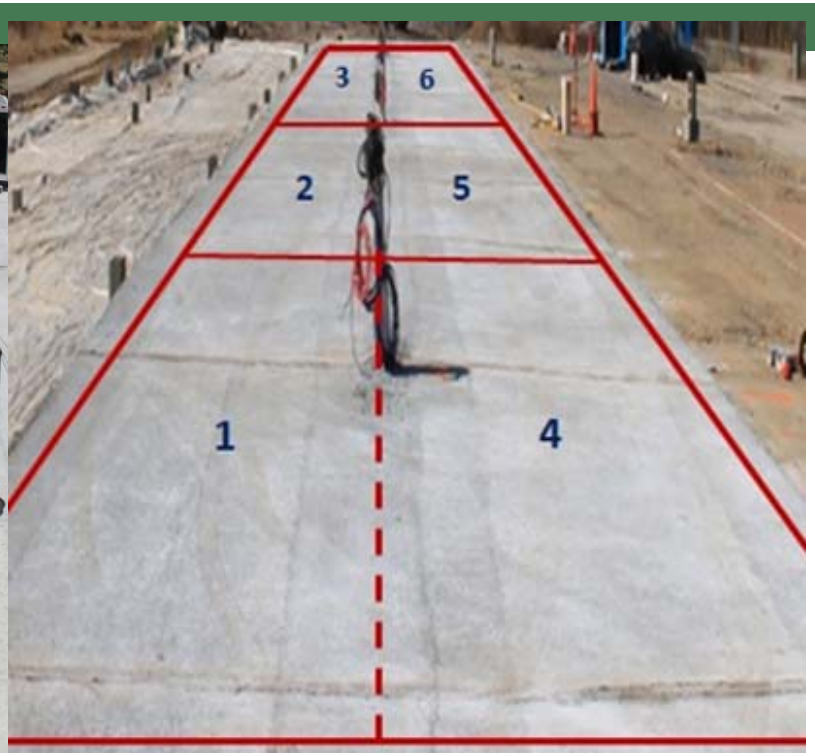
LOUISIANA TRANSPORTATION RESEARCH CENTER
LTRC

Accelerated Pavement Testing (contd..)

- Loading sequence

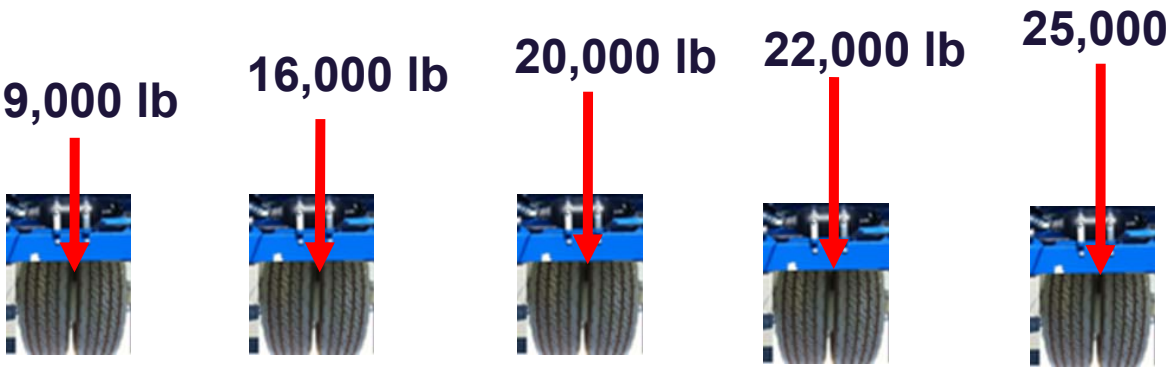


Accelerated Loading Testing



- Started on Section 4

8 " RCC
8.5" Soli Cement Base
10" Cement Treated Subgrade
Existing Subgrade



- Roughly 70,000 reps. for each load level,
- About 53,000 reps under 25-kip due to pumping occurred.

Loads vs. Number of Load Repetitions (KENPave + PCC/RCC Fatigue Equations)

Load (kips)	Fatigue Model	Section 1 8" RCC	Section 2 6" RCC	Section 3 4" RCC	Section 4 8" RCC	Section 5 6" RCC	Section 6 4" RCC
9	PCC	unlimited	unlimited	136,000	unlimited	unlimited	420,000
	RCC	95 millions	640,000	13,000	115 millions	8 millions	27,000
16	PCC	unlimited	12 millions	202	unlimited	unlimited	765
	RCC	6.5 millions	124,000	33	9.3 million	220,000	113
20	PCC	unlimited	65,000	2	unlimited	145,000	6
	RCC	960,000	7,000	0	1.5 million	14,500	1
25	PCC	unlimited	46,000	1	unlimited	12,250	1
	RCC	168,000	600	0	284,000	1,500	0

- **PCC Equation**

  For SR between 0.45 and 0.55 $N_f = \left(\frac{4.2577}{SR - 0.4325}\right)^{3.268}$

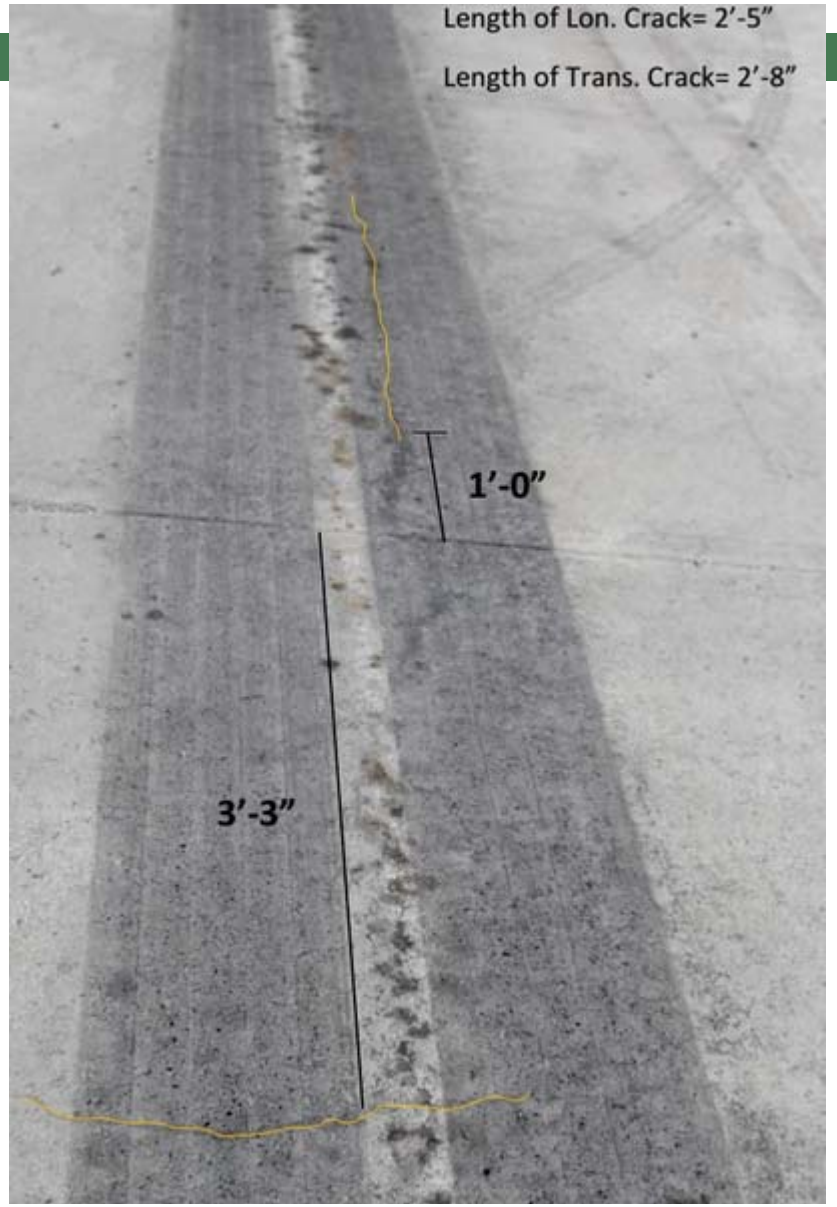
  For $SR > 0.55$ $\log N_f = 11.737 - 12.077(SR)$

- ***RCC-PAVE*** Equation

  $\log N_f = 10.25476 - 11.1872\,(SR)$

Cracking and Pumping

- After 53,000 repetitions of 25-kip load, Section 4 developed both transverse and longitudinal cracking;
- Joint pumping also observed under heavily raining weather, > 3 in. rainfall overnight



Pumping at Joint

Question?

Whether or not this should be considered as the test section failure is under further investigation:

- the estimated ESAL ≈ 10.9 millions
- the total damage > 100% when MR=612psi
- the total damage ≈ 41% when MR=800psi

Now the ATLaS has moved to section 5 for continuous testing.