PAVEMENT PERFORMANCE, FAA PAVEAIR AND RUNWAY LIFE EXTENSION

Abbas A Butt, Ph.D., P.E.
Hari Priya Pemmaraju Venkata, E.I.T.

2014 FAA WORLDWIDE AIRPORT TECHNOLOGY TRANSFER CONFERENCE
August 5-7, 2014

Engineering & Research Int'l, Inc.

Acknowledgments

The lead consultant on this project is SRA International, Inc. along with various sub-consultants

- **Gemini Technologies, Inc. (Gemini)**
- **Engineering and Research International, Inc. (ERI)**
- **Applied Research Associates, Inc (ARA)**

Federal Aviation Administration

SRA
Enduring Values. Inspired Performance.

gemini

ERI

ARA

Project Goals

Extend the expected life of large hub runway pavements from 20 to 40 years

Project Scope

- Analyze old and new runway pavements with respect to pavement properties and performance, and life cycle cost analysis of the pavement projects studied.
- Establish a PAVEAIR data warehouse for existing runway pavements (old asphalt, old concrete, new asphalt and new concrete) for which construction and long-term maintenance information is readily available and to collect additional field data for the selected sites. "Old pavement" refers to a pavement which has been in service for 20 years or more. "New pavement" refers to a pavement which has been in service for 4 years or less and the construction of which was funded by an AIP grant.

A Web-based Airport Pavement Management System Software

Engineering & Research Int'l, Inc.

FAA PAVEAIR Expected Functions to be Added

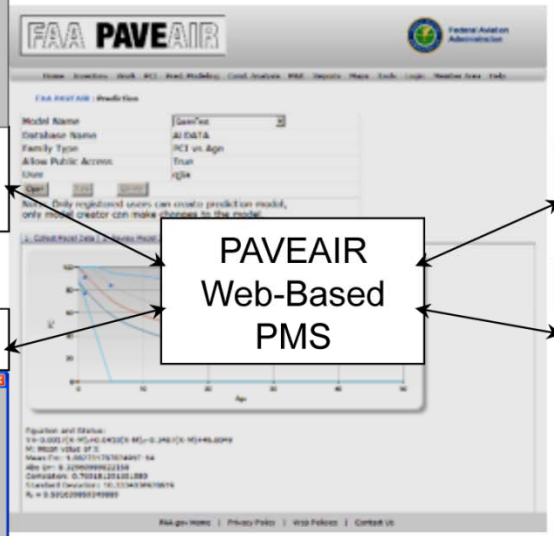
(from *Airport Technology Research Plan ... for the NextGen Decade, January 2012*)

1. Track the performance of individual distresses over time.
2. Additional distresses or independent measures of performance such as roughness.
3. Improved cost information entry and retrieval.
4. Improved prediction of remaining pavement life.
5. Provision for automatic calculation of life-cycle costs.
6. Integration, or interoperability, of other programs.
7. Network-wide analysis procedures.
8. Integration with geographic information systems (GIS).
9. Traffic data.
10. Environmental (climate) data.

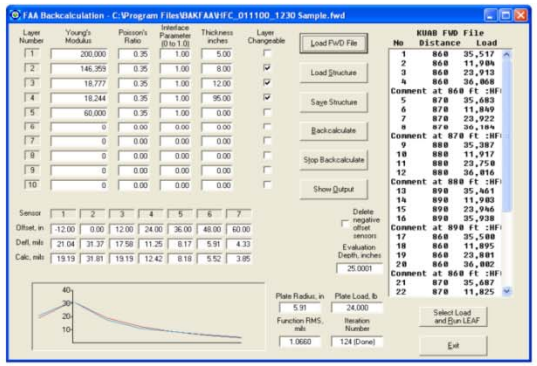
FAA PAVEAIR Integration

(from *Airport Technology Research Plan … for the NextGen Decade, January 2012*)

FAARFIELD Thickness Design

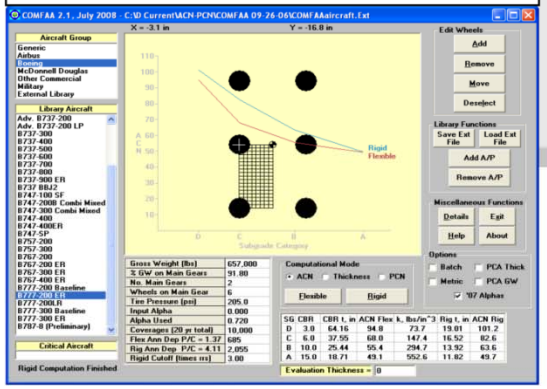


PAVEAIR Web-Based PMS

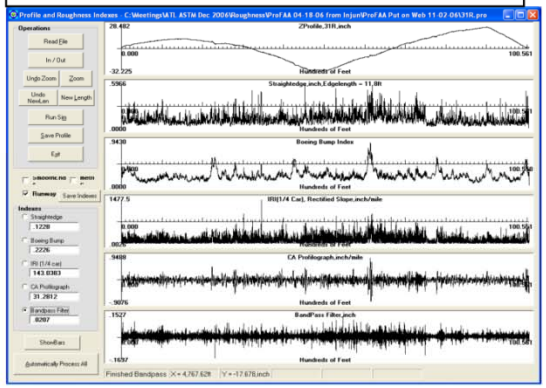


BAKFAA Strength Evaluation

COMFAA PCN Load Rating



ProFAA Roughness Condition Evaluation

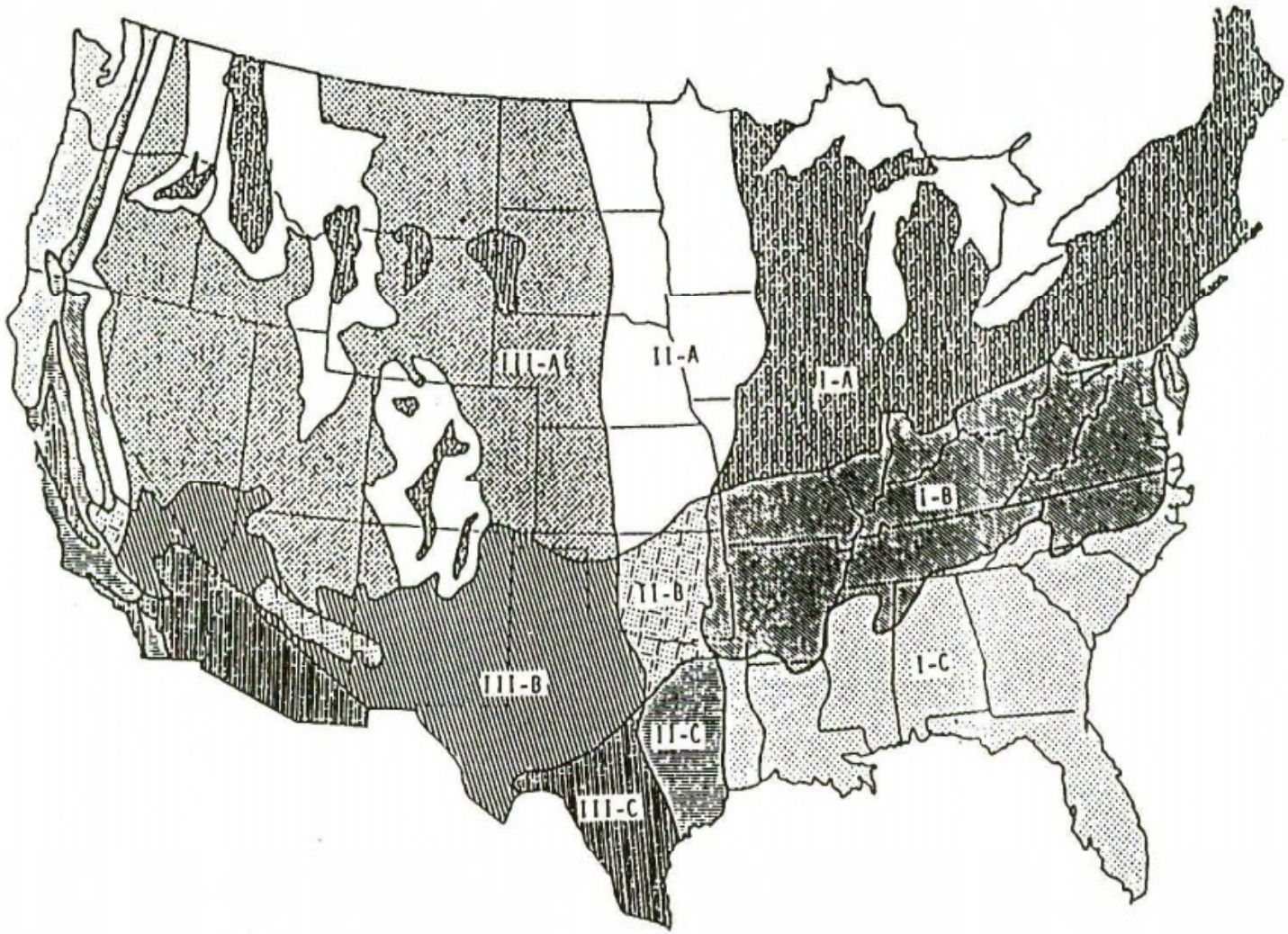


Large and Medium Hub Airports

(The National Plan of Integrated Airport Systems (NPIAS) for fiscal year 2013-2017)

FRI Engineering & Research Int'l, Inc.

Climatic Zones Based on Thornthwaite Potential Evaporation and Moisture Index
(Source: 1993 AASHTO Guide for Design of Pavement Structure)



Large and Medium Hub Airports
(Nine Climatic Zones)

FRI Engineering & Research Int'l, Inc.

Distribution of Runways by Climatic Zones
(2012 – 2013 Study Program)

MOISTURE → TEMPERATURE ↓	I WET	II MEDIUM	III DRY
A. COLD	* 10R-28L *** 10L-28R** *** 4-22** *** 4L-22R** **# 5R-23L** # 10C-28C		
B. TEMPERATE	# 1C-19C **# 1R-19L** *** 10-28** *** 1-19** * 5L-23R		
C. WARM	**# 16C-34C** # 16R-34L **# 17R-35L**	# 9-27 *** 10L-28R** * 10R-28L	*** 11L-29R** * 3-21 **# 6R-24L**

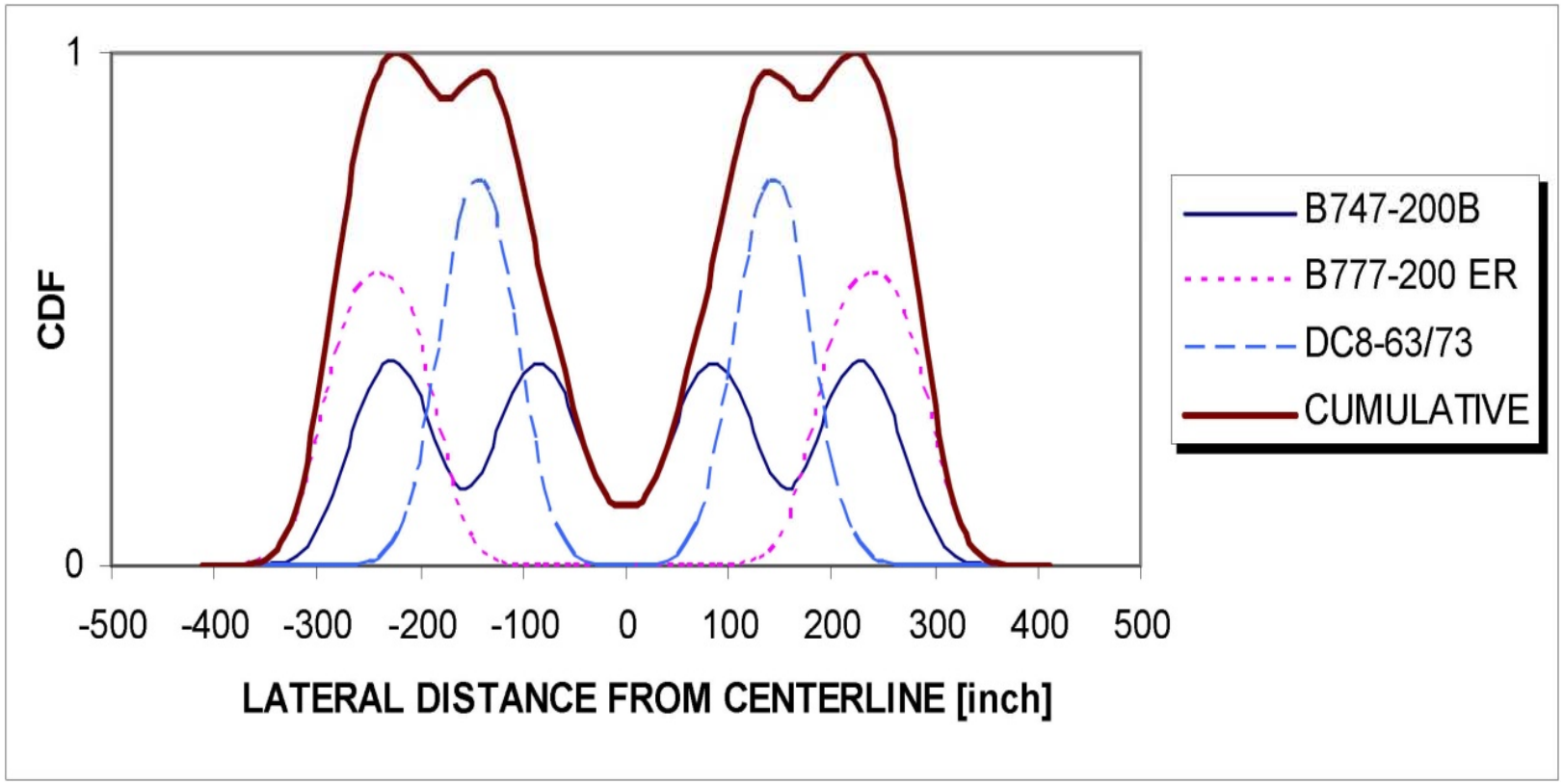
Notes:

* HMA Runway
# Concrete Runway

Red Color Font Old Runways
Black Color Font New Runways

Lateral Distribution of Traffic on Runway

(AC 150/5320-6E)



Traffic Load Distribution Patterns

(AC 150/5335-5B - APPENDIX 1)

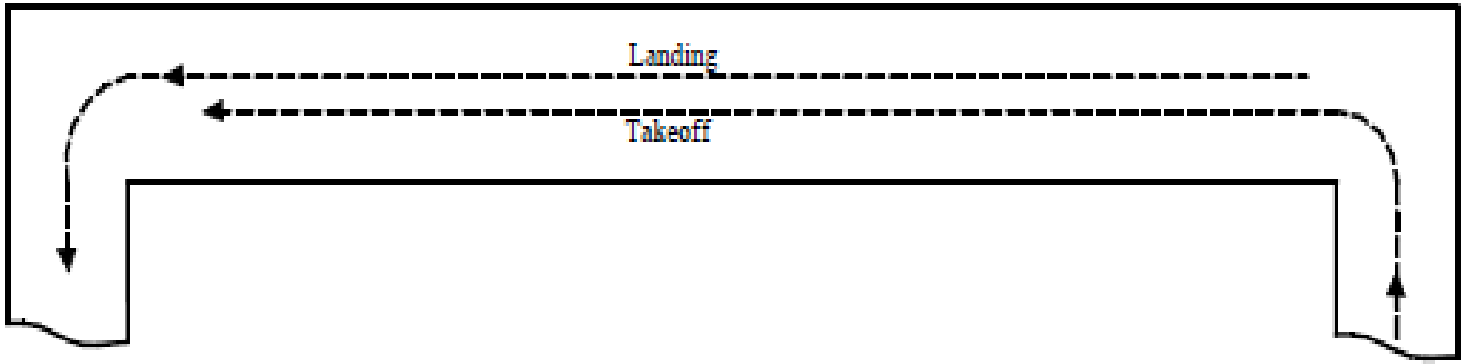


Figure A1-1a. Runway with Parallel Taxiway

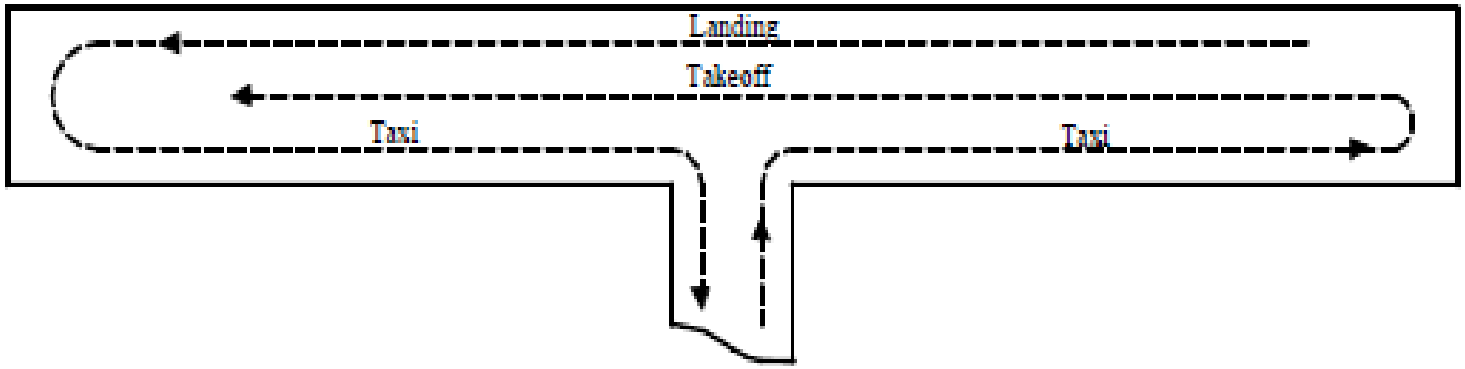
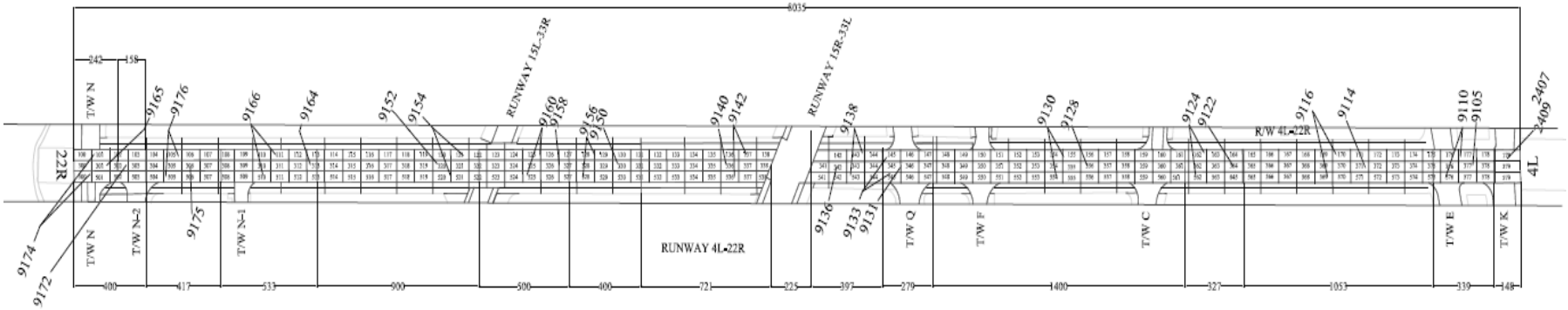


Figure A1-1b. Runway with Central Taxiway

It has been a difficult task in matching up the historical data to the current layout

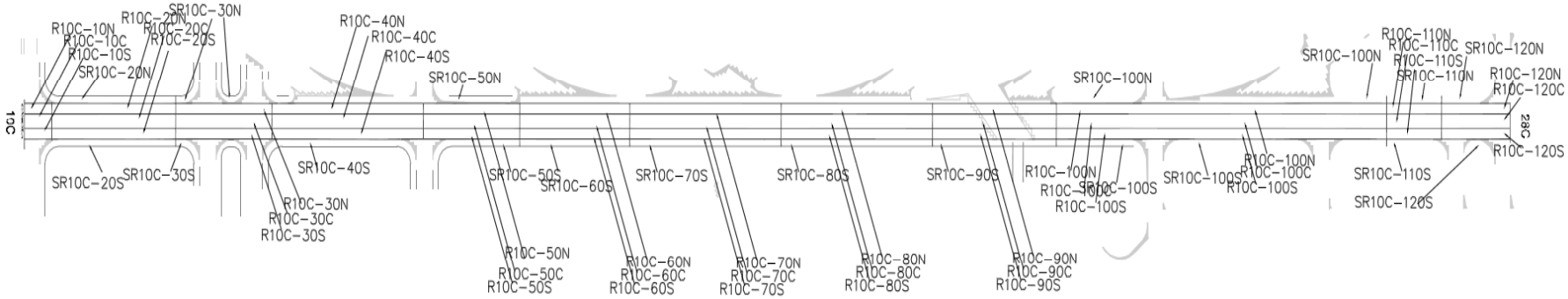
Examples of Network Identification Variability



Runway 4L/22R

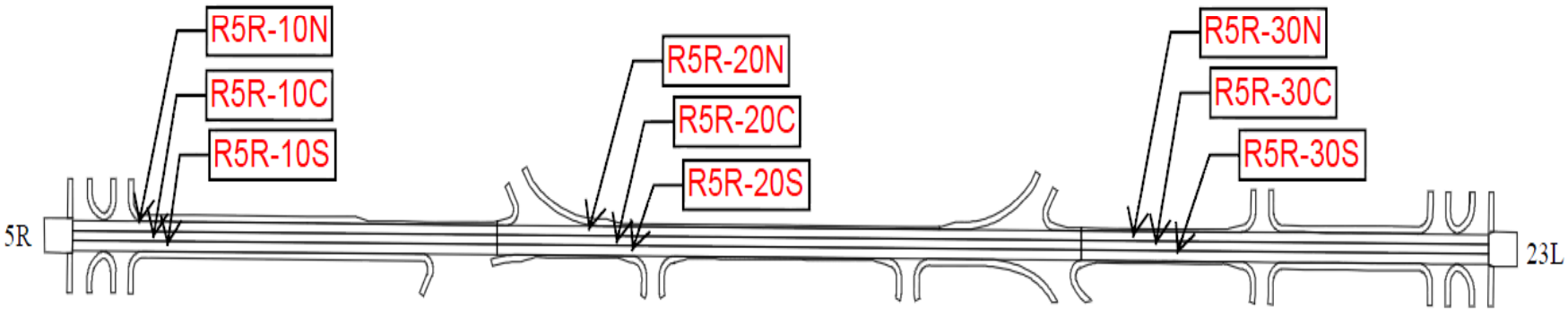
- The outer lanes within each uniform section have been assigned same section ID
- MicroPAVER Database was populated manually
- There were few sections that were combined with the other sections due to the overlay in 1996
- The historical PCI data (since 2000) for the old sections that were combined with the new sections is transferred to the new sections
- Features/sections have been merged or otherwise changed over the years

Examples of Network Identification Variability



Runway 10C/28C

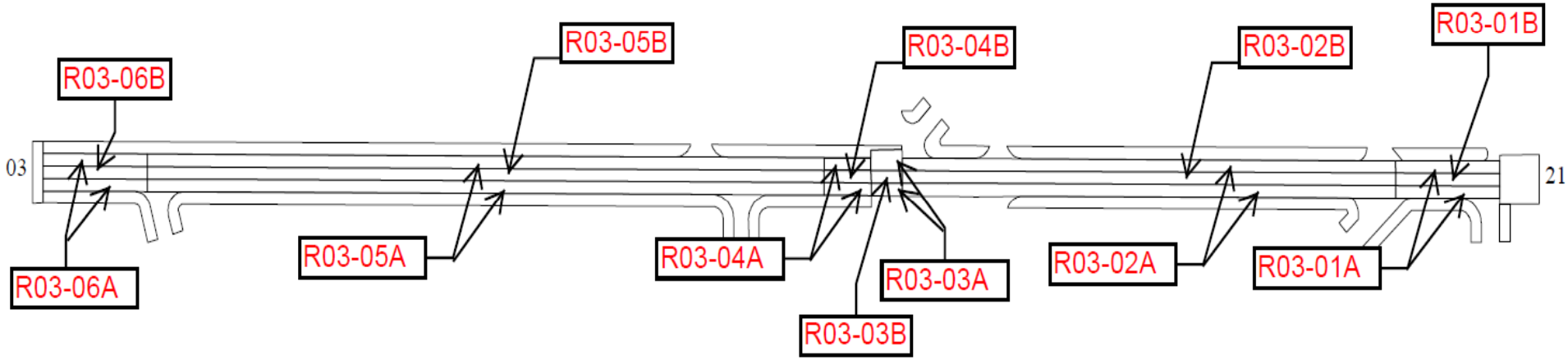
Examples of Network Identification Variability



Runway 5R/23L

- The total number of sample units within each uniform section were incorrect in the MicroPAVER database when compared to the network layout map
- Consultant utilized a MicroPAVER add-on for populating the database with inspection and distress data which did not import correctly

Examples of Network Identification Variability

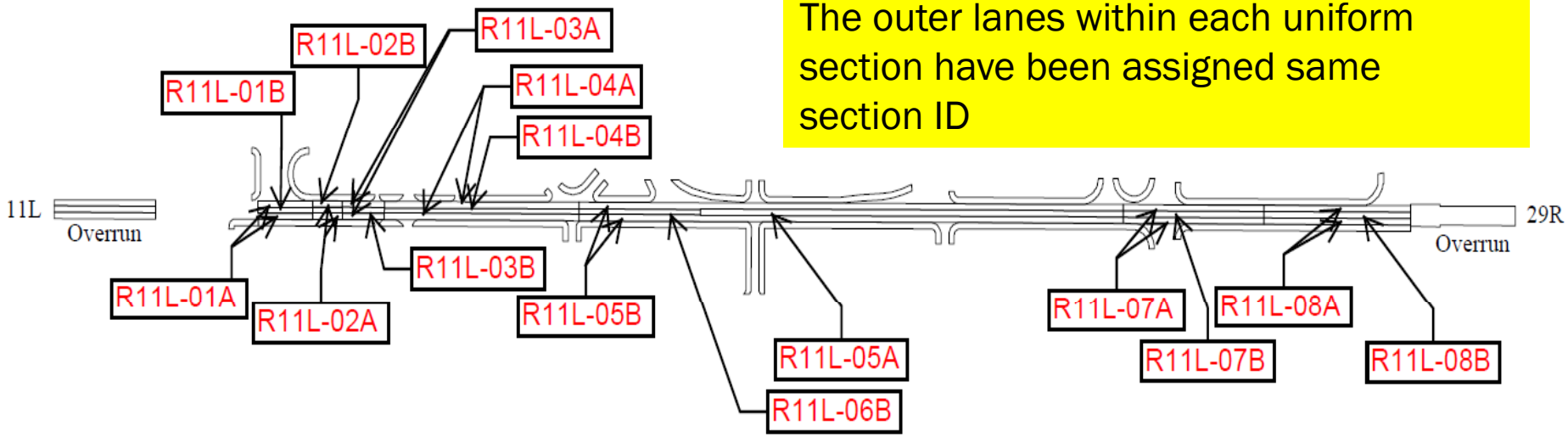


The outer lanes within each uniform section have been assigned same section ID

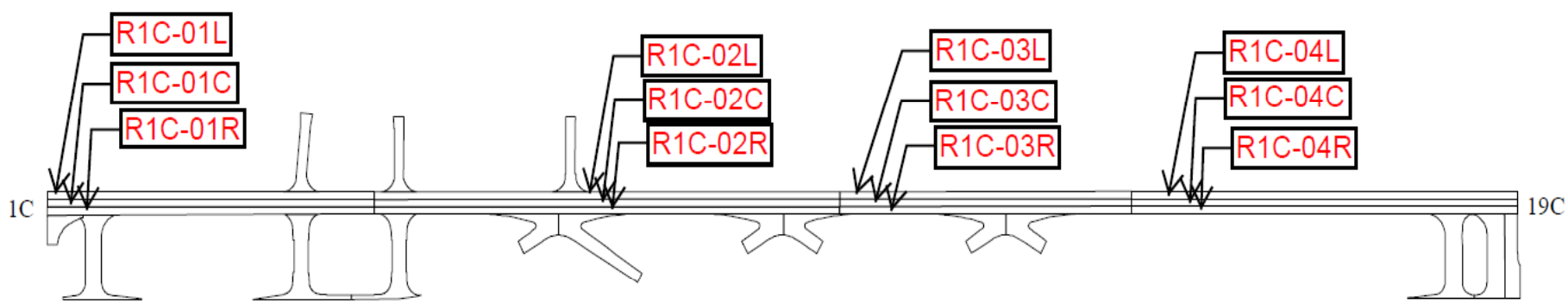
Runway 03/21

Examples of Network Identification Variability

The outer lanes within each uniform section have been assigned same section ID

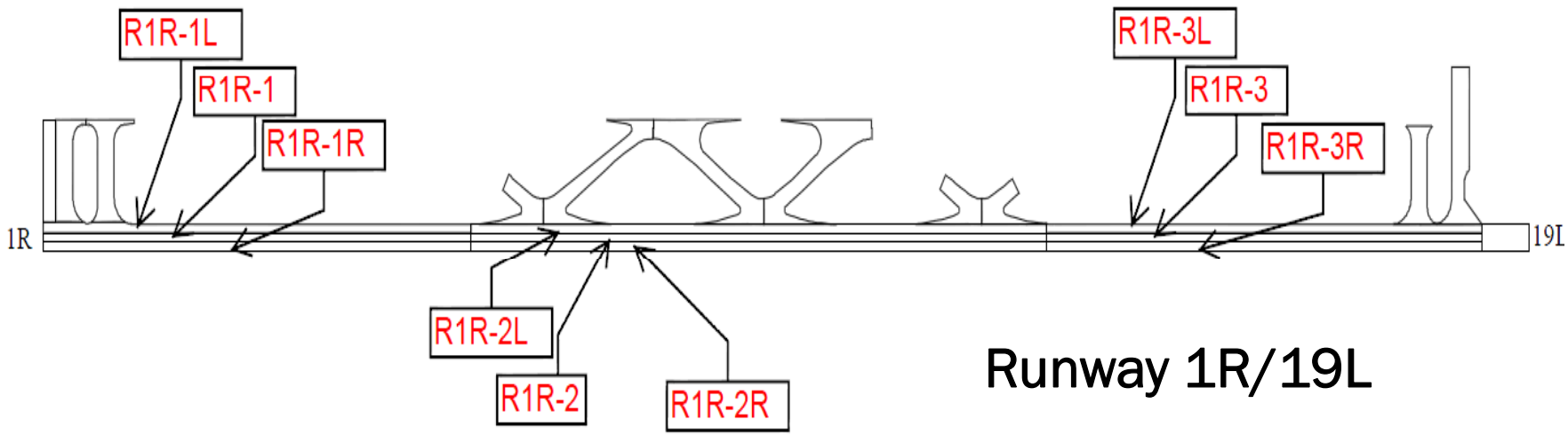


Runway 11L/29R



Runway 1C/19C

Examples of Network Identification Variability



- The Runway was re-sectioned and re-named during 2012 condition survey
- The historical PCI data was from 2003 to 2012
- Sections 2 & 3 consisted of 23 & 18 total number of SU's prior to 2012 survey
- In the latest 2012 database Sections 2 & 3 consisted of 24 & 17 total number of SU's

From FAA Advisory Circular AC 150/5320-6E, Paragraph 405.a:

TABLE 4-1. RIGID PAVEMENT DISTRESS TYPES USED TO CALCULATE THE STRUCTURAL CONDITION INDEX, SCI

Distress	Severity Level
Corner Break	Low, Medium, High
Longitudinal/Transverse/Diagonal Cracking	Low, Medium, High
Shattered Slab	Low, Medium, High
Shrinkage Cracks (cracking partial width of slab)[a]	Low
Spalling–Joint	Low, Medium, High
Spalling–Corner	Low, Medium, High

[a] Used only to describe a load-induced crack that extends only part of the way across a slab.
The SCI does not include conventional shrinkage cracks due to curing or other non load-related problems.
An SCI of 80 is the FAA definition of structural failure of a rigid pavement, and is consistent with 50 percent of slabs in the traffic area exhibiting a structural crack. The SCI allows a more precise and reproducible rating of a pavement's condition than the previous FAA condition factor ratings, C_b and C_r.

SCI?

- One Airport showed the joint spalling in both trafficked and non-trafficked areas.
- Dr. David Brill's report "calibration of FAARFIELD Rigid Pavement Design Procedure" did not use corner or joint spalls in calibration for SCI
- Shrinkage cracks difficult to separate in FAA PAVEAIR or MicroPAVER from load-induced cracks that extend only part of the way.
- 50% low severity linear cracking has a deduct value of 20, that translate to SCI of 80.
- One new airport showed joint spalling before the airport was opened to traffic
- What about SCI when high severity linear cracking has been repaired by patching or shattered slabs have been replaced by patching?

Ststructural Life and Functional Life?

<u>From FAA Advisory Circular AC 150/5320-6E, states in Paragraph 303.a:</u>

"Pavements designed and constructed in accordance with FAA standards are intended to provide a minimum structural life of 20 years that is free of major maintenance if no major changes in forecast traffic are encountered. Rehabilitation of surface grades and renewal of skid-resistant properties may be needed before 20 years because of destructive climatic effects and the deteriorating effects of normal usage."

And in paragraph 304.d. that:

The FAA design standard for pavements is based on a 20-year design life. The computer program is capable of considering other design life time frames, but the use of a design life other than 20 years constitutes a deviation from FAA standards.

Effect of Traffic Channelization on PCI and SCI

Runway	Surface	Age Yrs	PCI All	PCI Trafficked	PCI Non-Trafficked		SCI All	SCI Trafficked	SCI Non-Trafficked	% Change in SCI
11L/29R	AC	1	100	100			100	100		
11L/29R	AC	6	42	41	43		98	96	99	15
11L/29R	PCC	20	94	90	98		**94**	**90**	**98**	40
11L/29R	PCC	26	85	83	88		90	88	92	20
03/21	AC	<1	100	100	100		100	100	100	0
RW5L23R	AC	65	66	61	70		97	94	100	30
01R/19L	PCC	54	61	54	70		78	78	79	5
01C/19C	PCC	2	97	96	97		97	96	97	5
01C/19C	PCC	53	68	53	75		**79**	**69**	**85**	80
01/19	AC	2	100	99	100		100	100	100	0
5R/23L	PCC	24	69	67	71		93	91	95	20
6R/24L	PCC	23	68	47	79		81	75	83	40
6R/24L	PCC	45	80	76	83		**89**	**83**	**93**	50
10C/28C	PCC	<1	98	97	99		99	99	100	5

*Age is as of Last Inspection Date

% Change over 20 SCI Points Drop

ERI Engineering & Research Int'l, Inc.

Distress Associated with In-Pavement Light

Linear Cracking around the in-pavement light

Distress Associated with In-Pavement Light

Patch around the in-pavement light

Distress Associated with In-Pavement Light

Cracking around the In-Pavement Light

Distress Associated with In-Pavement Light

Patching around the in-pavement lights

Distress Associated with In-Pavement Light

In-Pavement Light in Good Condition

Distress Associated with In-Pavement Light

Cracking (May be due to ASR) around the in-pavement light

Distress Associated with In-Pavement Light

Low Severity Linear Cracking in and around the Utility Patch

Distress Associated with In-Pavement Light

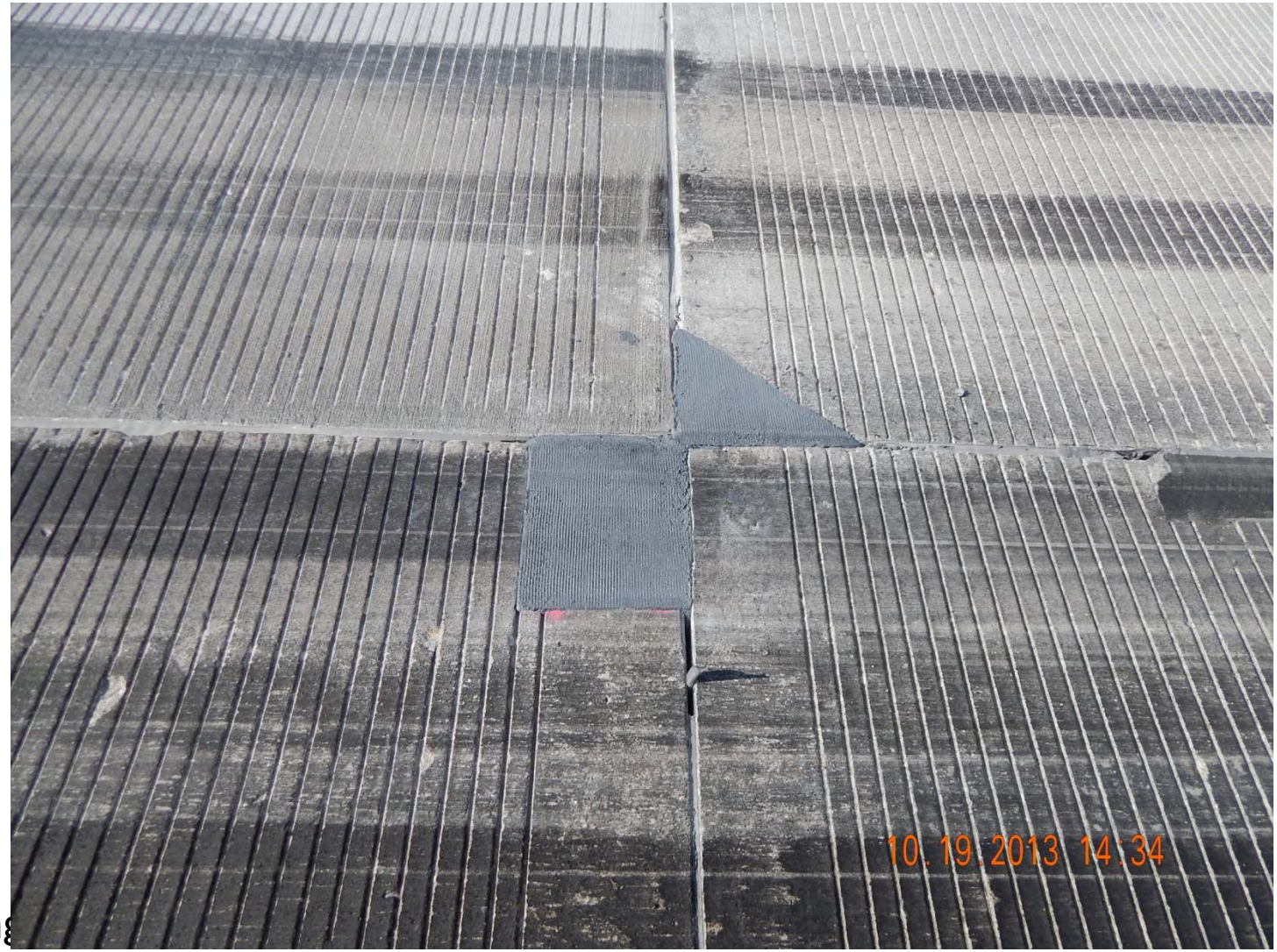
Longitudinal and Transverse Cracking (Note crack propagating from corner of Light Base)

Maintenance

Maintenance

Maintenance

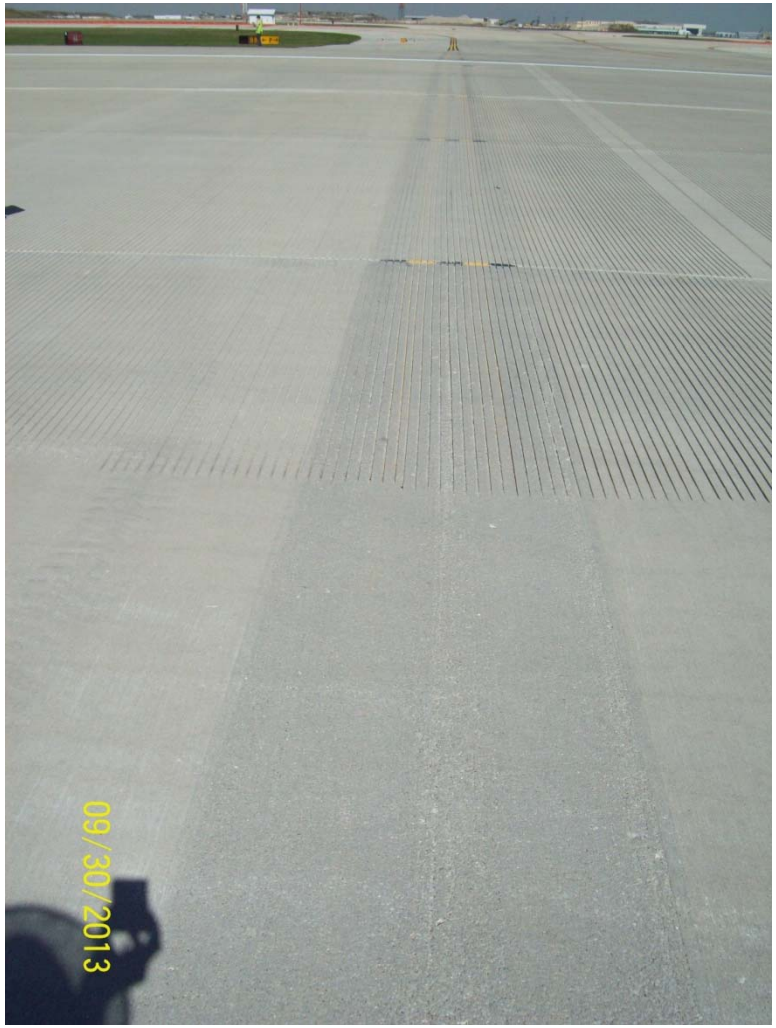
Maintenance



Questionable Distress

Questionable Distress

Questionable Distress



Questionable Distress

Questionable Distress

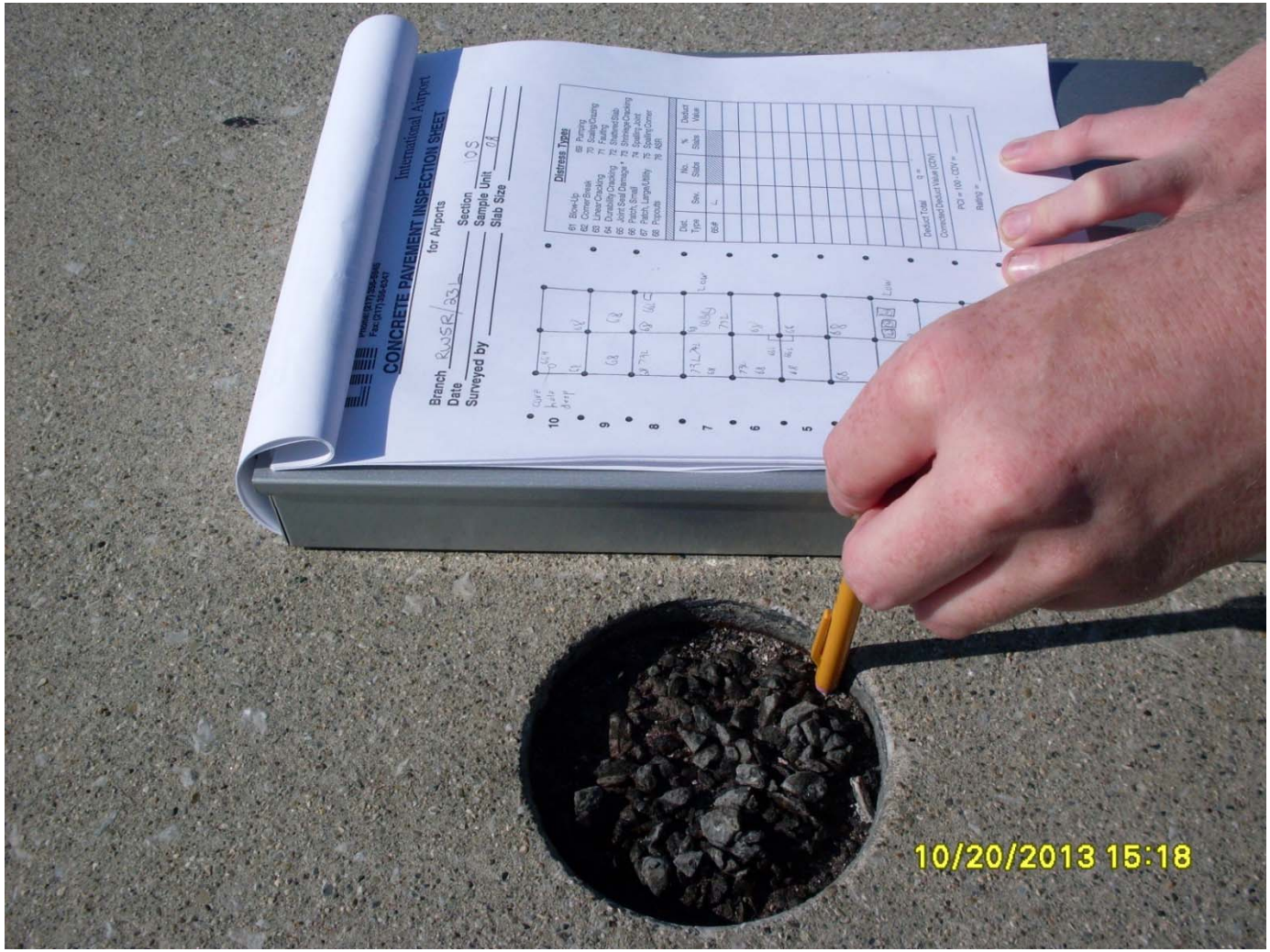
Questionable Distress

Questionable Distress

Questionable Distress

Questionable Distress

Questionable Distress



Engineering & Research Int'l, Inc.

Questionable Distress

Questionable Distress

Questionable Distress

Questionable Distress

Questionable Distress

Questionable Distress

Questionable Distress

Questionable Distress

Questionable Distress

Questionable Distress

Questions?

Thank you!

Engineering & Research Int'l, Inc.