

SOUTH CAROLINA PAVEMENT STRENGTH RATING STUDY



FAA Airport Pavement Working Group Meeting

April 17, 2013

OBJECTIVES/DEFINITIONS

- Update published pavement strength ratings in Master Record (Form 5010)
 - Pavement Classification Number (PCN)
 - Maximum gross aircraft weights by gear type
- Mainly interested in operational considerations for heavy aircraft (> 25,000 lbs.)
- PCN – expresses the load-carrying capacity of a pavement for unrestricted operations
- ACN – expresses the relative loading an aircraft will have on a pavement

AIRPORT MASTER RECORD

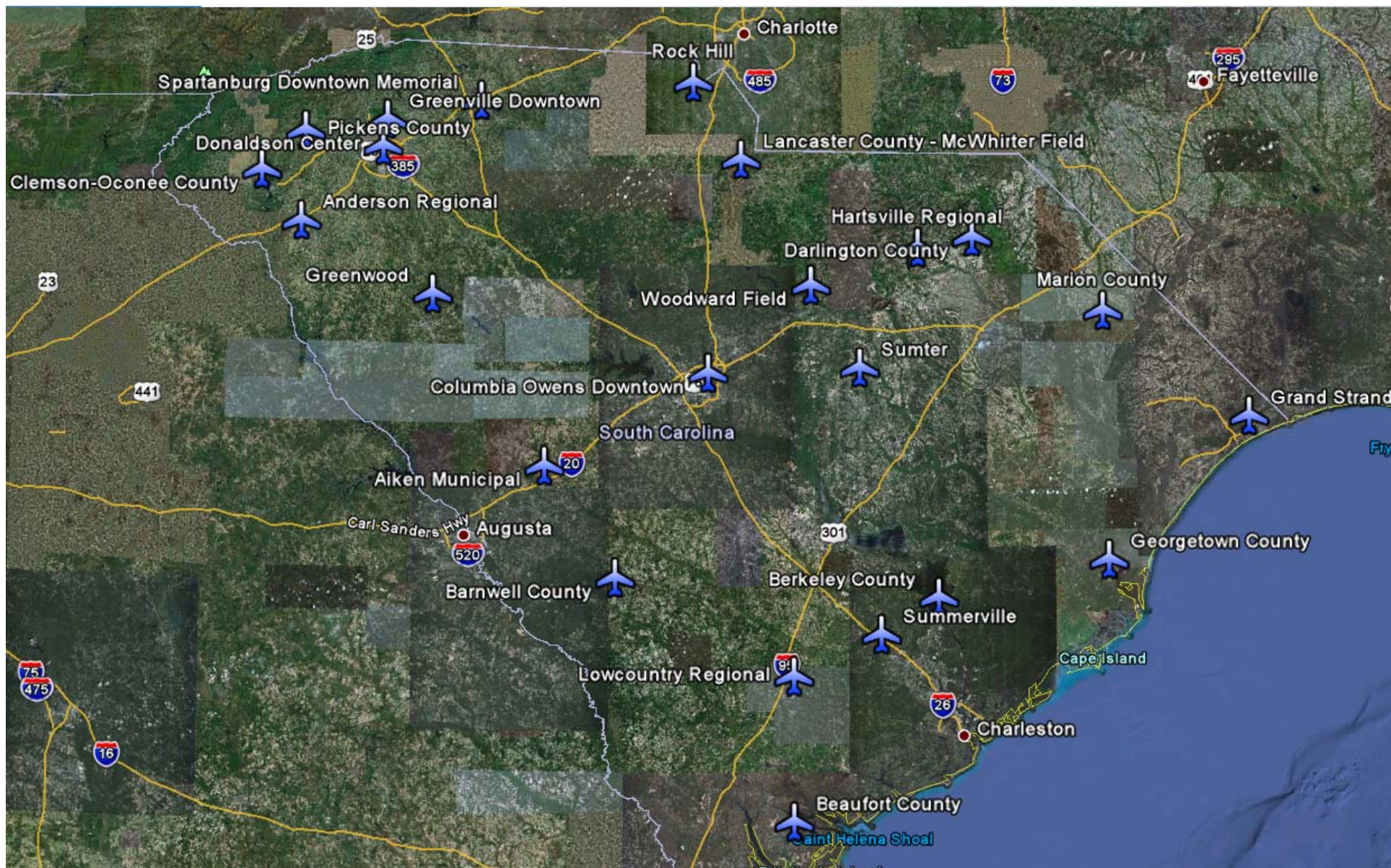
>1 ASSOC CITY:	4 STATE:	LOC ID:	FAA SITE NR:
>2 AIRPORT NAME:		5 COUNTY:	
3 CBD TO AIRPORT (NM):	6 REGION/ADO:	7 SECT AERO CHT:	

GENERAL	SERVICES	BASED AIRCRAFT
10 OWNERSHIP: >11 OWNER: >12 ADDRESS: >13 PHONE NR: >14 MANAGER: >15 ADDRESS: >16 PHONE NR: 17 ATTENDANCE SCHEDULE: MONTHS DAYS HOURS	>70 FUEL: >71 AIRFRAME RPRS: >72 PWR PLANT RPRS: >73 BOTTLE OXYGEN: >74 BULK OXYGEN: 75 TSNT STORAGE: 76 OTHER SERVICES:	90 SINGLE ENG: 91 MULTI ENG: 92 JET: TOTAL 93 HELICOPTERS: 94 GLIDERS: 95 MILITARY: 96 ULTRA-LIGHTS:
RUNWAY DATA	FACILITIES	OPERATIONS
18 AIRPORT USE: 19 ARPT LAT: 20 ARPT LONG: 21 ARPT ELEV: 22 ACREAGE: >23 RIGHT TRAFFIC: 24 NON-COMM LANDING: 25 NPAS/FEDERAL AGREEMENTS: 26 PART 139 INDEX:	>80 ARPT BCN: >81 ARPT LGT SKED: >82 UNICOM: >83 WIND INDICATOR: 84 SEGMENTED CIRCLE: 85 CONTROL TWR: 86 FSS: 87 FSS ON ARPT: 88 FSS PHONE NR: 89 TOLL FREE NR:	100 AIR CARRIER: 101 INTENTIONALLY LEFT BLANK: 102 AIR TAXI: 103 G A LOCAL: 104 G A ITNRNT: 105 MILITARY: TOTAL OPERATIONS FOR 12 MONTHS ENDING

>30 RUNWAY IDENT:
 >31 LENGTH:
 >32 WIDTH:
 33 SURF TYPE-COND:
 34 SURF TREATMENT:
 35 GROSS WT: S
 36 (IN THSDS) D
 37 20
 38 20/202
 39 PCN:
 LIGHTING/APCH AIDS
 >40 EDGE INTENSITY:
 >42 RWY MARK TYPE-COND:



The gross weight bearing strength and PCN will be determined for each pavement section within the scope of work.



GENERAL AVIATION AIRPORT PERSPECTIVE

- Airports evolve
 - Transitioning from small airports
 - Larger weight aircraft
- Airport Managers wear many hats
 - Present results for a broader audience, accessible
- FAQ – Can my pavement support this aircraft?
 - Determine acceptable operations of heavy aircraft
- Runways + taxiways + aprons

STANDARDIZATION OF REPORTING PAVEMENT STRENGTH

- In 1977 International Civil Aviation Organization (ICAO) develops & adopts first version of ACN/PCN methodology
 - Mostly used by military and large commercial service airports
- In 2009 draft version of FAA AC 150/5335-5B released (major overhaul)
 - FAA “turns on” PCN field on Form 5010 for GA airports
- In 2011 FAA AC 150/5335-5B becomes final
 - Challenge applying for low traffic operation scenarios

DATA COLLECTION – RECORDS REVIEW

- Records review & mapping
- Data sources:
 - 2001 pavement management database
 - Construction records since 2001
 - Traffic history (aircraft > 25,000 lbs.)
 - State had 4 years of traffic data for each airport

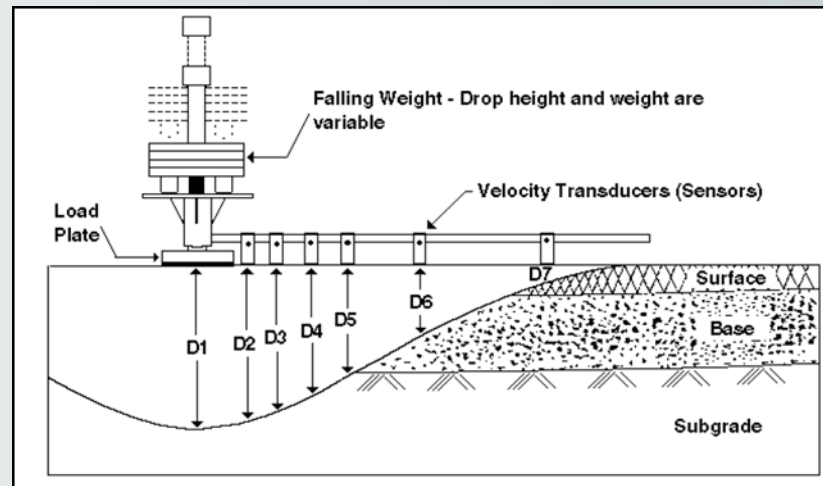
DATA COLLECTION – DEFLECTION TESTING

- Used falling weight deflectometer (FWD) to measure the structural characteristics of the pavement layers



DATA COLLECTION – FWD TESTING

Test Method	Main Objectives	Output Used to Determine
FWD	1 – estimate subgrade support 2 – determine moduli (stiffness) of each layer	<ul style="list-style-type: none"> • PCN subgrade classification A, B, C, D (California Bearing Ratio [CBR] & k values) • Define layer properties in PCN analysis



DATA COLLECTION – GPR TESTING

Test Method	Main Objectives	Output Used to Determine
GPR	1 – locate/quantify subsurface anomalies 2 – layer thickness determination	<ul style="list-style-type: none">• Location and extent of voids, structures, moisture issues• Layer characteristics



DATA COLLECTION - OTHERS

Test Method	Main Objectives	Output Used to Determine
Coring	1 – calibration for FWD & GPR 2 – layer thickness determination 3 – access to base layer for sampling	<ul style="list-style-type: none">• Layer thickness for FWD & GPR analysis• Adjust/confirm construction history data• Base layer identification
Distress	1 – qualify major distress types/severities 2 – evidence of subsurface voids, frost action, swelling soils	<ul style="list-style-type: none">• Cause of pavement deterioration (load-related, climate-related, or material-related)• Adjust FWD, GPR, and core testing patterns as warranted
Drainage	1 – evidence of poor drainage	<ul style="list-style-type: none">• Flag sections that may also need drainage improvements during the next pavement repair

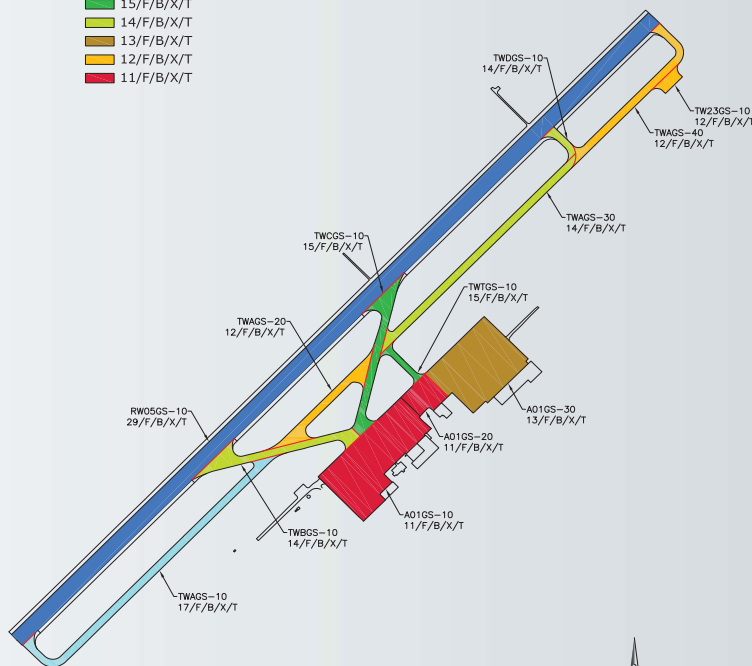
PCN ANALYSIS

- FAA AC 150/5335-5B become final at start of this project (revisions expected)
 - A pavement's PCN is compared to an aircraft's ACN
 - Gross aircraft weight capacity by gear type (single wheel, dual wheel, dual tandem wheel)
- If $ACN \leq PCN$, then that aircraft can operate on that pavement without restrictions
- Not a pavement design or evaluation procedure

PCN RESULTS

Legend
2012 PCN Values

- 29/F/B/X/T
- 17/F/B/X/T
- 15/F/B/X/T
- 14/F/B/X/T
- 13/F/B/X/T
- 12/F/B/X/T
- 11/F/B/X/T



Scale in Feet
150 0 150 300
Not to Scale

Aircraft maximum weight ratings and PCN values.

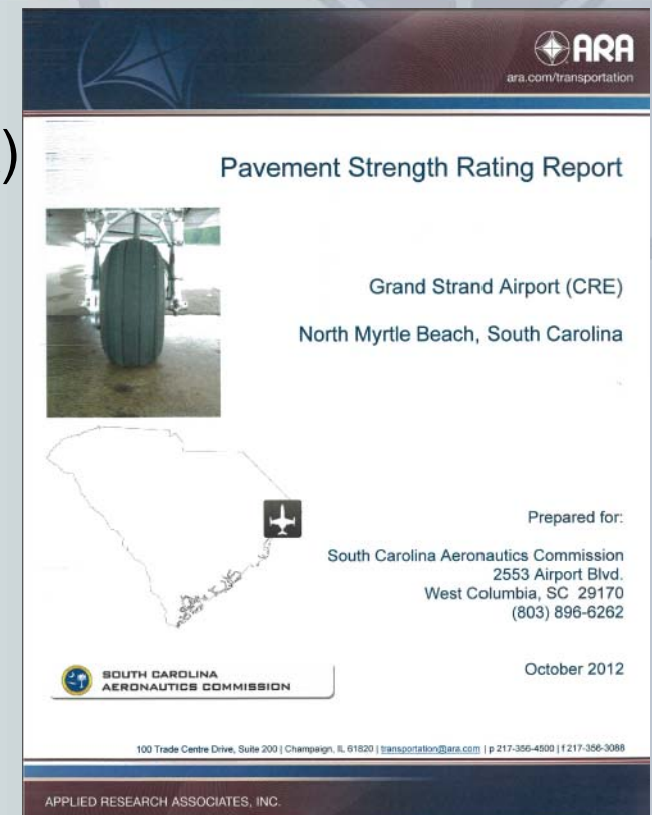
Pavement Section	SW*	DW*	PCN
A01GS-10	34.5	52	11/F/B/X/T
A01GS-20	34.5	52	11/F/B/X/T
A01GS-30	39.5	59	13/F/B/X/T
RW05GS-10	76	112	29/F/B/X/T
TW23GS-10	36	54	12/F/B/X/T
TWAGS-10	50.5	74	17/F/B/X/T
TWAGS-20	36	54	12/F/B/X/T
TWAGS-30	43	64	14/F/B/X/T
TWAGS-40	36	54	12/F/B/X/T
TWBGS-10	43	64	14/F/B/X/T
TWCGS-10	45	67	15/F/B/X/T
TWDGS-10	43	64	14/F/B/X/T
TWTGS-10	44.5	66	15/F/B/X/T

*Weights in thousands of pounds



REPORTING

- Individual airport reports
 - 3 copies (airport, SCAC, FAA)
 - Overload guidance
 - Source for future design considerations:
 - Identifies “weak links”
 - Modulus (E) data
 - Thickness (GPR coverage)
 - Subsurface anomalies (voids, moisture, utilities, settlement)



GIS - DATA AND RESULTS

- GIS shape files were incorporated with South Carolina's Facilities GIS system
 - FWD, GPR, and coring locations all geo-referenced
 - PCN, max aircraft gross weights by gear type
 - ACN/PCN scenarios for 21 common aircraft
 - Airport operators can evaluate acceptable operations of aircraft
 - Pavement ratings should be viewed as estimates of a representative value, not in absolute terms

AIRCRAFT USED FOR ACN/PCN

- Specific aircraft
 - Falcon 50, Falcon 900, Gulfstream II, III, IV, V
- Generic aircraft
 - Single Wheel (5, 10, 12.5, 15, 20, 25, 30, 35, 40)
 - Dual Wheel (15, 20, 25, 30, 35, 40)

(Aircraft weights ranged from 5,000 lbs to 91,000 lbs)



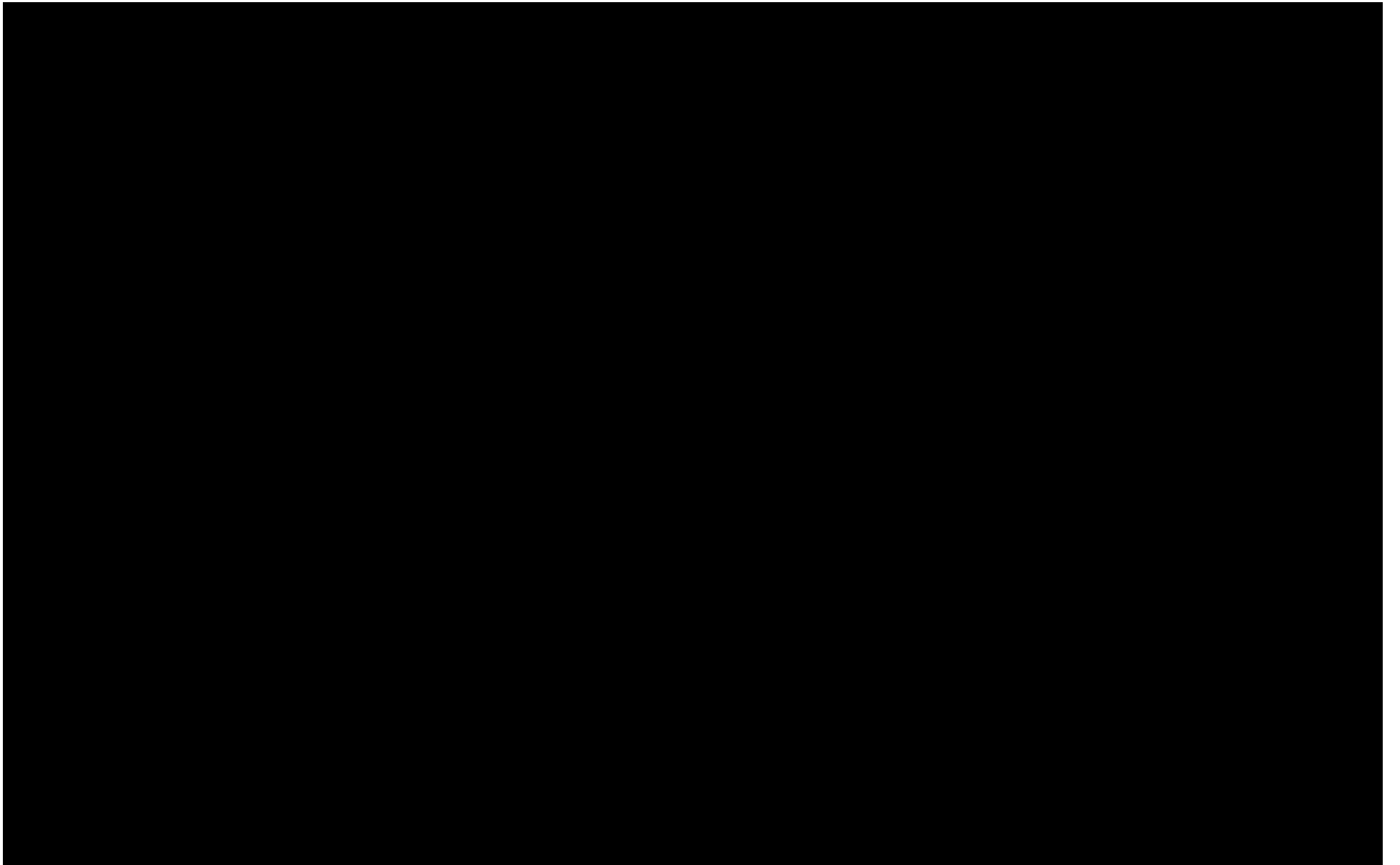
THANK YOU!!!

- South Carolina Aeronautics Commission
 - Mr. Jamey Kempson
 - Mr. Paul Werts
 - Mr. Matt Baker

ARA Point of Contacts

Bill Weiss
wweiss@ara.com
217-356-4500

Brian Aho
baho@ara.com
608-274-6409



PAVEMENT OVERLOAD GUIDANCE

- At the discretion of the Airport Manager:
 - Okay if $ACN/PCN \leq 1.10$
 - Overloads should not be permitted on pavements already exhibiting load-related distresses
 - Limit overloads during weakest time of year (wet subgrade)
 - Locations where overloads are permitted should be monitored for increased deterioration and FOD
 - Let the PCN remain, but apply local knowledge

TEAM MEMBERS AND ROLES

- ARA
 - Prime contractor, deflection testing, analysis, reporting
- Prime Engineering, Inc.
 - Records review
- Infrasense, Inc.
 - Ground penetrating radar (GPR)
- On-Spec Engineering
 - Pavement coring



ON - SPEC ENGINEERING. PC





Identity

Identify from: <Top-most layer>

MergedCores

- GMU A01-20 (Tower Ramp) Core 61.JPG

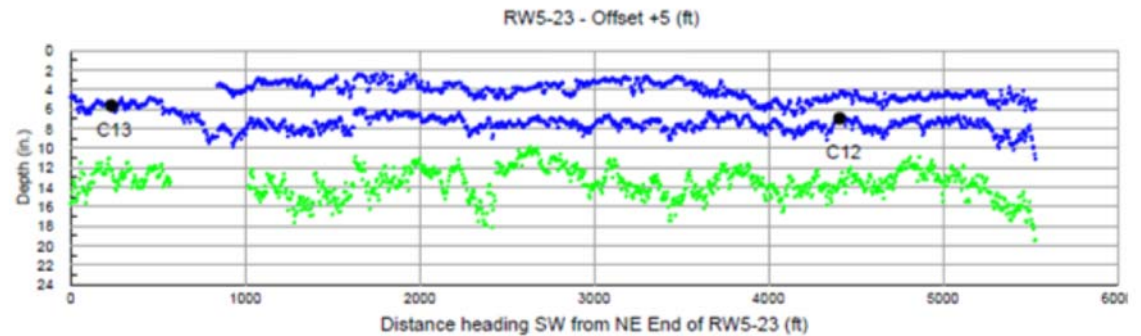
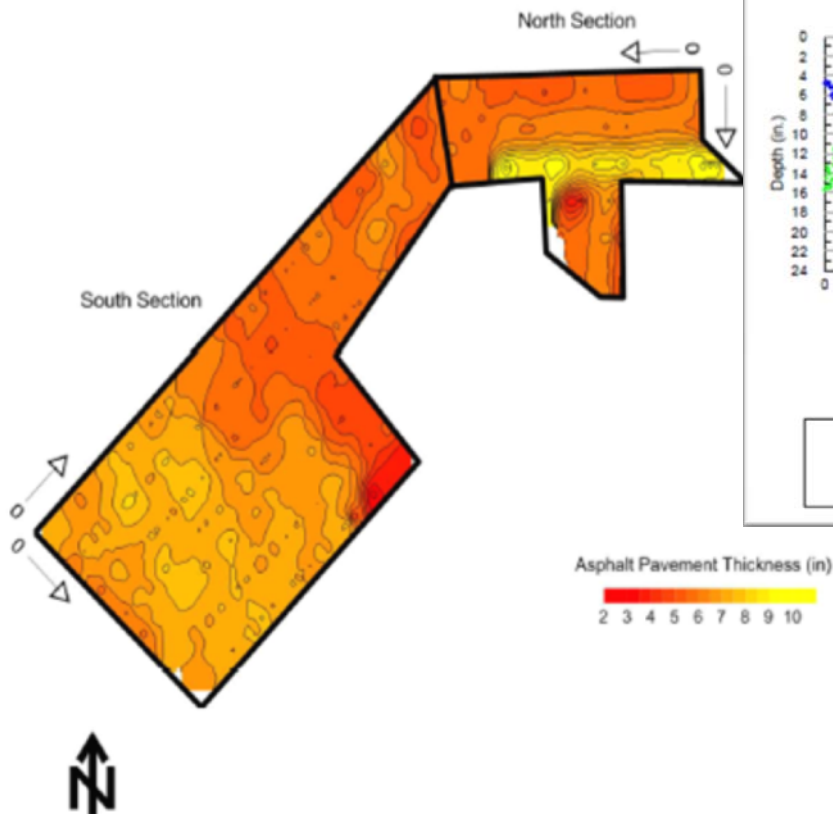
Location: 82°22'6.673"W 34°52'5.936"N

Field	Value
FID	61
Shape	Point ZM
Name	GMU A01-20 (Tower Ramp) Core 61.JPG
Image_Name	gmua01-20 (tower ramp) core 61.jpg
Airport	GMU
Airport_Co	Greenville Downtown
Triplan	3
Pic_Type	core
Point_Use	Apron
Branch	a01
Section	20
Link	\\008Group\Airport - PHESDOT Aeronautics\PO\T\T...



DATA COLLECTION – GPR TESTING

Asphalt Pavement Thickness



Sumter Airport (SMS)
Pavement Thickness Evaluation
prepared by: EMG date: 3/12/12

RW 5-23 and TWA
Sheet 1 of 1
checked by: KRM date: 3/13/12

● Core
○ Bottom of Asphalt
○ Bottom of Base

INFRASENSE, Inc.
Arlington, MA 02476

PCN CODE FORMAT – XX/1/2/3/4

XX = Pavement Classification Number

1 = Pavement Type Code

2 = Subgrade Strength Code

3 = Tire Pressure Code

4 = Evaluation Method Code

Pavement Type Code			
F- flexible (asphalt)			
R – rigid (PCC)			
Subgrade Strength Code			
Code	Category	Flexible Pavement CBR, %	Rigid Pavement <i>k</i> , pci
A	High	Over 13	Over 400
B	Medium	9 – 13	200 – 400
C	Low	4 – 8	100 – 200
D	Ultra low	< 4	< 100
Tire Pressure Code			
Code	Category	Allowable Tire Pressure, psi	
W	High	No limit	
X	Medium	146 – 217	
Y	Low	74 – 145	
Z	Ultra low	0 – 73	
Evaluation Method Code			
T – Technical Evaluation			
U – Using Aircraft			