Greenfield Municipal Airport

Pavement Classification Number Report

USING AIRCRAFT METHOD

PREPARED BY

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applied pavement TECHNOLOGY

GREENFIELD MUNICIPAL AIRPORT
PAVEMENT CLASSIFICATION NUMBER REPORT USING AIRCRAFT METHOD

PREPARED FOR:

IOWA DEPARTMENT OF TRANSPORTATION
AVIATION BUREAU

PREPARED BY:

APPLIED PAVEMENT TECHNOLOGY, INC.

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INTRODUCTION

As part of the airport pavement management system (APMS) update for the Iowa Department of Transportation, Aviation Bureau (Iowa DOT), Applied Pavement Technology, Inc. (APTech) determined Pavement Classification Numbers (PCNs) for runway pavements at Greenfield Municipal Airport and the other airports included in the 2018 phase of the APMS update. The PCNs established as part of this project will help decision-makers from the Iowa DOT, the Federal Aviation Administration (FAA), and Greenfield Municipal Airport determine what aircraft should (or should not) be able to safely use the airport without causing damage to the valuable runway infrastructure. Taxiway and apron pavements were not evaluated as part of this project and might have varying structural capacities.

In order to determine PCNs using a technical approach, pavement cross section, subgrade strength, and aircraft traffic data are required. The Iowa DOT, through collaboration with the FAA, provided design records when available. However, this information was not available for Runway 7/25 or Runway 14/32, and pavement testing to obtain pavement or subgrade layer properties was not included as part of this project. As an alternative approach, the Using Aircraft Method is applied to determine runway PCNs where required inputs for a technical calculation are not available.

Through a review of publicly available data and input from Airport Managers, APTech compiled representative traffic data for consideration in determining the associated PCNs. The largest Aircraft Classification Number (ACN) associated with an aircraft regularly using the facility is generally reported as the PCN, assuming there is not significant load-related damage, per the Using Aircraft Method outlined in FAA Advisory Circular 150/5335-5C, *Standardized Method of Reporting Airport Pavement Strength—PCN*. ACNs were determined using the FAA's COMFAA 3.0 software. Additional considerations are presented under the PCN Determination heading in this report.

The pavement sectioning is consistent with the nomenclature identified as part of the APMS update and used for Pavement Condition Index (PCI) inspections, where sections are defined by attributes such as cross section, construction history, traffic use, and overall performance. The map included in Appendix A identifies the pavement that was analyzed at Greenfield Municipal Airport.

This report includes a general overview of the Aircraft Classification Number–Pavement Classification Number (ACN–PCN) system; relevant information regarding the PCI results, especially regarding load-related distress; inputs for determining PCNs; and the resulting PCNs.

PAVEMENT CONDITION AND CONSTRUCTION SUMMARY

As part of the Iowa DOT statewide APMS project, APTech visually assessed the pavement using the PCI procedure. This procedure is described in FAA Advisory Circular 150/5380-6C, *Guidelines and Procedures for Maintenance of Airport Pavements*, FAA Advisory Circular 150/5380-7B, *Airport Pavement Management Program (PMP)*, and ASTM D5340-12, *Standard Test Method for Airport Pavement Condition Index Surveys,* and is supported by the PAVER pavement management software. Detailed information regarding the PCI procedure and results can be found in the Pavement Management Report for this airport.

Pavement condition data are not directly used in the structural analysis; however, the results should be considered when determining the PCN to publish. For example, a pavement exhibiting a significant amount of load-related distress provides a strong indication that the past traffic has exceeded the limits the structure can support. The following distresses are considered load-related:

- Hot-mix asphalt (HMA)-surfaced pavement
  - Alligator (fatigue) cracking
  - Rutting
- Portland cement concrete (PCC) pavement
  - Corner break
  - Longitudinal, transverse, and diagonal (LTD) cracking
  - Shattered slab

For reference, the percent of the PCI deduct caused by load-related distress and the specific load-related distress(es) recorded during the most recent pavement inspection at Greenfield Municipal Airport are summarized in Table 1.

Table 1. PCI results.

Branch[1]	Section[1]	Surface Type[2]	Last Construction Date	2018 PCI	Deduct due to Load-Related Distress, %	Load-Related Distress Observed[3]
R07GR	01	PCC	6/1/1994	87	15	Corner Break, LTD Cracking
R14GR	01	PCC	9/1/2001	84	10	Corner Break, LTD Cracking
R14GR	02	PCC	6/1/1994	70	66	Corner Break, LTD Cracking
R14GR	03	PCC	6/1/1994	72	26	Corner Break, LTD Cracking
R14GR	04	PCC	9/1/2001	92	0	None

[1]See Figure A-1 located in Appendix A for the location of the branch and section.

[2]AC = asphalt cement concrete; AAC = asphalt overlay on AC; PCC = portland cement concrete; APC = asphalt overlay on PCC.

[3]Distress types are defined by ASTM D5340-12.

Runway 7/25 and Sections 02 and 03 of Runway 14/32 were reconstructed with PCC pavement in 1994. In 2001, Sections 01 and 04 of Runway 14/32 were reconstructed with PCC pavement. On Runway 14/32, the sections constructed in 1994 have the lowest PCIs. All runway sections but Section 04 of Runway 14/32 contain load-related distress. One other small runway section is included in the APMS and is located at either end of Runway 7/25 (Section 02); this area is for aircraft to turn around and is not part of the actual runway. This area was not included in the PCN analysis because the overall capacity of the runway is generally not restricted by such area.

Detailed work history information for Runways 7/25 and 14/32 are entered in the APMS PAVER database. A summary of available construction information is presented in Table 2.

Table 2. Pavement cross section information.

Branch[1]	Section[1]	Construction Date	Layer Thickness, in	Material Type
R07GR	01	6/1/1994	Unknown	PCC[2]
R14GR	01	9/1/2001	Unknown	PCC[2]
R14GR	02	6/1/1994	Unknown	PCC[2]
R14GR	03	6/1/1994	Unknown	PCC[2]
R14GR	04	9/1/2001	Unknown	PCC[2]

[1]See Figure A-1 located in Appendix A for the location of the branch and section.
[2]In addition to the PCC layer, information regarding any underlying base layers is unknown.

ACN–PCN OVERVIEW

The ACN–PCN system of reporting pavement strength was developed by the International Civil Aviation Organization (ICAO). Because the United States is a member of this organization, the FAA is obligated to adhere to this system and provides guidance to comply with the ICAO standards.

The ACN–PCN procedure is structured so that a pavement with a given PCN can support an aircraft that has an ACN equal to or less than the PCN. Likewise, the pavement cannot, according to the procedure, handle frequent loadings from an aircraft with an ACN exceeding the PCN. Some infrequent overloads are allowed in accordance with the general overload guidance, which is presented within this report. Aircraft operators are required to obtain permission to use a facility when their aircraft's ACN exceeds the published PCN.

ACNs

According to FAA Advisory Circular 150/5335-5C, the ACN is defined as a number that expresses the relative effect of an aircraft at a given weight on a pavement structure for a specified standard subgrade strength. The ACN can be calculated for any operating weight. Higher ACNs indicate an aircraft has a more severe effect on the pavement, while lower values indicate a less severe effect. ACNs are reported by pavement type for each subgrade strength category. Stronger subgrade support conditions (e.g., granular subgrade soils with higher k-values or California Bearing Ratios [CBRs]) correspond to lower ACNs as compared to weaker subgrade support conditions. The ACN has a minimum value of 0 and no upper limit.

A list of ACNs for common aircraft is shown in Table 3 to assist decision-makers with determining whether the analyzed pavements can realistically support aircraft that might not be in the traffic mix. The listed ACNs were determined using the FAA's COMFAA software and are presented for each subgrade strength category for both flexible and rigid pavement types; the presented ACNs are for the specified aircraft weight and tire pressure. For a given aircraft, the ACNs will decrease as aircraft weight decreases. It is also worth noting that tire pressure influences the ACNs determined for specific aircraft. For example, given two aircraft with similar weights and gear configurations (for a specific pavement type and subgrade strength category), the aircraft with the lower tire pressure will have a lower ACN, indicating that its demand on a pavement is less than a similar aircraft with a higher tire pressure.

Table 3. ACNs for common aircraft by pavement type and subgrade category (not specific to this airport).

Aircraft	Weight, lbs	Tire Pressure, psi	Gear Type[1]	ACN: Flexible Pavement, Subgrade Category A	ACN: Flexible Pavement, Subgrade Category B	ACN: Flexible Pavement, Subgrade Category C	ACN: Flexible Pavement, Subgrade Category D	ACN: Rigid Pavement, Subgrade Category A	ACN: Rigid Pavement, Subgrade Category B	ACN: Rigid Pavement, Subgrade Category C	ACN: Rigid Pavement, Subgrade Category D
Chk.Six-PA-32	3,400	50	S	1	1	1	1	1	1	1	1
Seneca-II	4,570	55	S	1	1	2	2	1	1	1	1
Aztec-D	5,200	46	S	1	1	2	2	1	2	2	1
Baron-E-55	5,424	56	S	1	1	2	2	2	2	2	2
Navajo-C	6,536	66	S	2	2	2	3	2	2	2	2
GrnCaravanCE208B	8,750	75	S	2	3	3	3	3	3	3	3
Air Tractor 502	9,000	98	S	3	3	4	4	3	3	3	3
Citation 525	10,500	98	S	4	4	4	4	4	4	4	4
Air Tractor 802	14,200	130	S	5	6	6	6	6	6	6	6
Citation-550B	15,000	130	S	6	6	6	6	6	6	6	6
Citation-V	16,500	130	S	6	7	7	7	6	7	7	7
Sabreliner-40	19,035	185	S	8	8	8	8	8	8	8	8
Sabreliner-60	20,372	214	S	9	9	9	9	9	9	9	9
Shorts 360	27,200	78	S	7	9	10	11	9	9	9	9
King Air B-100	11,500	52	D	1	2	2	3	2	2	2	3
Super King Air-B200	12,590	98	D	2	3	3	4	3	3	3	4
Super King Air-300	14,100	92	D	3	3	4	4	3	4	4	4
Super King Air-350	15,100	92	D	3	3	4	5	4	4	4	4
Learjet-55	21,500	201	D	6	6	7	7	7	7	8	8
Hawker-800	27,520	135	D	7	7	8	9	8	8	9	9
Falcon-2000	35,000	197	D	9	10	11	11	11	11	12	12
Falcon-50	38,800	208	D	10	11	12	13	13	13	13	14
Falcon-900	45,500	145	D	12	13	14	15	14	15	15	16
Challenger-CL-604	48,200	145	D	12	12	14	16	14	14	15	15
Gulfstream-G-II	66,000	160	D	18	20	21	22	21	22	23	23
Gulfstream-G-IV	75,000	185	D	22	24	25	25	26	26	27	28

[1]Configuration of the main gear: S = single wheel and D = dual wheel (as defined in FAA Order 5300.7, *Standard Naming Convention for Aircraft Landing Gear Configurations*).

PCNs

The PCN is assigned to a pavement and expresses the relative load-carrying capacity of that pavement. Ideally, the PCN will be determined based on aircraft departures (frequency and weight) along with any pavement and subgrade layer properties. If these data become available, APTech recommends a technical evaluation be completed to determine the PCN.

FAA Advisory Circular 150/5335-5C states the following regarding the Using Aircraft Method of reporting PCNs:

> *The accuracy of this method is greatly improved when aircraft traffic information is available. Significant over-estimation of the pavement capacity can result if an excessively damaging aircraft, which uses the pavement on a very infrequent basis, is used to determine the PCN. Likewise, significant under-estimation of the pavement capacity can lead to uneconomic use of the pavement by preventing acceptable traffic from operating. Use of the Using Aircraft Method is discouraged on a long-term basis due to the concerns listed above.*

As with the ACN, the PCN has a minimum value of 0 and has no upper limit. In addition to the numerical value, the PCN is reported with four codes, which represent the following categories:

- Pavement Type
  - R = Rigid
  - F = Flexible
- Subgrade Strength Category
  - A = High (k-value ≥ 442 psi/in or CBR ≥ 13)
  - B = Medium (221 psi/in < k-value < 442 psi/in or 8 < CBR < 13)
  - C = Low (92 psi/in < k-value ≤ 221 psi/in or 4 < CBR ≤ 8)
  - D = Ultra Low (k-value ≤ 92 psi/in or CBR ≤ 4)
- Maximum Allowable Tire Pressure
  - W = Unlimited (no pressure limit)
  - X = High (pressure limited to 254 psi)
  - Y = Medium (pressure limited to 181 psi)
  - Z = Low (pressure limited to 73 psi)
- Pavement Evaluation Method
  - T = Technical Evaluation
  - U = Using Aircraft Evaluation

General Overload Guidance

For aircraft with an ACN that exceeds the PCN, ICAO overload guidance can be referenced. Alternatively, aircraft with ACNs greater than the PCNs for analyzed facilities may be able to safely use these pavements (following the ACN–PCN procedure) by operating at a reduced weight. If these aircraft do not operate at their analyzed weight, then the PCN should be determined using the operating weights.

In general, for flexible pavements, aircraft with ACNs in excess of 10 percent of the reported PCN should be restricted from operating on the given facility to avoid potential damage to the pavement. For rigid pavements, aircraft with ACNs in excess of 5 percent of the reported PCN

should be restricted. Exceeding this recommendation may result in a reduced pavement life. Appendix D of FAA Advisory Circular 150/5335-5C presents the following guidance for pavement overloads (ICAO 1983):

- For flexible pavements, occasional traffic cycles by aircraft with an ACN not exceeding 10 percent above the reported PCN should not adversely affect the pavement.
- For rigid or composite pavements, occasional traffic cycles by aircraft with an ACN not exceeding 5 percent above the reported PCN should not adversely affect the pavement.
- The annual number of overload traffic cycles should not exceed approximately 5 percent of the total annual aircraft traffic cycles. [As additional guidance, the FAA recommends limiting the overload cycles to 500 coverages; the corresponding number of annual departures depends on the aircraft and its typical pass-to-coverage ratio.]
- Overloads should not normally be permitted on pavements exhibiting signs of load-related distress, during periods of thaw following frost penetration, or when the strength of the pavement or its subgrade could be weakened by water.
- When overload operations are conducted, the airport owner should regularly inspect the pavement condition. The airport owner should periodically review the criteria for overload operations. Excessive repetition of overloads can cause a significant reduction in pavement life or accelerate when a pavement will require a major rehabilitation.

In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive.

PCN DETERMINATION—USING AIRCRAFT METHOD

Aircraft traffic is the primary consideration when reporting a PCN following the Using Aircraft Method. The PCN is reported based on the pavement type (rigid or flexible) corresponding to a given subgrade category. For the Using Aircraft Method, the specific strength is not required, but a subgrade category should be specified so the corresponding ACN can be referenced. The subgrade strength category D was chosen based on documentation from the taxiway construction project at this airport and was assumed to be similar to Runways 7/25 and 14/32 (corresponding with a subgrade k-value of 50 psi/in); specifically, it was obtained from 2003 FAA Form 5100 taxiway pavement design documentation.

APTech compiled traffic data to provide a representation of the aircraft using each runway based on publicly available information, including referencing published capacity data. This information was provided to the Airport Manager for review, who noted that the traffic was representative of the aircraft using Runways 7/25 and 14/32 on a regular basis. Representative traffic information is presented in Table 4 along with the corresponding ACNs (as determined using COMFAA) for the pavement types and subgrade strength categories associated with Greenfield Municipal Airport.

Table 4. Traffic data.

Aircraft	Weight, lbs	Gear Type[1]	Tire Pressure, psi	ACN: Rigid Pavement, Subgrade Category D
Skyhawk-172	2,558	S	50	1
Navajo-C	6,536	S	66	2
Air Tractor 502	9,000	S	98	3
Citation CJ2+	12,500	S	130	5
Air Tractor 802	14,200	S	130	6

[1]Defined by the configuration of the main gear: S = single wheel and D = dual wheel (as defined in FAA Order 5300.7, *Standard Naming Convention for Aircraft Landing Gear Configurations*).

Based on the representative aircraft using Runways 7/25 and 14/32, of which the most critical aircraft is the Air Tractor 802 with an ACN of 6 for the given pavement type and subgrade category, the PCN and corresponding allowable aircraft weights are presented in Table 5. These values are determined based on the weight of the determining aircraft and are not specific for any particular aircraft model. The PCNs can be reported to the FAA's regional office using the results from this report.

Table 5. PCN results and corresponding allowable aircraft weights.

Branch	PCN	Single Wheel[1] Allowable Aircraft Weight, lbs
Runway 7/25	6/R/D/W/U	14,200[2]
Runway 14/32	6/R/D/W/U	14,200[2]

[1]Refers to the aircraft's main gear type.

[2]Based on the weight of the determining aircraft.

Load-related distresses were observed during the 2018 PCI inspection on both runways, which indicates that some aircraft may be overloading the pavement. Therefore, additional investigation is recommended to determine a more accurate assessment of the capacity of the runways. Furthermore, the overall pavement condition and progression of distress should continue to be monitored.

The ICAO overload guidance, included in the ACN–PCN Overview chapter of this report, can be referenced for aircraft with an ACN that exceeds the PCN for a specified pavement, although this information is more applicable for PCNs determined from a Technical Evaluation Method. Alternatively, aircraft with ACNs greater than the documented PCN may be able to use the facility, following the ACN–PCN procedure, by operating at a reduced weight. In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive.

SUMMARY

This report presents an overview of the ACN–PCN procedure and documents the representative traffic considered when determining the PCN following the FAA's Using Aircraft Method, as described in FAA Advisory Circular 150/5335-5C. The PCN recommended for publication for Runway 7/25 is 6/R/D/W/U and for Runway 14/32 is 6/R/D/W/U. Load-related distresses were observed during the 2018 PCI inspection on both runways, which indicates that some aircraft may be overloading the pavement.

ACNs of common aircraft are provided, and overload guidance is presented. In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive.

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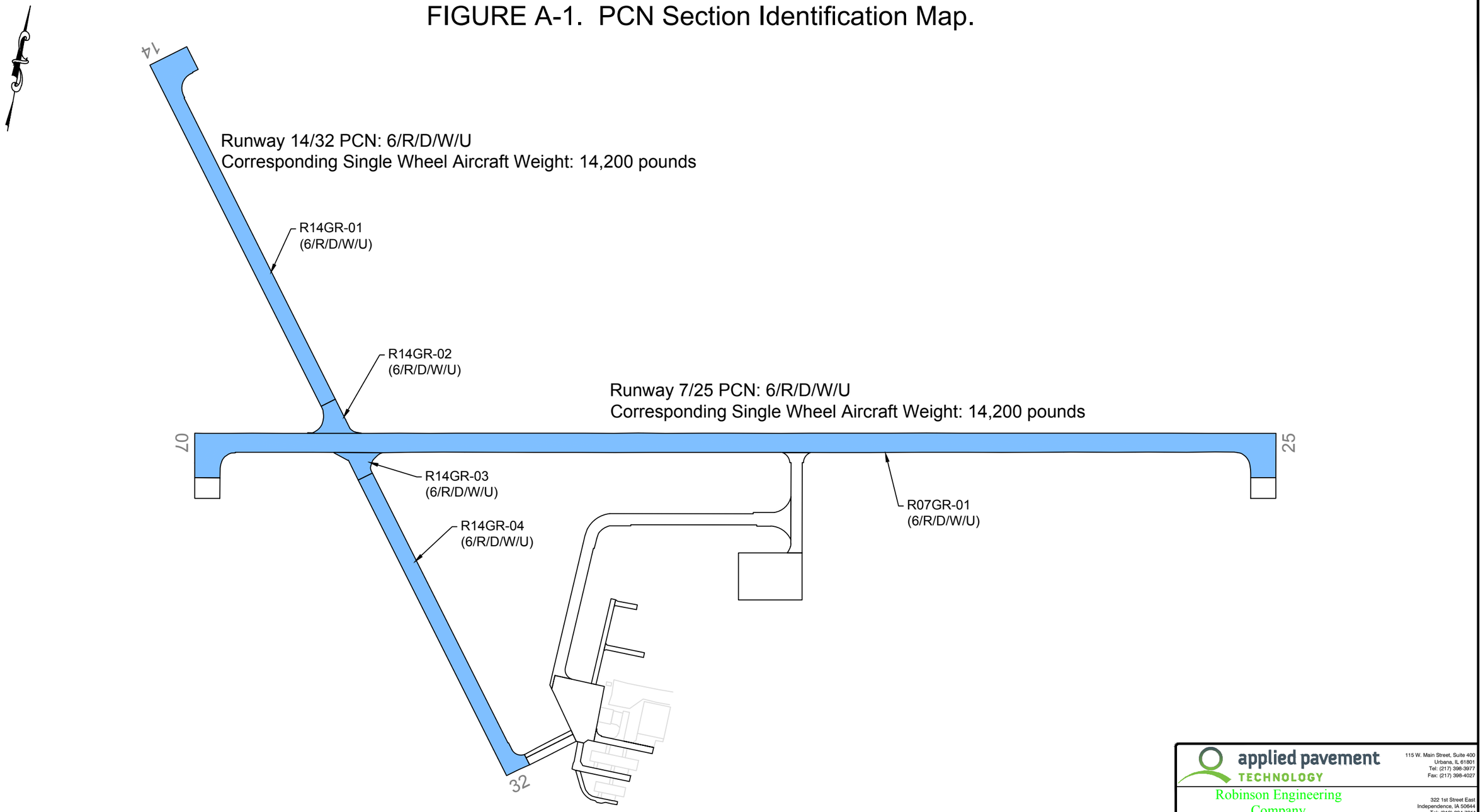
APPENDIX A

PCN SECTION IDENTIFICATION MAP

FIGURE A-1. PCN Section Identification Map.



LEGEND

R02AT-10 — BRANCH IDENTIFIER, SECTION IDENTIFIER
(32/F/A/X/T) — PCN VALUE
SECTION BREAK LINE
PCN SECTION

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