Carroll Municipal-
Arthur N. Neu Airport

Pavement Classification Number Report

TECHNICAL EVALUATION

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applied pavement
TECHNOLOGY

CARROLL MUNICIPAL-ARTHUR N. NEU AIRPORT PAVEMENT CLASSIFICATION NUMBER REPORT TECHNICAL EVALUATION

PREPARED FOR:

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF AVIATION

PREPARED BY:

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INTRODUCTION

As part of the airport pavement management system (APMS) update for the Iowa Department of Transportation, Office of Aviation (Iowa DOT), Applied Pavement Technology, Inc. (APTech) determined Pavement Classification Numbers (PCNs) for runway pavements at Carroll Municipal-Arthur N. Neu Airport and other airports included in the 2017 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 Carroll Municipal-Arthur N. Neu 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.

Critical inputs for determining PCNs using a technical approach include pavement cross section, subgrade strength, and aircraft traffic. The Iowa DOT, through collaboration with the FAA, provided design records containing pavement cross section and subgrade data. Where recent design information was available, traffic data associated with the pavement design were also provided. In cases where this information was not directly available, through a review of publicly available data and input from Airport Managers, APTech compiled a representative traffic mix for use in the PCN analysis.

APTech used the collected information to determine the PCNs for each included pavement section in accordance with the FAA Advisory Circular 150/5335-5C, *Standardized Method of Reporting Airport Pavement Strength – PCN*, and supporting COMFAA 3.0 software. Note that PCNs are only intended as a method to report pavement strength for pavements designed for airplane loads of 12,500 pounds or greater. The pavement sections are consistent with those 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 included pavement sections at Carroll Municipal-Arthur N. Neu 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; required inputs for determining PCNs; and the resulting PCNs.

PAVEMENT CONDITION SUMMARY

As part of the Iowa DOT's 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 in the calculation:

- 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 Carroll Municipal-Arthur N. Neu Airport are summarized in Table 1.

Table 1. PCI results.

Branch[1]	Section[1]	Surface Type[2]	Last Construction Date	2017 PCI	Deduct due to Load-Related Distress, %	Load-Related Distress Observed[3]
R03CA	01	PCC	9/16/2006	85	31	LTD Cracking
R03CA	02	PCC	9/16/2006	82	54	Corner Break, LTD Cracking, Shattered Slab
R13CA	02	PCC	6/1/1972	67	8	LTD Cracking
R13CA	03	PCC	6/1/1988	85	7	Corner Break, LTD Cracking
R13CA	04	PCC	1/3/1993	89	29	Corner Break, LTD Cracking
R13CA	05	PCC	1/3/1993	94	13	LTD Cracking

[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 13-31 Sections 04 and 05, representing the extended and widened areas of the runway, were constructed approximately 21 years after Section 02 and 5 years after Section 03 of the runway mainline. As such, Sections 02 and 03 have lower PCIs with more overall distresses recorded; however, all sections have load-related distress identified.

Sections 01 and 02 of Runway 3-21 are located on either side of Runway 13-31 and were constructed at the same time in 2006; however, Section 02 located to the north has a slightly lower PCI with more load-related distress noted than Section 01.

ACN–PCN OVERVIEW

The ACN–PCN system of reporting pavement strength was developed by the International Civil Aviation Organization (ICAO). Since 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 the 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 (i.e., rigid or flexible) and subgrade strength category (i.e., A, B, C, or D, as defined later). Pavements with a PCC layer are generally considered rigid, including those with an HMA overlay; HMA pavements (without underlying PCC layers) are considered flexible. 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 2 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 COMFAA, the FAA's 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 2. 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
KingAir B-100	11,500	52	D	1	2	2	3	2	2	2	3
SuperKingAir-B200	12,590	98	D	2	3	3	4	3	3	3	4
SuperKingAir-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 in terms of allowable load for unrestricted operations based on aircraft departures (frequency and weight) and pavement layer properties. The determined PCN is specific for the given conditions and should be recalculated if the aircraft types or volumes change significantly. 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 (as shown in Tables 5 and 6), then the PCN should be recalculated using the operating weights. That said, aircraft would need to be restricted to these analyzed weights to avoid the potential for damaging the pavement.

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 the FAA Advisory Circular 150/5335-5C presents the following guidance for pavement overloads (taken from ICAO Aerodrome Design Manual, 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.

Where overload operations are conducted, the airport/agency should regularly monitor the condition of the affected pavement and periodically review the criteria for overload operations since excessive repetition of overloads can cause severe shortening of pavement life or require major rehabilitation of the pavement. In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive.

PCN ANALYSIS INPUTS

The analysis approach using COMFAA, the FAA's software, uses the same methodology as the FAA's conventional design procedure outlined in the FAA Advisory Circular 150/5320-6D, *Airport Pavement Design and Evaluation*. It incorporates the CBR design procedure for flexible pavements, which determines the required thickness of pavement layers to protect the underlying layers from rutting. For rigid pavements, the design procedure is based on the Westergaard solution for a loaded elastic plate on a Winkler foundation to limit cracking in the PCC pavement.

The aircraft data, subgrade support values (CBR for flexible pavement or effective top-of-base k-value for rigid pavement), and pavement evaluation thicknesses are used directly in COMFAA. For rigid pavements, the PCC flexural strength is also a direct input. Using these inputs, COMFAA iteratively adjusts the critical aircraft weight until the required pavement thickness determined using the software matches the existing pavement cross section. This process is repeated within COMFAA such that each aircraft in the mix is analyzed as the critical aircraft. This calculation produces a PCN associated with each analyzed aircraft; in general, the highest PCN associated with the "regularly using" aircraft is selected to represent the section.

Pavement and Subgrade Layer Properties

Runway 13-31 Section 03 was constructed in 1961, overlaid with HMA in 1972, and then overlaid with PCC in 1988. Section 02 was constructed in 1972 with PCC. Sections 04 and 05 were both constructed in 1993 to extend and widen the runway. Runway 3-21 was constructed in 2006.

Pavement cross section information (material types and thicknesses) for Runway 3-21 was obtained from 2006 FAA Form 5100 pavement design documentation, for Runway 13-31 Sections 02 and 03 from 1972 FAA pavement strength survey documents, and for extension and widening of Runway 13-31 Sections 04 and 05 from 1993 FAA Form 5100 pavement design documentation.

A subgrade k-value of 25 psi/in was obtained from the 2006 records for Runway 3-21. The upper 8 inches of subgrade was fly ash treated, which was assumed to increase the subgrade strength to the FAA's recommended minimum value of 68 psi/in (equivalent to a CBR of 3). This is the value used for the PCN analysis. A subgrade k-value of 100 psi/in was obtained from the 2009 records for the Runway 13-31 parallel taxiway and was assumed for all sections of Runway 13-31. Table 4 indicates different values for rigid pavement because it represents the effective top-of-base k-values. For Runway 13-31 Section 03, the underlying HMA material was analyzed as a stabilized base layer, contributing to the relatively high k-value shown in the table.

A flexural strength of 650 psi was conservatively selected and used in this analysis.

Detailed work history information for each pavement section, as it is entered in the APMS PAVER database, is presented in Appendix D of the complementary Pavement Management Report for this airport. A summary of the relevant layer thickness information for the PCN analysis is presented in Table 3.

Table 3. Pavement cross section information.

Branch[1]	Section[1]	Construction Date	Layer Thickness, in	Material Type
R03CA	01	9/16/2006	5	PCC (P-501)
R03CA	02	9/16/2006	5	PCC (P-501)
R13CA	02	6/1/1972	6	PCC (P-501)
R13CA	02	6/1/1972	6	Aggregate (P-154)
R13CA	03	6/1/1988	5	PCC (P-501)
R13CA	03	6/1/1972	2	HMA (P-401)
R13CA	03	6/1/1961	2	HMA (P-401)
R13CA	03	6/1/1961	8	Aggregate (P-208)[2]
R13CA	04	1/3/1993	6	PCC (P-501)
R13CA	04	1/3/1993	6	Aggregate (P-154)
R13CA	05	1/3/1993	6	PCC (P-501)
R13CA	05	1/3/1993	6	Aggregate (P-154)

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

[2] Assumed material type for analysis.

The pavement evaluation thickness used for calculating PCNs is determined differently for flexible and rigid pavements. Furthermore, the subgrade strength used for rigid pavement PCN analysis is also determined differently than for flexible pavement. These inputs are listed in Table 4 for each analyzed pavement section; a brief explanation on how these inputs are determined is described in the following paragraphs.

Table 4. Pavement evaluation thickness and subgrade strength for COMFAA analysis.

Branch[1]	Section[1]	Evaluation Thickness, in	Pavement Type	Subgrade Top-of-Base k-value, psi/in	Subgrade Category
R03CA	01	5	R	68	D
R03CA	02	5	R	68	D
R13CA	02	6	R	145	C
R13CA	03	5	R	242	B
R13CA	04	6	R	145	C
R13CA	05	6	R	145	C

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

For flexible pavement, the evaluation thickness used for the PCN calculation is based on converting the existing pavement layers to a reference FAA cross section using FAA-recommended layer equivalency factors, as defined in the FAA Advisory Circular 150/5335-5C. Because there are no aircraft in the traffic mix with four or more wheels on a main gear (i.e., analyzed aircraft are limited to S or D gear types), the following standard FAA cross section is used: 3-inch HMA layer (P-401) on a 6-inch high-quality granular base layer (P-209 or similar). The FAA's COMFAA Support Spreadsheet was used to compute the evaluation thickness, which is a direct input in the PCN analysis. The subgrade strength in terms of a CBR is also a direct input into the PCN calculation for flexible pavements.

For rigid pavement, the thickness of the PCC layer is used as the evaluation thickness. In addition to the PCC layer thickness, the PCC flexural strength is also a direct input for PCN analysis of rigid pavement. Base layers are taken into account by converting to a top-of-base k-value (i.e., adjusting the support conditions) rather than contributing to the overall evaluation thickness. The FAA's COMFAA Support Spreadsheet is used to determine the top-of-base k-value used in the PCN analysis.

For composite pavements analyzed as rigid structures, the thickness of the HMA surface is converted to an equivalent PCC thickness and combined with the PCC thickness to compute the evaluation thickness (where 2.5 inches of HMA is considered to be equivalent to 1 inch of PCC, following FAA guidance).

Traffic

The traffic data provide a representation of the aircraft using each facility and are an estimate of the 20-year average annual departures. Only departures are used for the analysis following the FAA's procedure because they generally have heavier loads due to fuel weight. When actual operating weights of aircraft were not specified, maximum takeoff weights (MTOW) are used, which incorporates some conservatism into the analysis. The entire aircraft traffic mix associated with each facility is entered directly into COMFAA. Because PCN calculations are dependent on the aircraft using a facility, PCNs should be recalculated if the aircraft mix or volume changes significantly.

As previously stated, APTech compiled a representative traffic mix for use in the PCN analysis based on available information. The traffic data for Runways 3-21 and 13-31 were determined through a review of publicly available data and input from the Airport Manager. The traffic for Runway 13-31 includes much of the same traffic as Runway 3-21, plus some heavier aircraft. This information is presented in Tables 5 and 6 along with the corresponding ACNs (as determined using COMFAA) for the pavement types and subgrade strength categories associated with Carroll Municipal-Arthur N. Neu Airport.

Table 5. Traffic data for Runway 3-21.

Aircraft	Weight, lbs	Gear Type[1]	Tire Pressure, psi	Annual Departures for Runway 3-21	ACN: Rigid Pavement, Subgrade Category D
Skyhawk-172	2,558	S	50	1,200	1
Navajo-C	6,536	S	66	1,200	2
Air Tractor 502	9,000	S	98	1,200	3
Air Tractor 802	14,200	S	130	250	6
Citation-550B	15,000	S	130	150[2]	6
Super King Air-350	15,100	D	92	150	4

[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*).

[2] Departure volumes were increased from the amount shown to correspond to at least 1,000 coverages in order to report a PCN that accounts for regular use of this aircraft.

Table 6. Traffic data for Runway 13-31.

Aircraft	Weight, lbs	Gear Type[1]	Tire Pressure, psi	Annual Departures for Runway 13-31	ACN: Rigid Pavement, Subgrade Category B	ACN: Rigid Pavement, Subgrade Category C
Skyhawk-172	2,558	S	50	1,200	1	1
Navajo-C	6,536	S	66	1,200	2	2
Air Tractor 502	9,000	S	98	1,200	3	3
Air Tractor 802	14,200	S	130	250	6	6
Citation-550B	15,000	S	130	150	6	6
Shorts 360	27,200	S	78	100[2]	9	9
Super King Air-350	15,100	D	92	150	4	4
Hawker-800	27,520	D	135	100	8	9

[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*).

[2] Departure volumes were increased to correspond to at least 1,000 coverages in order to report a PCN that accounts for regular use of this aircraft.

To account for back-taxiing needs, the FAA's PCN analysis allows the number of aircraft passes per traffic cycle to be increased. A pass to traffic cycle (P/TC) ratio of one was used in most cases with a standard runway and parallel taxiway configuration. A P/TC ratio of two was used for runways with a mid-field taxiway configuration, which would require aircraft to back-taxi prior to takeoff. A P/TC ratio of one was used for Runway 3-21 and Runway 13-31 based on taxiway access to the approach ends of Runways 21, 13, and 31.

When the pavement capacity greatly exceeds the load applied by the aircraft in the analyzed traffic mix, analysis inputs are adjusted to attain a cumulative damage factor (CDF) of 0.15, per guidance in the FAA Advisory Circular 150/5335-5C. Additionally, PCNs are based on aircraft that regularly use a facility, where the FAA Advisory Circular 150/5335-5C defines aircraft that regularly use the pavement as those with more than 1,000 coverages over the 20-year analysis period. As such, the reported PCNs are based on at least 1,000 coverages of the determining aircraft.

A coverage represents a full-load application on a point in the pavement to account for aircraft/pilot wander. The number of passes required to statistically "cover" the intended wheel path on the pavement is expressed by a pass to coverage (P/C) ratio (where a pass is a one-time movement of the aircraft over the pavement). The P/C ratio varies by aircraft, where smaller aircraft generally have more wander. Coverages were determined using COMFAA. Appendix A of the FAA Advisory Circular 150/5335-5C provides more detailed definitions regarding traffic terminology.

PCN RESULTS

The PCNs associated with each included pavement section are presented in Table 7 along with corresponding allowable aircraft weights (as determined using the FAA's COMFAA support spreadsheet, which are approximations and are not specific for any particular aircraft model). The corresponding allowable aircraft loads presented in Table 7 are based on general correlations and are not specific to the analyzed aircraft. These PCNs can be reported to the FAA's regional office using the results from this report and/or the information in the standard FAA form provided in Appendix B, which contains the applicable 5010 data elements.

Table 7. PCN results and corresponding allowable aircraft weights.

Branch[1]	Section[1]	PCN	Single Wheel[2] Allowable Aircraft Weight, lbs	Dual Wheel[2] Allowable Aircraft Weight, lbs
R03CA	01	6/R/D/W/T	19,500	-
R03CA	02	6/R/D/W/T	19,500	-
R13CA	02	10/R/C/W/T	31,500	43,000
R13CA	03[3]	7/R/B/W/T	23,000	-
R13CA	04	10/R/C/W/T	31,500	43,000
R13CA	05	10/R/C/W/T	31,500	43,000

[1] See Figure A-1 located in Appendix A for the location of the branch and section.
[2] Refers to the aircraft's main gear type.
[3] This section is not structurally adequate to handle some of the operations of the analyzed aircraft Shorts-360 and Hawker-800 on Runway 13-31.

The recommended PCN for Runway 3-21 is 6/R/D/W/T. The PCN analysis indicates that Runway 3-21 is structurally adequate for the traffic listed in Table 5, as shown in Figure 1. Because load-related distress was observed during the 2017 PCI inspection, the condition of this pavement and the progression of distress should be monitored. While the Air Tractor 802 and Citation-550B have ACNs that align with the PCN of this runway, this is a result of rounding to whole numbers, as is done for PCN reporting. The detailed analysis of the traffic indicates slight overloading of the collective aircraft traffic outlined in Table 5 (specifically that the cumulative damage factor of the Air Tractor 802 plus the Citation-550B is greater than one, with a factor of one corresponding with the safe allowable loading limitations).

The recommended PCN for Runway 13-31 is 7/R/B/W/T based on the structural capacity of the controlling pavement structure, Section 03. The PCN analysis indicates that the runway is not structurally adequate for some of the traffic listed in Table 6. Figure 2 illustrates the extent to which the ACNs of some of the analyzed aircraft (namely Shorts-360 and Hawker-800) exceed the calculated PCN for Section 03. To avoid overloading Section 03 of this runway, the Airport could consider limiting the weight of the Shorts-360 and Hawker-800 to approximately 23,000 pounds, based on the estimated departures that are listed in Table 6 (i.e., 100 annual departures of each aircraft). As with Runway 3-21, because load-related distress was observed and this analysis indicates overloading, the condition of this pavement and the progression of distress should be monitored.

Figure 1. ACN–PCN comparison for Runway 3-21.

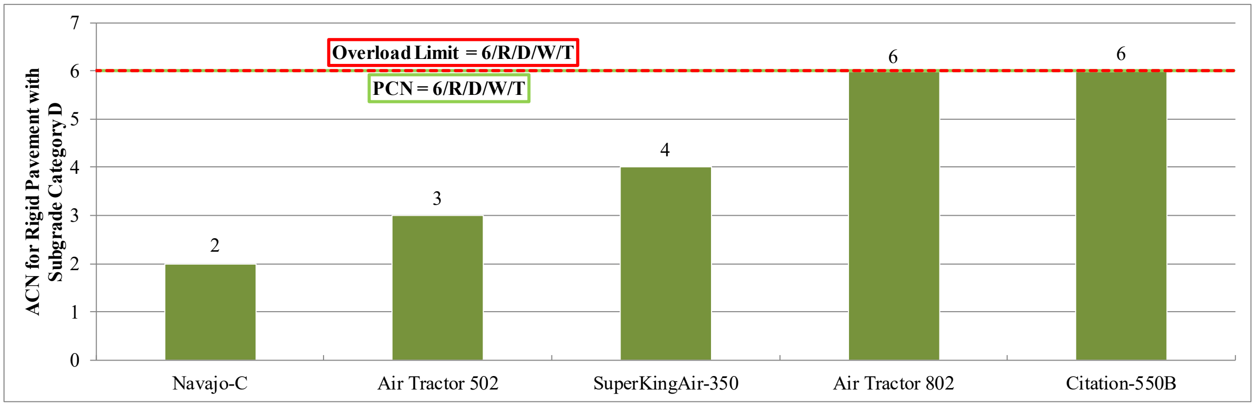
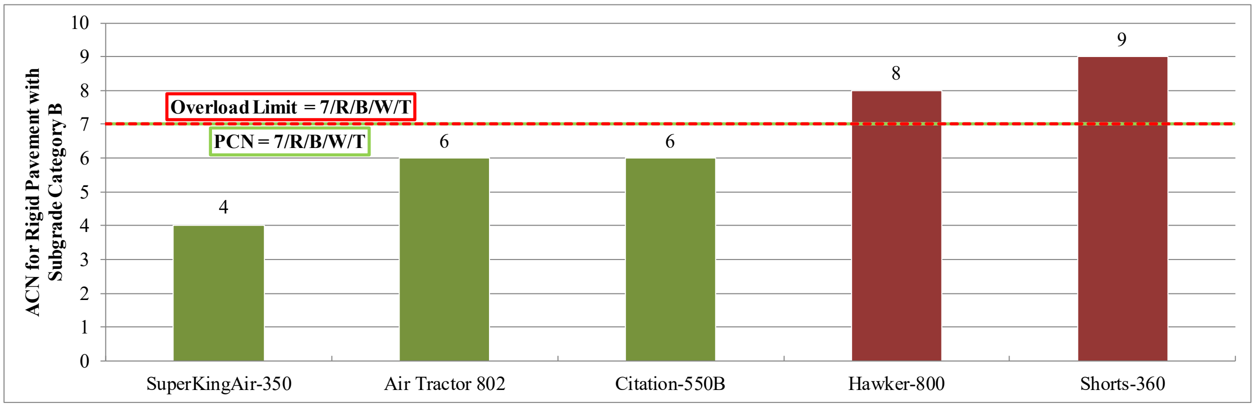


Figure 2. ACN–PCN comparison for Runway 13-31.



The discussion presented herein is based on a straightforward comparison between ACNs (for the aircraft at their analyzed weights) and PCNs for each pavement section. 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. 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.

In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive. While the FAA's pavement structural capacity approach is conservative, where overload operations are conducted, Carroll Municipal-Arthur N. Neu Airport should be aware of the effect and risks of operating these aircraft based on the PCN analysis results determined using the Technical Evaluation Method.

SUMMARY

This report presents an overview of the ACN–PCN procedure, summarizes the inputs used for the calculation (including the subgrade strength, PCC flexural strength where applicable, pavement evaluation thickness, and traffic), and documents the results of the PCN analysis. Additionally, 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.

The PCNs presented within this document are determined using the FAA's Technical Evaluation Method for determining PCNs, as described in the FAA Advisory Circular 150/5335-5C. The PCNs recommended for publication are 6/R/D/W/T for Runway 3-21 and 7/R/B/W/T for Runway 13-31. Runway 3-21 pavement is structurally adequate for the analyzed aircraft; however, Runway 13-31 pavement is not structurally adequate for the analyzed traffic where ACNs of included aircraft (specifically Shorts-360 and Hawker-800) are exceeding the recommended PCN. Additional details are presented within the report.

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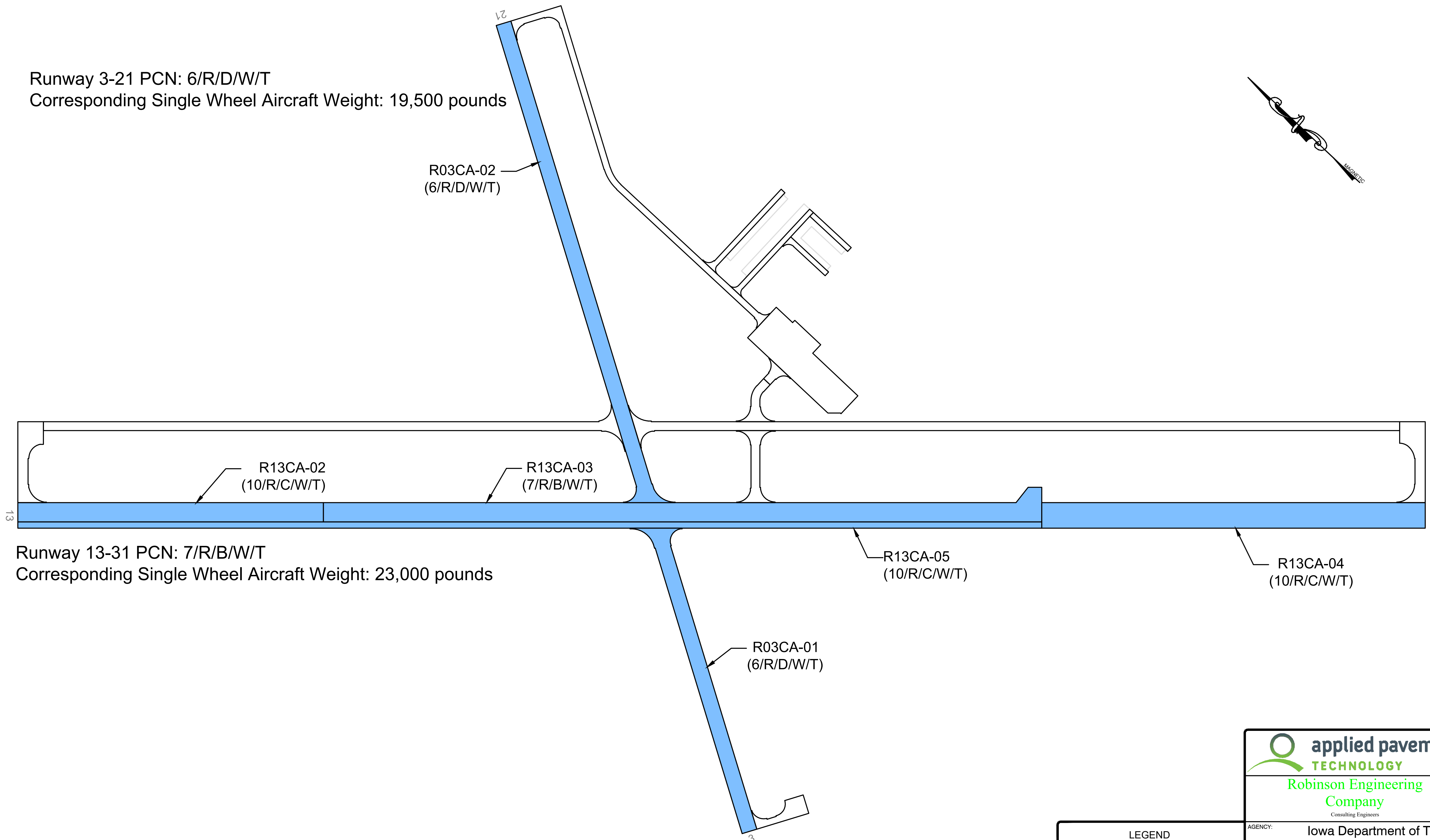
Appendix A

PCN Section Identification Map

FIGURE A-1. PCN Section Identification Map



LEGEND

BRANCH IDENTIFIER
SECTION IDENTIFIER
R1533AL-01
(32/F/A/X/T) PCN VALUE
SECTION BREAK LINE
PCN SECTION

applied pavement TECHNOLOGY
115 W. Main Street, Suite 400
Urbana, IL 61801
Tel: (217) 398-3977
Fax: (217) 398-4027

Robinson Engineering Company
Consulting Engineers
322 1st Street East
Independence, IA 50644
Tel: (319) 334-7211

AGENCY: Iowa Department of Transportation
Office of Aviation

LOCATION: Carroll Municipal - Arthur N. Neu Airport
Carroll, Iowa

PAGE TITLE: PCN Section Identification Map

PROJECT DATE: SEP. 2017	CREATION DATE: AUG. 2018	PROJECT MANAGER: LJR	JOB NUMBER: 17-020-AM01
DRAWING SCALE: 1"=400'	LAST MODIFIED DATE: AUG. 2018	REVISED BY: MDK	DRAWN BY: KEW
FILENAME: Carroll.dwg		LAYOUT NAME/NUMBER: PCN	PAGE NUMBER: A-1

Appendix B

FAA Form 5010 Data Elements

Figure B-1. Form 5010 Data Elements
(Standard Form from the FAA's Support Spreadsheet for COMFAA 3.0).

- A Flexible Category (CBR 15)
- B Flexible Category (CBR 10)
- C Flexible Category (CBR 6)
- D Flexible Category (CBR 3)

- A Rigid Category (k 552 pci)
- B Rigid Category (k 295 pci) (selected)
- C Rigid Category (k 147 pci)
- D Rigid Category (k 74 pci)

TIRE PRESSURE

- W Unlimited
- X 218 psi
- Y 145 psi
- Z 73 psi

METHOD USED

- Using Aircraft
- Technical (selected)

Project info

AIRCRAFT GEAR TYPE IN TRAFFIC MIX

- [x] S (single wheel gear)
- [x] D (dual wheel gear)
- [ ] 2D (dual tandem wheel gear)
- [ ] 3D (triple tandem wheel gear) e.g B-777
- [ ] DDT or W/B (tandem gear under wing AND tandem gear under body) e.g. B-747, A-340-600, A-380

Airport LOC-ID CIN

Pavement ID

Enter PCN

Form 5010 Data Element	Gross Weight and PCN
#35 S gear	
#36 D gear	
#37 DT gear	
#38 DDT gear	
#39 PCN	

IF 3D or W/B Gear Checked, #38 = PCN
Please Add Data Element #38 Remark

3D	
2D/2D2	
2D/3D2W	
2D/3D2B	

Report Minimum Gross Weight

Save Form 5010 Data

Clear Data

Airport LOC-ID	Pavement ID	#35 S GW	#36 D GW	#37 DT GW	#38 DDT GW	#39 PCN
CIN	R03CA-01	19.5	<min			6/R/D/W/T
CIN	R03CA-02	19.5	<min			6/R/D/W/T
CIN	R13CA-02	31.5	43			10/R/C/W/T
CIN	R13CA-03	23	<min			7/R/B/W/T
CIN	R13CA-04	31.5	43			10/R/C/W/T
CIN	R13CA-05	31.5	43			10/R/C/W/T

PREPARED FOR

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DECEMBER 2018