GRI
9750 SW Nimbus Avenue
Beaverton, OR 97008-7172
p | 503-641-3478 f | 503-644-8034

September 16, 2019



Century West Engineering Corporation
5331 SW Macadam Avenue, Suite 287
Portland, OR 97239

Attention: James Kirby, PE
Senior Project Manager

**SUBJECT: Pavement Classification Number (PCN) Evaluation of Runway 17-35**
**Aurora State Airport (UAO)**
**Aurora, Oregon**

As requested, GRI conducted a pavement evaluation at Aurora State Airport (UAO) in support of the Oregon Department of Aviation (ODA) to develop a pavement classification number (PCN) for Runway 17-35.

## PROJECT DESCRIPTION

Our work included review of relevant ODA records for Runway 17-35, falling weight deflectometer (FWD) testing, core explorations, and engineering analyses in accordance with Federal Aviation Administration (FAA) Advisory Circular 150/5335-5C, *Standardized Method of Reporting Airport Pavement Strength – PCN*. According to the FAA, the PCN is a number that expresses the load-carrying capacity of a pavement for unrestricted operations. We determined the PCN using the Technical Evaluation Method specified in Advisory Circular 150/5335-5C.

## BACKGROUND

Based on information provided in the ODA pavement evaluation/maintenance management program report prepared by Pavement Consultant Inc. in 2018, a 4,100-ft-long segment on the north end of the runway was first constructed in 1943 and in 1993, a 900-ft-long extension was built to the south. The last major rehabilitation on the runway was conducted in 2005 and generally consisted of a 2- to 3-in. overlay.

The current Airport Master Record, FAA Form 5010, lists the gross weight limit for a single-wheel, main-gear aircraft and a dual-wheel, main-gear aircraft at 30,000 and 45,000 lbs, respectively. UAO currently does not have an established PCN.

## FIELD WORK

### Site Reconnaissance

A visual pavement reconnaissance was performed by GRI engineers on August 12, 2019, to assess the general surface condition of the pavements within the project and to identify core exploration locations.

## Falling Weight Deflectometer Tests

GRI conducted FWD testing on August 20, 2019, along the full length of the runway. The testing was conducted in accordance with FAA Advisory Circular 150/5370-11b, *Use of Nondestructive Testing in the Evaluation of Airport Pavements,* using our KUAB 2m Model 150 FWD device.

FWD testing was completed along test lines located at 7 ft west and 12 ft east of the runway centerline. The tests were spaced at approximately 200-ft intervals within the runway keel section. The approximate locations of the test lines are shown on Figure 1.

The FWD test procedures are described in Appendix A. The data were normalized to a 30,000-lb load basis and the FWD deflection data are shown in Table 1A.

We also reviewed the load-response data measured by the FWD to provide a preliminary understanding of the overall stiffness of the pavement structure. Although this information does not provide information about the stiffness of individual soil and pavement layers, it does provide a quick assessment of the overall stiffness of the pavement system to gauge the variability of pavement stiffness within a particular pavement facility. Impact stiffness modulus (ISM) is inversely proportional to deflection and is therefore a direct measurement of the combined stiffness, or resistance to deflection induced by FWD loading, of the pavement and subgrade soils. As such, it is usually a relative measure of the pavement's ability to support loads, i.e., high ISM modulus values usually correspond to high pavement strength and vice versa. The profile of relative pavement strength along the two FWD test lines, as measured by resistance to deflection under FWD loading, is plotted for each FWD test location on Figure 4A. Additional discussion regarding ISM is provided in Appendix A.

## Coring Explorations

**General.** On August 20, 2019, GRI conducted three core explorations, all of which were located over cracks. The approximate locations of the explorations are shown on the Site Plan, Figure 1. Details of our field investigations are further discussed in Appendix A of this report and the core explorations are summarized in Table 1.

**Table 1: SUMMARY OF CORING EXPLORATION RESULTS**

| Core No. | FWD Test No. | Test Line | Station | Asphalt Concrete Thickness, in. | Aggregate Base Thickness, in. | Drilled Over a Crack? | Depth of Crack, in. |
|---|---|---|---|---|---|---|---|
| B-1 | 26 | 7 ft west | 56+81 | 8.75 | 15.00 | Yes | 2.50 |
| B-2 | 16 | 7 ft west | 39+51 | 9.00 | 15.00 | Yes | 3.25 |
| B-3 | 32 | 12 ft east | 19+41 | 9.00 | 15.00 | Yes | 2.50 |

## Existing Pavement Conditions

Overall, the pavement surface of Runway 17-35 appears to be in good condition. The primary distresses observed on the runway are low- to medium-severity longitudinal cracking, primarily at paving-panel joints or along the centerline; low-severity weathering; and isolated low-severity alligator cracking within the gear paths.

Since the alligator cracking within the gear paths (noted above) is a load-associated distress, in our opinion, it warranted further investigation and we therefore conducted the three core explorations in areas of alligator cracking on the runway. As shown in Table 1 and the photo logs on Figures 1A through 3A in Appendix A, the cracking is top down and extends to a depth of 2.5 in. in cores B-1 and B-3 and to a depth of 3.25 in. in B-2. These types of cracks may be induced by excessive shear stresses imposed by aircraft wheel loads at the runway surface and can typically be repaired by milling to the depth of cracking and overlaying. In our opinion, pavement exhibiting this type of distress should be rehabilitated when the cracking progresses to the point that spalling begins to occur and therefore represents a significant Foreign Object Damage (FOD) potential. The core samples also exhibit delamination (separation of asphalt concrete [AC] layers) at a depth of 2.5 and 3.25 in. in cores B-2 and B-3, respectively. The depth of delamination generally agrees with the thickness of the 2005 overlay.

## DESIGN PROCEDURES AND ANALYSIS

### Traffic Loading

Century West Engineering Corporation (CWE) provided an estimate of the aircraft traffic-volume data consisting of the number of operations (i.e., either an arrival or departure) for Runway 17-35 in 2018 from the FAA Traffic Flow Management System Counts (TFMSC). Our traffic-loading estimate is based on an annual growth rate of 1.58% per year, which is based on the aviation forecasts provided in the current master plan for UAO (WHPacific, 2012).

The COMFAA 3.0 software used to compute the PCN has inputs for each aircraft type (in the mix), which include the type of aircraft, gross weight, and number of annual departures over a 20-year period. The program does not take into account the annual growth rate, so we calculated the total departures from 2020 to 2040 to determine the equivalent annual number of departures for the analysis. The aircraft mix and annual number of departures we input into COMFAA are provided in Table 2.

**Table 2: RUNWAY 17-35: AIRCRAFT TYPES AND DEPARTURE VOLUMES**

| Aircraft Type | Maximum Takeoff Weight, lbs | Design Aircraft for COMFAA | 2018 Annual Operations | 2040 Annual Operations | Values Entered into COMFAA | |
|---|---|---|---|---|---|---|
| | | | | | Equivalent Airplane | Annual # of Departures |
| Bombardier Global Express | 92,500 | Gulfstream G-V | 50 | 61 | Gulfstream G-V | 64 |
| Gulfstream G600 | 91,600 | Gulfstream G-V | 2 | 3 | | |
| Gulfstream V | 76,850 | Gulfstream G-IV | 2 | 3 | Gulfstream G-IV | 7 |
| Gulfstream IV | 73,200 | Gulfstream G-IV | 2 | 3 | | |
| Dassault Falcon 900 | 45,503 | Falcon-900 | 68 | 83 | Falcon-900 | 83 |
| Bombardier Challenger 600 | 45,100 | Challenger CL-604 | 58 | 70 | Challenger CL-604 | 176 |
| Bombardier Challenger 300 | 38,850 | Challenger CL-604 | 88 | 106 | | |
| Dassault Falcon 2000 | 41,000 | Falcon-2000 | 34 | 42 | Falcon-2000 | 42 |
| Dassault Falcon 50 | 37,480 | Falcon-50 | 276 | 332 | Falcon-50 | 424 |
| Dassault Falcon 20 | 28,650 | Falcon-50 | 76 | 92 | | |
| Cessna Citation 750 | 36,600 | Citation X | 104 | 126 | Citation X | 292 |

| Aircraft Type | Maximum Takeoff Weight, lbs | Design Aircraft for COMFAA | 2018 Annual Operations | 2040 Annual Operations | Values Entered into COMFAA | |
|---|---|---|---|---|---|---|
| | | | | | Equivalent Airplane | Annual # of Departures |
| Cessna Citation 680 | 30,775 | Citation X | 138 | 167 | | |
| Hawker 800 | 28,000 | Hawker-800 | 34 | 42 | Hawker-800 | 42 |
| Gulfstream G150 | 26,100 | D-35 | 80 | 97 | D-35 | 97 |
| Astra 1125 | 24,650 | D-30 | 96 | 117 | D-30 | 117 |
| Cessna Citation 650 | 22,000 | Citation VI/VII | 98 | 119 | Citation VI/VII | 119 |
| Learjet 60 | 23,500 | Learjet-55 | 30 | 36 | | |
| Learjet 55 | 21,500 | Learjet-55 | 4 | 6 | Learjet-55 | 57 |
| Learjet 75 | 21,500 | Learjet-55 | 12 | 15 | | |
| Learjet 45 | 20,500 | Learjet-35A/65A | 110 | 133 | | |
| Learjet 35 | 18,000 | Learjet-35A/65A | 8 | 10 | Learjet-35A/65A | 254 |
| Learjet 31 | 15,500 | Learjet-35A/65A | 92 | 111 | | |
| Cessna Citation 560 | 20,000 | Citation 550B | 704 | 847 | Citation 550B | 1,102 |
| Cessna Citation 550 | 13,300 | Citation 550B | 212 | 255 | | |
| Phenom 300/ Embraer 300 | 17,968 | D-25 | 56 | 68 | D-25 | 68 |
| | | **Total Operations:** | **2,434** | | | **2,944** |

### Backcalculation Analysis of FWD Test Data

The elastic moduli of the subgrade soil at the boring locations were backcalculated from the FWD test data. The average minus-one standard deviation subgrade moduli for each analysis unit (design modulus) are shown at the bottom of the backcalculation analysis results in Table 2A in Appendix A.

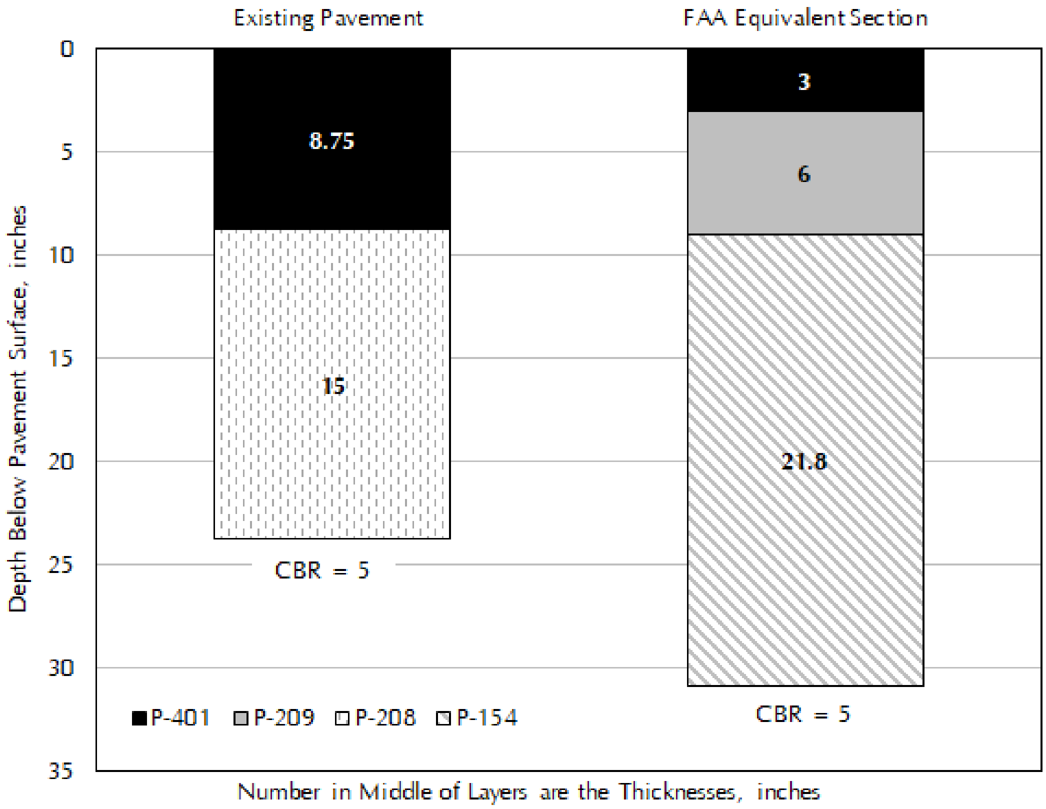
## PAVEMENT CLASSIFICATION NUMBER (PCN) CALCULATIONS

As requested by the ODA, we calculated the PCN for Runway 17-35 for each aircraft in the fleet mix based on the critical pavement-layer thickness and subgrade-support characteristics developed herein. The California bearing ratio (CBR) used in the PCN analysis is based on the backcalculated design modulus from Analysis Unit 2 in Table 2A in Appendix A and was calculated using the typical correlation between CBR and Resilient Modulus ($M_r$) and the correlation adopted by the FAA in Advisory Circular 150/5320-6F, *Airport Pavement Design and Evaluation*, which is represented by the following:

$$CBR = M_r / 1{,}500$$

The analysis was conducted using the FAA's Support Spreadsheet, COMFAA 3.0. The pavement-layer thicknesses were converted into an equivalent pavement section using the appropriate subgrade-support code and the default values for the conversion factors given in Advisory Circular 150/5335-5C. Based on our analysis, the equivalent pavement section is also shown on the following figure.

**EQUIVALENT PAVEMENT SECTION FOR RUNWAY 17-35**




Results of the PCN computations summarized in Table 3 are based on the departure traffic provided by CWE. For Runway 17-35, we recommend publishing the PCN value shown in Table 3. The corresponding PCN elements of the runway are summarized in Form 5010 (Table 1B) in Appendix B.

**Table 3: RECOMMENDED UPDATES TO FAA FORM 5010 FOR UAO RUNWAY 17-35**

| Runway | PCN | Aircraft Gross Weight, thousands lbs | |
|---|---|---|---|
| | | Single Wheel Main Gear | Dual Wheel Main Gear |
| 17-35 | 40/F/C/X/T | 102 | 145 |

Our recommended single-wheel, main-gear and dual-wheel, main-gear aircraft gross weights are 102,000 and 143,000 lbs, respectively. The increase in wheel-load capacity (as compared to the current Airport Master Record, FAA Form 5010) is likely due to the increased structural capacity related to the 2005 overlay. Additional discussion regarding the PCN methodology and reporting is provided in Appendix B.

## LIMITATIONS

This pavement report has been prepared for use by the Oregon Department of Aviation and Century West Engineering Corporation and should not be relied upon by any other entity without the written permission of an authorized representative. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the analysis of the pavements at the time of publication.

PCN system is only intended as a method that airport operators can use to evaluate acceptable operations of aircraft. It is not intended as a pavement design or pavement evaluation procedure, nor does it restrict or replace the methodology used to design or evaluate a pavement structure.

Our work has been performed in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the locale. The results and conclusions submitted in this report are based on the data obtained from our sources of information discussed in this report. No other warranty, expressed or implied, is made.

Please contact the undersigned if you have any questions regarding this report or any other pavement considerations associated with this project.

Submitted for GRI,

Renews 12/2020

Michael J. Maloney, PE
Principal

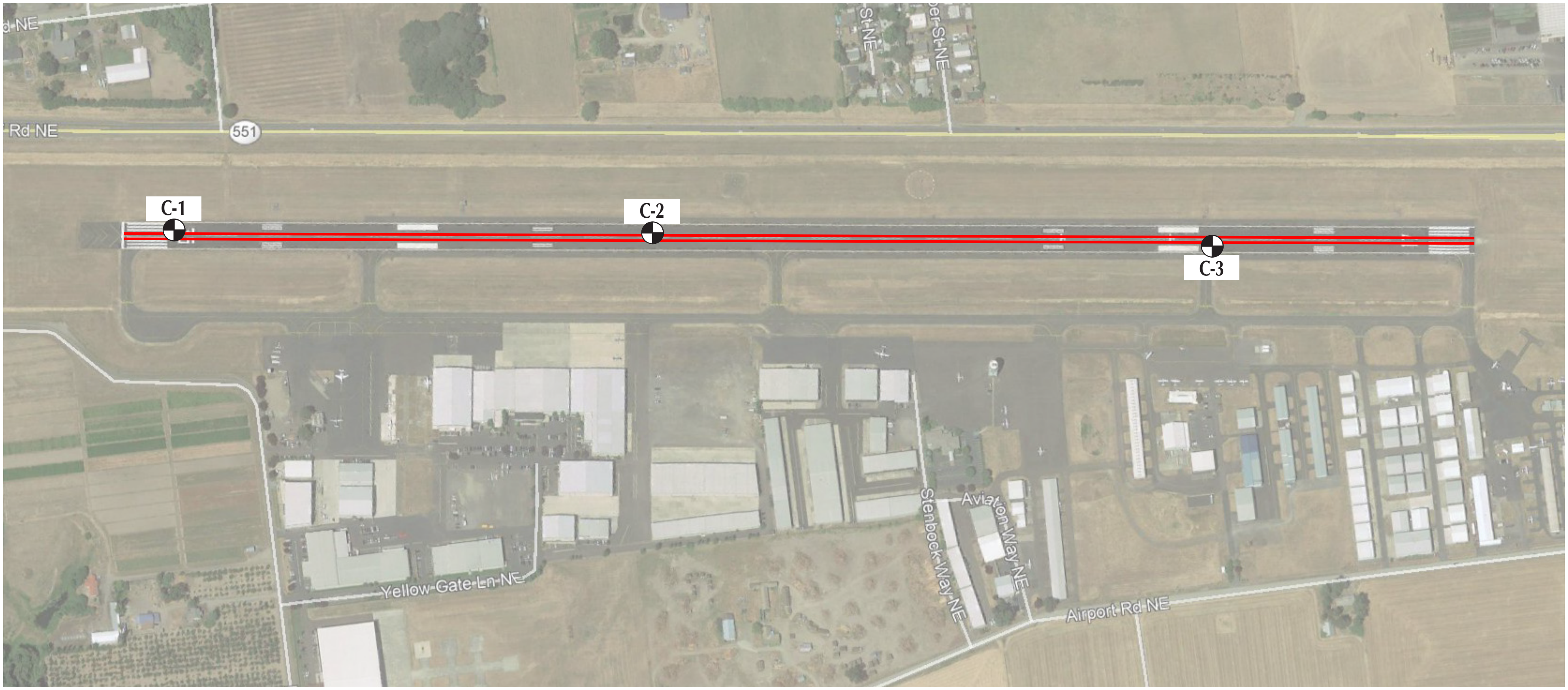
Lindsi A. Hammond, PE
Associate

This document has been submitted electronically.

**References**

WHPacific, Inc., 2012, Aurora State Airport, Airport Master Plan Update.

Pavement Consultants Inc., 2018, 2018 Pavement Evaluation / Maintenance Management Program: Aurora State Airport.




PAVEMENT CORE COMPLETED BY GRI
(AUGUST 20, 2019)

FWD TESTING COMPLETED BY GRI
(AUGUST 20, 2019)

SITE PLAN FROM GOOGLE EARTH (IMAGE DATE JULY 2018)

North

0 600 1,200 FT

GRI

CENTURY WEST ENGINEERING CORPORATION
AURORA STATE AIRPORT – RUNWAY 17-35 PCN EVALUATION

# SITE PLAN

SEP. 2019 JOB NO. 6289 FIG. 1

# APPENDIX A

*Field Explorations and FWD Data*

## APPENDIX A

## FIELD EXPLORATIONS AND FWD DATA

### FIELD EXPLORATIONS

Existing pavement and subsurface conditions on Runway 17-35 were investigated by GRI on August 20, 2019, with three core explorations, designated B-1 through B-3. The approximate locations of the explorations are shown on the Site Plan, Figure 1. The field exploration and laboratory programs completed for this project are described below.

#### Pavement Core Explorations

The pavement was cored at each exploration location to assist in evaluation of the type of cracking and/or the thickness and condition of the asphalt concrete (AC). The pavement was cored using an electric drill owned and operated by GRI. Photographs of the core locations and core samples are shown on Figures 1A through 3A. Below the AC, we excavated to a maximum total depth of 24 in. below ground surface to observe the condition of the aggregate base (AB) and subgrade, if encountered. The subgrade was not encountered during our explorations and the AB was classified as silty sandy gravel ranging from angular to rounded and up to 1 to 1.5 in. in diameter.

### FWD DATA

Falling weight deflectometer (FWD) tests were conducted by GRI on August 20, 2019, using our KUAB Model 150 FWD. The annual reference calibration for the FWD was accomplished in October 2019 at the KUAB manufacturing facility in Savoy, Illinois.

The FWD testing on Runway 17-35 was accomplished along test lines located at 7 ft west and 12 ft east of the runway centerline. The tests were completed at approximately 200-ft intervals within the keel section of the runway.

#### General

Geodetic coordinates of all test locations were measured from GPS signal using a submeter-capable Trimble™ GPS receiver with the antenna mounted on the FWD above the load plate.

The FWD load is generated by a two-mass/two-buffer, falling-weight system that produces a nearly haversine-shaped load-pulse waveform. The buffer and weight combination used for these tests produces a load rise time of approximately 14 milliseconds with an equivalent haversine frequency of approximately 32 Hz. The load pulse was applied to the pavement surface through a 450-mm-diameter (8.86-in.-radius), four-part, segmented plate designed to apply uniform surface pressure distribution despite irregularities in the pavement surface. Air temperature and pavement surface temperature (the latter measured by infrared thermometer) were recorded for each test.

#### Test Data

The average deflections from the two nominal 32,000-lb impact loads were linearly normalized to a 30-kip (30,000-lb) load basis and are tabulated in Table 1A of this appendix. The measurement units for the test data are distance in feet, deflections in mil units (1 mil = 0.001 in.), load in pounds, sensor distance in inches, load plate radius in inches, and temperature in degrees Fahrenheit.

**Impact Stiffness Modulus (ISM)**

The Impact Stiffness Modulus (ISM) shown in units of kips per square inch (ksi) is the composite stiffness, or dynamic plate bearing modulus, of all the materials beneath the pavement/roadway surface. It is computed using the Boussinesq formula for surface deflection beneath the center of a uniformly loaded circular area on a linear-elastic half space, with a Poisson's ratio of 0.50. The surface deflection measured at the center of the FWD load plate (D0) was used to compute the surface modulus. The magnitude of the ISM is inversely proportional to deflection and comparable to the elastic modulus. The difference between the pavement ISM and elastic modulus is that the elastic modulus represents the elastic load-deformation response of an individual pavement layer or the subgrade soil, whereas the pavement ISM represents the composite elastic load-deformation response of all materials (pavement layers and subgrade soil) below the pavement surface. Therefore, the ISM (as computed from the deflection measured beneath the FWD load plate) cannot be taken as representative of the elastic modulus of any single pavement layer or the subgrade soil. However, since it is a measurement of the combined stiffness of the pavement structure and subgrade soil, it is often useful for evaluation of variation in pavement stiffness and for assessment of relative pavement strength. Plots of the ISMs are shown on Figure 4A.

**Table 1A - FWD NORMALIZED DEFLECTION TEST DATA**
**RUNWAY 17-35: AURORA STATE AIRPORT (UAO)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Test Section: | RW 17-35 | | | | | | | |
| Start Point: | North edge of runway, 10+00 | | | | | | | |
| Test Date: | 8/20/2019 | | | | | | | |
| Test File: | 6289-Aurora Airport.fwd | | | | | | | |
| Load Plate Radius, in: | 8.86 | | | | | | | |
| Sensor Distance, in: | 0 | 12 | 18 | 24 | 36 | 48 | 60 | 72 |

Deflections Normalized to 30000 lbf Basis

| Test No. | Test Station | Test Line | Core | D 1, mils | D 2, mils | D 3, mils | D 4, mils | D 5, mils | D 6, mils | D 7, mils | D 8, mils | Surface Temp., °F | Time | Surface Modulus, Ksi | ISM, kips/in | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10+50 | 7' w | | 28.54 | 24.85 | 21.17 | 18.56 | 13.73 | 10.05 | 7.37 | 5.54 | 68 | 1:24:59 | 57 | 1,051 | 7' west |
| 2 | 12+50 | 7' w | | 25.28 | 20.28 | 16.82 | 14.62 | 10.56 | 7.81 | 5.80 | 4.50 | 71 | 1:26:36 | 64 | 1,187 | |
| 3 | 14+49 | 7' w | | 30.42 | 25.52 | 21.55 | 18.73 | 13.50 | 9.84 | 7.24 | 5.55 | 71 | 1:27:52 | 53 | 986 | |
| 4 | 16+51 | 7' w | | 29.35 | 24.82 | 20.94 | 18.25 | 13.29 | 9.74 | 7.15 | 5.47 | 71 | 1:29:09 | 55 | 1,022 | |
| 5 | 18+50 | 7' w | | 24.65 | 20.46 | 17.12 | 14.81 | 10.62 | 7.71 | 5.71 | 4.47 | 71 | 1:30:14 | 66 | 1,217 | |
| 6 | 20+56 | 7' w | | 27.93 | 22.60 | 18.54 | 15.81 | 11.05 | 7.98 | 5.87 | 4.66 | 71 | 1:31:20 | 58 | 1,074 | |
| 7 | 22+50 | 7' w | | 25.72 | 21.22 | 17.71 | 15.34 | 11.10 | 8.13 | 6.06 | 4.70 | 71 | 1:32:26 | 63 | 1,166 | |
| 8 | 24+51 | 7' w | | 26.54 | 21.58 | 17.98 | 15.18 | 10.67 | 7.71 | 5.71 | 4.47 | 71 | 1:33:33 | 61 | 1,130 | |
| 9 | 26+53 | 7' w | | 26.28 | 20.74 | 17.15 | 14.64 | 10.47 | 7.67 | 5.83 | 4.64 | 70 | 1:34:39 | 62 | 1,142 | |
| 10 | 28+55 | 7' w | | 26.82 | 22.10 | 18.49 | 15.98 | 11.58 | 8.49 | 6.34 | 4.95 | 71 | 1:35:42 | 60 | 1,119 | |
| 11 | 30+54 | 7' w | | 26.27 | 21.60 | 18.22 | 15.84 | 11.70 | 8.66 | 6.45 | 4.96 | 71 | 1:37:01 | 62 | 1,142 | |
| 12 | 32+54 | 7' w | | 30.95 | 25.88 | 21.81 | 19.07 | 13.97 | 10.26 | 7.67 | 5.78 | 71 | 1:38:07 | 52 | 969 | |
| 13 | 34+52 | 7' w | | 36.96 | 27.64 | 22.18 | 18.81 | 13.26 | 9.67 | 7.12 | 5.56 | 71 | 1:39:22 | 44 | 812 | |
| 14 | 36+57 | 7' w | | 32.41 | 26.67 | 22.42 | 19.26 | 13.87 | 10.02 | 7.26 | 5.44 | 70 | 1:40:28 | 50 | 926 | |
| 15 | 38+52 | 7' w | | 28.76 | 23.55 | 19.60 | 16.84 | 12.06 | 8.67 | 6.34 | 4.88 | 70 | 1:41:38 | 56 | 1,043 | |
| 16 | 39+51 | 7' w | B-2 | 34.09 | 27.13 | 22.55 | 19.48 | 14.13 | 10.46 | 7.65 | 5.72 | 70 | 1:43:21 | 47 | 880 | B-2 |
| 17 | 40+51 | 7' w | | 27.27 | 22.43 | 18.67 | 16.13 | 11.60 | 8.44 | 6.11 | 4.75 | 70 | 1:44:29 | 59 | 1,100 | |
| 18 | 42+51 | 7' w | | 31.58 | 25.74 | 21.56 | 18.44 | 13.11 | 9.35 | 6.80 | 5.10 | 70 | 1:45:38 | 51 | 950 | |
| 19 | 44+51 | 7' w | | 29.21 | 23.02 | 18.77 | 15.98 | 11.24 | 7.90 | 5.76 | 4.52 | 70 | 1:46:46 | 55 | 1,027 | |
| 20 | 46+50 | 7' w | | 29.41 | 23.54 | 19.35 | 16.44 | 11.40 | 7.92 | 5.78 | 4.50 | 70 | 1:47:53 | 55 | 1,020 | |
| 21 | 48+52 | 7' w | | 28.25 | 23.01 | 19.08 | 16.26 | 11.38 | 8.17 | 6.06 | 4.66 | 70 | 1:49:02 | 57 | 1,062 | |
| 22 | 50+52 | 7' w | | 39.77 | 29.04 | 22.94 | 19.04 | 12.53 | 8.69 | 6.21 | 4.86 | 70 | 1:50:10 | 41 | 754 | |
| 23 | 52+50 | 7' w | | 34.37 | 27.28 | 22.48 | 18.86 | 12.83 | 8.94 | 6.47 | 5.08 | 70 | 1:51:20 | 47 | 873 | |
| 24 | 54+51 | 7' w | | 44.23 | 34.59 | 27.53 | 22.75 | 14.74 | 9.70 | 6.77 | 5.20 | 69 | 1:52:33 | 37 | 678 | |
| 25 | 56+40 | 7' w | | 37.32 | 28.83 | 22.75 | 18.62 | 11.88 | 7.81 | 5.61 | 4.42 | 67 | 1:53:49 | 43 | 804 | |
| 26 | 56+81 | 7' w | B-1 | 35.88 | 28.79 | 23.20 | 19.31 | 12.57 | 8.38 | 5.79 | 4.55 | 70 | 1:55:03 | 45 | 836 | B-1 |
| 27 | 58+50 | 7' w | | 35.45 | 27.78 | 22.05 | 18.05 | 11.74 | 7.82 | 5.60 | 4.34 | 65 | 1:56:22 | 46 | 846 | 5875=s end end 7' west |
| 28 | 11+50 | 12' e | | 25.22 | 21.35 | 18.22 | 15.93 | 11.88 | 8.90 | 6.66 | 5.09 | 68 | 2:05:27 | 64 | 1,190 | 12' east |
| 29 | 13+50 | 12' e | | 30.01 | 25.29 | 21.29 | 18.67 | 13.66 | 10.11 | 7.43 | 5.70 | 70 | 2:07:03 | 54 | 1,000 | |
| 30 | 15+51 | 12' e | | 30.03 | 25.22 | 21.26 | 18.42 | 13.46 | 9.89 | 7.28 | 5.64 | 70 | 2:08:15 | 54 | 999 | |
| 31 | 17+53 | 12' e | | 28.42 | 22.94 | 19.00 | 16.27 | 11.53 | 8.38 | 6.20 | 4.83 | 70 | 2:09:28 | 57 | 1,056 | |
| 32 | 19+41 | 12' e | B-3 | 34.02 | 25.85 | 20.87 | 17.26 | 11.79 | 8.33 | 6.13 | 4.74 | 70 | 2:13:56 | 48 | 882 | B-3 |
| 33 | 21+50 | 12' e | | 21.06 | 17.31 | 14.42 | 12.49 | 9.07 | 6.79 | 5.19 | 4.17 | 70 | 2:16:05 | 77 | 1,425 | |
| 34 | 23+52 | 12' e | | 25.55 | 21.01 | 17.53 | 15.14 | 11.13 | 8.27 | 6.23 | 4.95 | 70 | 2:17:18 | 63 | 1,174 | |
| 35 | 25+52 | 12' e | | 21.98 | 17.91 | 15.02 | 13.04 | 9.69 | 7.31 | 5.60 | 4.43 | 69 | 2:18:26 | 74 | 1,365 | |
| 36 | 27+51 | 12' e | | 26.27 | 20.79 | 16.87 | 14.33 | 10.21 | 7.48 | 5.62 | 4.44 | 69 | 2:19:33 | 62 | 1,142 | |
| 37 | 29+50 | 12' e | | 34.66 | 28.16 | 23.24 | 19.76 | 13.95 | 10.10 | 7.48 | 5.79 | 69 | 2:20:42 | 47 | 866 | |

## Table 1A - FWD NORMALIZED DEFLECTION TEST DATA
## RUNWAY 17-35: AURORA STATE AIRPORT (UAO)

Deflections Normalized to 30000 lbf Basis

| Test No. | Test Station | Test Line | Core | D 1, mils | D 2, mils | D 3, mils | D 4, mils | D 5, mils | D 6, mils | D 7, mils | D 8, mils | Surface Temp., °F | Time | Surface Modulus, Ksi | ISM, kips/in | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38 | 31+52 | 12' e | | 27.24 | 22.35 | 18.84 | 16.39 | 12.19 | 9.20 | 6.99 | 5.47 | 69 | 2:21:52 | 59 | 1,101 | |
| 39 | 33+49 | 12' e | | 26.34 | 21.87 | 18.38 | 15.90 | 11.64 | 8.78 | 6.71 | 5.25 | 69 | 2:23:00 | 61 | 1,139 | |
| 40 | 35+53 | 12' e | | 24.64 | 20.22 | 16.91 | 14.67 | 10.73 | 8.01 | 6.08 | 4.83 | 69 | 2:24:09 | 66 | 1,218 | |
| 41 | 37+51 | 12' e | | 29.65 | 24.86 | 20.96 | 18.32 | 13.45 | 9.99 | 7.38 | 5.60 | 69 | 2:25:16 | 55 | 1,012 | |
| 42 | 39+50 | 12' e | | 25.27 | 21.38 | 17.99 | 15.86 | 11.68 | 8.77 | 6.56 | 5.13 | 69 | 2:26:26 | 64 | 1,187 | |
| 43 | 41+51 | 12' e | | 25.80 | 21.67 | 18.35 | 15.90 | 11.67 | 8.62 | 6.43 | 4.94 | 69 | 2:27:34 | 63 | 1,163 | |
| 44 | 43+50 | 12' e | | 27.58 | 23.19 | 19.57 | 17.18 | 12.51 | 9.22 | 6.76 | 5.14 | 69 | 2:28:38 | 59 | 1,088 | |
| 45 | 45+51 | 12' e | | 26.22 | 21.41 | 17.71 | 15.13 | 10.72 | 7.77 | 5.72 | 4.51 | 69 | 2:29:48 | 62 | 1,144 | |
| 46 | 47+54 | 12' e | | 28.02 | 22.49 | 18.48 | 15.60 | 10.83 | 7.75 | 5.68 | 4.46 | 69 | 2:30:56 | 58 | 1,071 | |
| 47 | 49+51 | 12' e | | 27.34 | 22.44 | 18.36 | 15.67 | 11.04 | 7.94 | 5.90 | 4.62 | 69 | 2:32:04 | 59 | 1,097 | |
| 48 | 51+53 | 12' e | | 30.35 | 24.69 | 20.12 | 17.00 | 11.60 | 8.11 | 5.96 | 4.66 | 69 | 2:33:11 | 53 | 988 | |
| 49 | 53+55 | 12' e | | 31.95 | 26.02 | 21.17 | 17.69 | 11.99 | 8.46 | 6.17 | 4.85 | 69 | 2:34:18 | 51 | 939 | |
| 50 | 55+50 | 12' e | | 36.26 | 28.03 | 22.28 | 18.48 | 12.16 | 8.34 | 6.04 | 4.75 | 69 | 2:35:31 | 45 | 827 | |
| 51 | 57+51 | 12' e | | 32.67 | 26.40 | 21.38 | 17.62 | 11.50 | 7.75 | 5.50 | 4.31 | 67 | 2:36:47 | 49 | 918 | 5878=s end end 12' east |

GRI

# Table 2A - BACKCALCULATION ANALYSIS SUMMARY
# RUNWAY 17-35: AURORA STATE AIRPORT (UAO)

**Runway 17-35: Aurora State Airport (UAO)**
Based on FWD Testing Conducted: 8/20/2019
Start Station: North edge of runway, 10+00

| FWD Test # | Test Station | Test Line | Core Exploration | Analysis Unit | D0, mils | AC Thickness, inches | AB Thickness, inches | Subgrade Modulus, psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 10+50 | 7' w | | 1 | 28.54 | 9.00 | 15.00 | 10,402 |
| 2 | 12+50 | 7' w | | 1 | 25.28 | 9.00 | 15.00 | 15,441 |
| 3 | 14+49 | 7' w | | 1 | 30.42 | 9.00 | 15.00 | 11,553 |
| 4 | 16+51 | 7' w | | 1 | 29.35 | 9.00 | 15.00 | 11,570 |
| 5 | 18+50 | 7' w | | 1 | 24.65 | 9.00 | 15.00 | 12,902 |
| 6 | 20+56 | 7' w | | 1 | 27.93 | 9.00 | 15.00 | 11,768 |
| 7 | 22+50 | 7' w | | 1 | 25.72 | 9.00 | 15.00 | 14,630 |
| 8 | 24+51 | 7' w | | 1 | 26.54 | 9.00 | 15.00 | 12,567 |
| 9 | 26+53 | 7' w | | 1 | 26.28 | 9.00 | 15.00 | 15,004 |
| 10 | 28+55 | 7' w | | 1 | 26.82 | 9.00 | 15.00 | 14,486 |
| 11 | 30+54 | 7' w | | 1 | 26.27 | 9.00 | 15.00 | 13,228 |
| 12 | 32+54 | 7' w | | 1 | 30.95 | 9.00 | 15.00 | 10,155 |
| 13 | 34+52 | 7' w | | 1 | 36.96 | 9.00 | 15.00 | 9,847 |
| 14 | 36+57 | 7' w | | 1 | 32.41 | 9.00 | 15.00 | 10,365 |
| 15 | 38+52 | 7' w | | 1 | 28.76 | 9.00 | 15.00 | 10,556 |
| 16 | 39+51 | 7' w | B-2 | 1 | 34.09 | 9.00 | 15.00 | 9,726 |
| 17 | 40+51 | 7' w | | 1 | 27.27 | 9.00 | 15.00 | 10,489 |
| 18 | 42+51 | 7' w | | 1 | 31.58 | 9.00 | 15.00 | 11,108 |
| 19 | 44+51 | 7' w | | 1 | 29.21 | 9.00 | 15.00 | 11,314 |
| 20 | 46+50 | 7' w | | 1 | 29.41 | 9.00 | 15.00 | 11,087 |
| 21 | 48+52 | 7' w | | 1 | 28.25 | 9.00 | 15.00 | 14,129 |
| 22 | 50+52 | 7' w | | 2 | 39.77 | 8.75 | 15.00 | 8,814 |
| 23 | 52+50 | 7' w | | 2 | 34.37 | 8.75 | 15.00 | 9,367 |
| 24 | 54+51 | 7' w | | 2 | 44.23 | 8.75 | 15.00 | 6,713 |
| 25 | 56+40 | 7' w | | 2 | 37.32 | 8.75 | 15.00 | 9,796 |
| 26 | 56+81 | 7' w | B-1 | 2 | 35.88 | 8.75 | 15.00 | 7,615 |
| 27 | 58+50 | 7' w | | 2 | 35.45 | 8.75 | 15.00 | 9,512 |
| 28 | 11+50 | 12' e | | 1 | 25.22 | 9.00 | 15.00 | 12,541 |
| 29 | 13+50 | 12' e | | 1 | 30.01 | 9.00 | 15.00 | 11,399 |
| 30 | 15+51 | 12' e | | 1 | 30.03 | 9.00 | 15.00 | 9,781 |
| 31 | 17+53 | 12' e | | 1 | 28.42 | 9.00 | 15.00 | 11,645 |
| 32 | 19+41 | 12' e | B-3 | 1 | 34.02 | 9.00 | 15.00 | 10,977 |
| 33 | 21+50 | 12' e | | 1 | 21.06 | 9.00 | 15.00 | 17,720 |
| 34 | 23+52 | 12' e | | 1 | 25.55 | 9.00 | 15.00 | 13,364 |
| 35 | 25+52 | 12' e | | 1 | 21.98 | 9.00 | 15.00 | 14,811 |
| 36 | 27+51 | 12' e | | 1 | 26.27 | 9.00 | 15.00 | 14,236 |
| 37 | 29+50 | 12' e | | 1 | 34.66 | 9.00 | 15.00 | 11,837 |
| 38 | 31+52 | 12' e | | 1 | 27.24 | 9.00 | 15.00 | 10,942 |
| 39 | 33+49 | 12' e | | 1 | 26.34 | 9.00 | 15.00 | 11,421 |
| 40 | 35+53 | 12' e | | 1 | 24.64 | 9.00 | 15.00 | 14,477 |
| 41 | 37+51 | 12' e | | 1 | 29.65 | 9.00 | 15.00 | 10,835 |
| 42 | 39+50 | 12' e | | 1 | 25.27 | 9.00 | 15.00 | 11,501 |
| 43 | 41+51 | 12' e | | 1 | 25.80 | 9.00 | 15.00 | 13,236 |
| 44 | 43+50 | 12' e | | 1 | 27.58 | 9.00 | 15.00 | 11,913 |

## Table 2A - BACKCALCULATION ANALYSIS SUMMARY
## RUNWAY 17-35: AURORA STATE AIRPORT (UAO)

| FWD Test # | Test Station | Test Line | Core Exploration | Analysis Unit | D0, mils | AC Thickness, inches | AB Thickness, inches | Subgrade Modulus, psi |
|---|---|---|---|---|---|---|---|---|
| 45 | 45+51 | 12' e | | 1 | 26.22 | 9.00 | 15.00 | 12,250 |
| 46 | 47+54 | 12' e | | 1 | 28.02 | 9.00 | 15.00 | 11,825 |
| 47 | 49+51 | 12' e | | 1 | 27.34 | 9.00 | 15.00 | 12,606 |
| 48 | 51+53 | 12' e | | 2 | 30.35 | 8.75 | 15.00 | 11,238 |
| 49 | 53+55 | 12' e | | 2 | 31.95 | 8.75 | 15.00 | 10,326 |
| 50 | 55+50 | 12' e | | 2 | 36.26 | 8.75 | 15.00 | 9,761 |
| 51 | 57+51 | 12' e | | 2 | 32.67 | 8.75 | 15.00 | 9,341 |

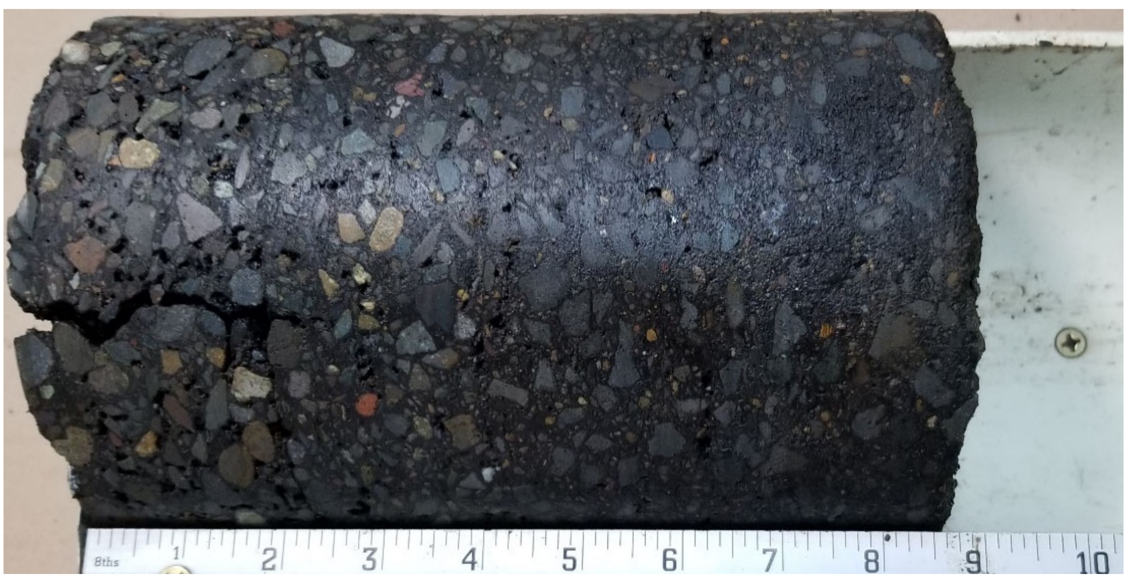
**Statistical Summary**

| Structural Unit# | From Sta | To Sta | PAVER PMP Unit | Average D0, mils | Average AC Thickness, in. | Average AB Thickness, in. | Average Subgrade Modulus, psi |
|---|---|---|---|---|---|---|---|
| 1 | 0+00 | 49+51 | R17AU-01 | 28.10 | 9.00 | 15.00 | 12,235 |
| 2 | 0+00 | 58+50 | R17AU-02 | 35.83 | 8.75 | 15.00 | 9,248 |

**Design Subgrade Resilient Modulus**

| Structural Unit # | From | To | PAVER PMP Unit | Average Subgrade Modulus, psi | Standard Deviation, psi | Average Subgrade – Standard Deviation, psi | CBR, Mr (psi)/1500 |
|---|---|---|---|---|---|---|---|
| 1 | 10+50 | 49+51 | R17AU-01 | 12,235 | 1,800 | 10,435 | 7 |
| 2 | 50+52 | 58+50 | R17AU-02 | 9,248 | 1,294 | 7,955 | 5 |


**Core B-1 (RW 17-35 8′ West of Centerline, Station 56+81, FWD 26)**



**B-1 (Pavement Core Sample, 8.75 in.)**

GRI

PAVEMENT CORE PHOTOGRAPHS


**Core B-2 (RW 17-35 8′ West of Centerline, Station 39+51, FWD 16)**


**B-2 (Pavement Core Sample, 9.0 in.)**

GRI

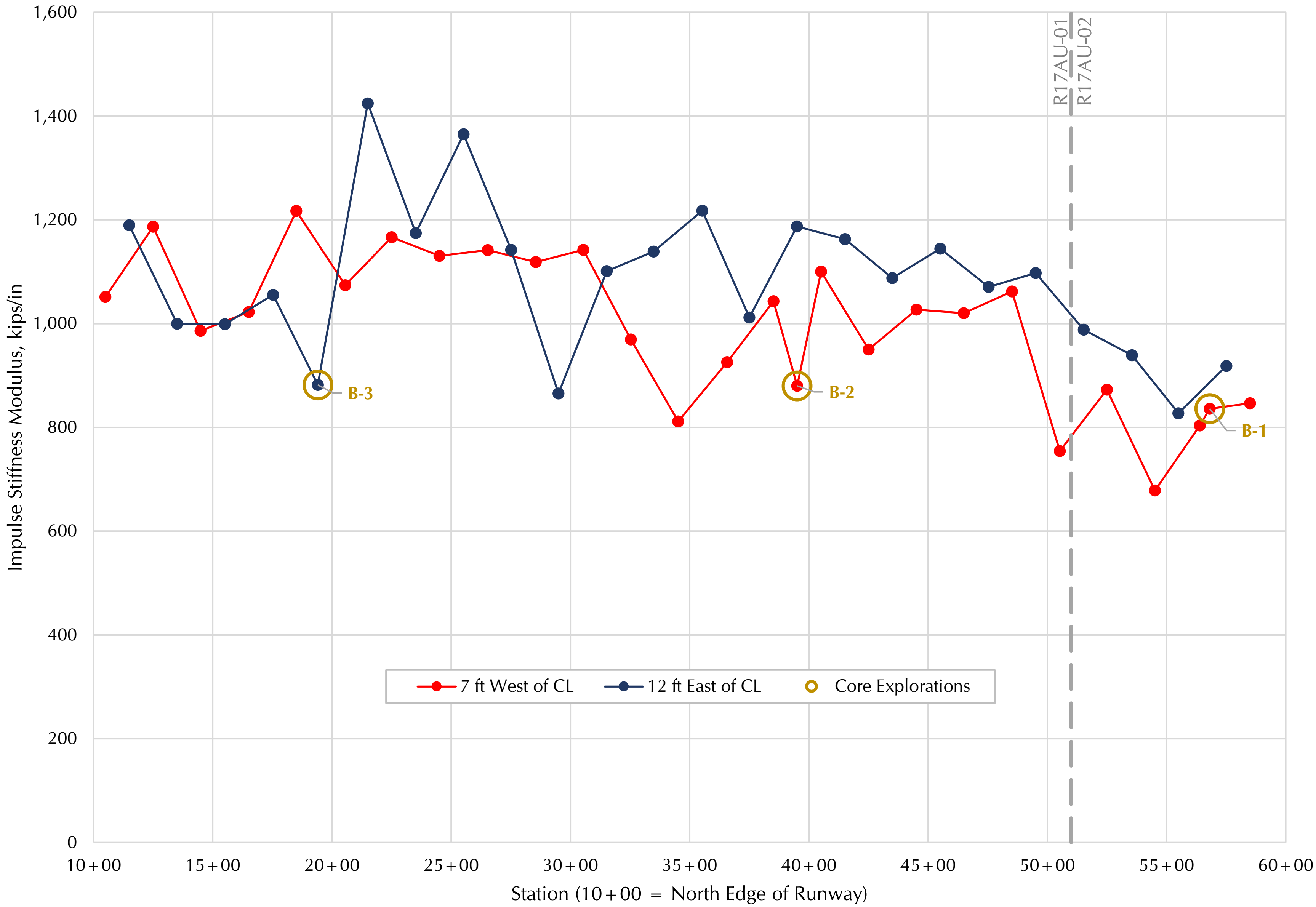
PAVEMENT CORE PHOTOGRAPHS


**Core B-3 (RW 17-35 12′ East of Centerline, Station 19+41, FWD 32)**


**B-3 (Pavement Core Sample, 9.0 in.)**

PAVEMENT CORE PHOTOGRAPHS

SEP. 2019 | JOB NO. 6289 | FIG. 3A




GRI

# IMPULSE STIFFNESS MODULUS

SEP. 2019 JOB NO. 6289 FIG. 4A

# APPENDIX B

*Pavement Classification Number Analysis*

## APPENDIX B

## PAVEMENT CLASSIFICATION NUMBER ANALYSIS

### BACKGROUND

In 2014, the FAA instituted a requirement that Part 139-certified airports be assigned pavement classification number (PCN) data. The PCN is required because the United States is a member state of the International Civil Aviation Organization (ICAO), the international regulatory body for air traffic. ICAO adopted the Aircraft Classification Number (ACN)-Pavement Classification Number (ACN-PCN) method to allow any airport a standardized method for reporting the effect of aircraft that use the facility, as well as the load-carrying capacity of the pavement (ICAO, 1999).

The ACN is a number that expresses the relative effect of an aircraft at a given configuration on a pavement structure for a specified standard subgrade strength. Conversely, the PCN is defined as a number that expresses the load-carrying capacity of a pavement for unrestricted operations. Therefore, the ACN-PCN system is structured so that a pavement with a particular PCN value can support unlimited repetitions of an aircraft that has an ACN equal to or less than the pavement's PCN value.

In the ACN/PCN method, the PCN, pavement type, subgrade strength category, tire pressure category, and evaluation method are all reported together. A code system has been implemented to allow an abbreviated presentation of the necessary information. The pavement type is abbreviated "R" for rigid (portland cement concrete [PCC]) and "F" for flexible (AC) pavements. Four subgrade categories, A, B, C, and D, indicate high, medium, low, and ultra-low subgrade strengths, respectively. The four tire-pressure categories, W, X, Y, and Z, indicate high, medium, low, and very low tire pressures, respectively. The evaluation methods are T for a technical evaluation and U for an evaluation based on the type and weight of the aircraft that commonly use the airfield. For example, the PCN code 90/F/C/W/T indicates that the PCN number is 90, that the pavement is flexible, that there is a low-strength subgrade, that high-pressure tires are allowed, and that a technical evaluation was performed to determine the PCN rating.

### METHODOLOGY

As noted above, the pavement strength evaluation was accomplished in accordance with the Technical Method described in Advisory Circular 150/5335-5C. To complete the analysis, the following information was used for Runway 17-35:

**Aircraft Traffic Volume:** The traffic volume estimate was provided by Century West Engineering Corporation in terms of operations for Runway 17-35. The COMFAA 3.0 program includes a library of standard aircraft types, and we used the default gear weight for each aircraft in the aircraft fleet mix.

**Pavement Structure:** As noted earlier herein, the pavement thickness and subgrade support characteristics were estimated based on the FWD backcalculation results and core explorations.

The results of our PCN analysis are summarized in Form 5010 – Airport Master Record (Table 1B) and presented on Figure 1B of this appendix.

**Reference**

ICAO, 1999, Aerodrome standards – aerodrome design and operations, Annex 14, Third Edition.

# Table 1B - FORM 5010 AIRPORT MASTER RECORD

| | | | |
|---|---|---|---|
| ○ A Flexible Category (CBR 15) | **TIRE PRESSURE** | **METHOD USED** | **Project info** |
| ○ B Flexible Category (CBR 10) | ○ W Unlimited | ○ Using Aircraft | Aurora State Airport |
| ● C Flexible Category (CBR 6) | ● X 254 psi | ● Technical | |
| ○ D Flexible Category (CBR 3) | ○ Y 145 psi | | |
| | ○ Z 73 psi | | |

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

**AIRCRAFT GEAR TYPE IN TRAFFIC MIX**

- ☑ S (single wheel gear)
- ☑ 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** UAO

**Pavement ID** RW 17-35

**Enter PCN** 40

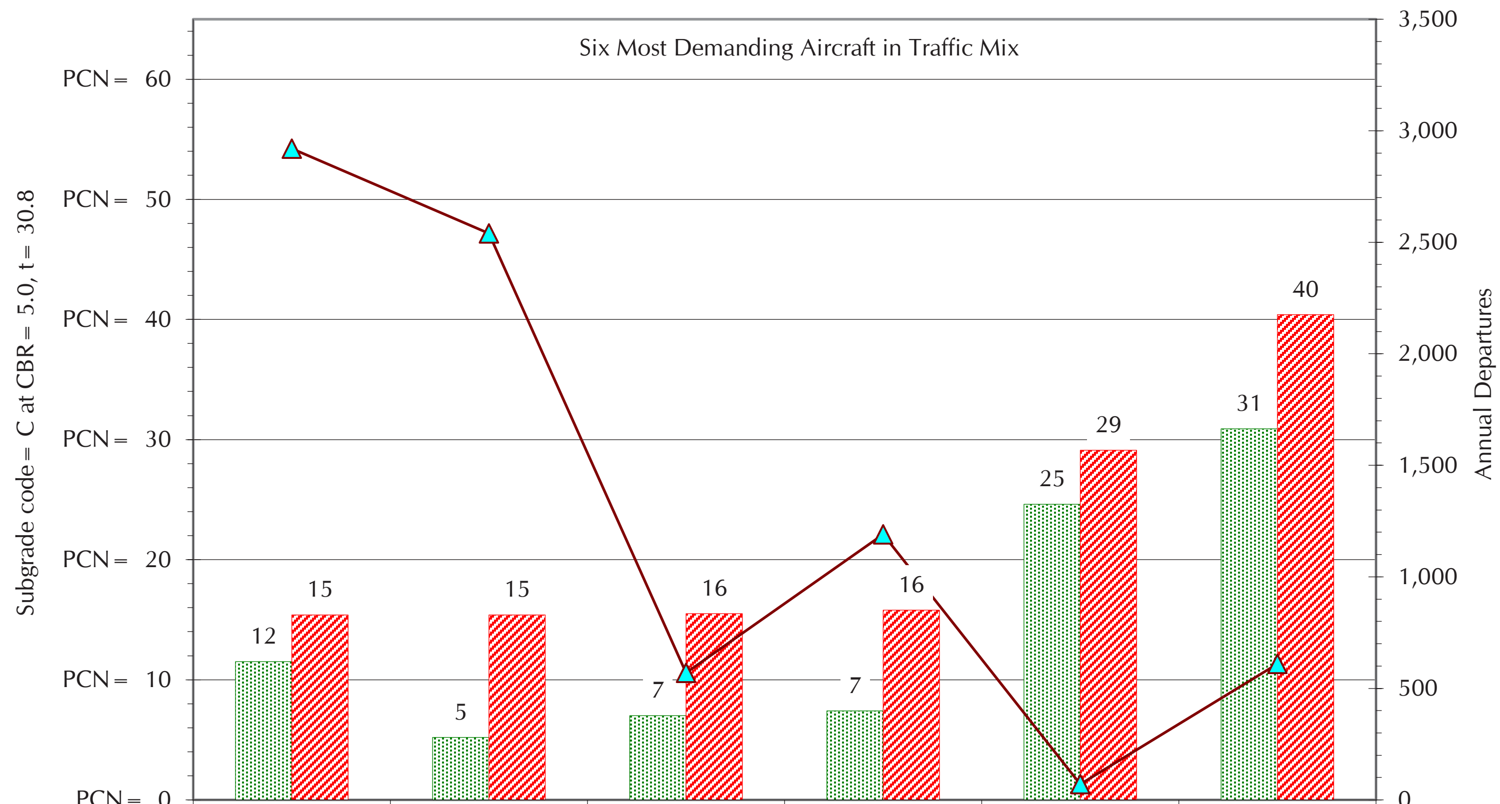
**IF 3D or W/B Gear Checked, #38 = PCN**
**Please Add Data Element #38 Remark**

| Form 5010 Data Element | Gross Weight and PCN |
|---|---|
| #35 S gear | 102 |
| #36 D gear | 143 |
| #37 DT gear | |
| #38 DDT gear | |
| #39 PCN | 40/F/C/X/T |

| | |
|---|---|
| 3D | |
| 2D/2D2 | |
| 2D/3D2W | |
| 2D/3D2B | |

} Report Minimum Gross Weight

| Airport LOC-ID | Pavement ID | #35 S GW | #36 D GW | #37 DT GW | #38 DDT GW | #39 PCN |
|---|---|---|---|---|---|---|
| UAO | 17-35 | 102 | 143 | | | 40/F/C/X/T |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |




| | Citation-X | Learjet-35A/65A | Learjet-55 | Citation-VI/VII | Gulfstream-G-IV | Gulfstream-G-V |
|---|---|---|---|---|---|---|
| 1. Aircraft ACN at traffic mix GW | 11.5 | 5.2 | 7.0 | 7.4 | 24.6 | 30.9 |
| 2. Calculated PCN at CDF max. GW | 15.4 | 15.4 | 15.5 | 15.8 | 29.1 | 40.4 |
| 3. Annual Departures from traffic mix | 2,920 | 2,540 | 570 | 1,190 | 70 | 610 |

GRI

# PAVEMENT CLASSIFICATION CHART

SEP. 2019 JOB NO. 6289 FIG. 1B