

Republic of the Philippines CIVIL AVIATION AUTHORITY OF THE PHILIPPINES

ADVISORY CIRCULAR

STRENGTH RATING Of Aerodrome pavements

AC AGA-ACR-PCR-01-2024

Aerodrome & Air Navigation Safety Oversight Office (AANSOO) Office of the Director General Civil Aviation Authority of the Philippines MIA Road, Pasay City 1300

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Advisory Circulars (AC) are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with regulatory requirements, or to explain certain regulatory requirements by providing interpretative and explanatory materials.

CAAP will generally accept that when the provisions of an Advisory Circular have been met, compliance with the relevant regulatory obligations has been satisfied.

Where an AC is referred to in a "Note" within regulatory documentation, the AC remains as guidance material.

ACs should always be read in conjunction with the

referenced regulations.

AC AGA-ACR-PCR-01-2024 STRENGTH RATING OF AERODROME PAVEMENTS

I. PURPOSE

The purpose of this AC is to provide aerodrome operators with guidance specifically on the design and evaluation of pavements used by aircrafts having a maximum take-off weight of more than 5,700 and the reporting of runway, taxiway and apron pavement strength in accordance with the new International Civil Aviation Organization (ICAO) strength rating method (ACR-PCR).

II. CANCELLATION OF AC 139-04-A

This AC cancels AC 139-04-A, Pavement Strength and Overload Considerations, effective November 28, 2024.

III. REFERENCES

2.

1. Regulations

a) CAAP Manual of Standards for Aerodromes

- International Civil Aviation Organization documents
 - a) ICAO Document 9157 Aerodrome Design Manual Part 1: Runways; and
 - b) ICAO Document 9157 Aerodrome Design Manual Part 2: Pavements
- 3. International Organization Guidance Material

a) FAA AC 150/5335-5D

IV. ACKNOWLEDGEMENT

AANSOO of the Civil Aviation Authority of the Philippines acknowledges the valuable information provided by ICAO through its published documents and other related guidance materials and best practices developed by international organizations.

V. COPIES OF THIS AC

AC AGA-ACR-PCR-01-2024 is available and can be downloaded at the official website of CAAP at <u>www.caap.gov.ph</u>. A printed copy of this AC can be requested from the Regulatory Safety Standards Division (RSSD) of the Aerodrome and Air Navigation Safety Oversight Office (AANSOO), Civil Aviation Authority of the Philippines, located at MIA Road corner, Ninoy Aquino Avenue, Pasay City, Metro Manila, 1300 with Tel. No.: (02) 8246-4988.

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FOREWORD

In 2009, ICAO established a Study Group to investigate updating the international method of reporting pavement strengths. The study group was directed to revise the method, and ICAO adopted with Amendment 15 to Annex 14, the Aircraft Classification Rating - Pavement Classification Rating (ACR-PCR) method. Implementation by all member States, including the Philippines, shall commence between July 2020 and November 2024.

On the transition of the new rating system, CAAP will adopt the necessary provisions and require all aerodrome operators to submit and publish their ACR-PCR values in the AIP not later than November 28, 2024.

CAAP recommends the guidelines and specifications in this AC for reporting airport pavement strength using the standardized Aircraft Classification Rating-Pavement Classification Rating (ACR-PCR) method for all paved runways, taxiways, and aprons at all airports

Aerodrome operators are required to provide strength rating of aerodrome pavements using the ACR-PCR method and publish the rating in the Philippine AIP. This advisory circular briefly explains the ACR-PCR method and offers guidelines on what degree of overloading may be considered acceptable for an aerodrome pavement.

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CHAPTER 1. DEFINITIONS AND ACRONYMS

1.1 Definitions

Terms that have specific meaning within this AC are defined below.

Aggregate. General term for the mineral fragments or particles which, through the agency of a suitable binder, can be combined into a solid mass, e.g., to form a pavement.

Aircraft Classification Number (ACN). A number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade strength.

Aircraft classification rating (ACR). A number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade strength.

Asphalt. Highly viscous binder occurring as a liquid or semi-solid form of petroleum, also referred as bitumen. May be found in natural deposits or may be a refined product.

Base course (or base). The layer or layers of specified or selected material of designed thickness placed on a subbase or subgrade to support a surface course.

Bearing strength. The measure of the ability of a pavement to sustain the applied load, also referred as bearing capacity or pavement strength.

California Bearing Ratio (CBR). The bearing ratio of soil determined by comparing the penetration load of the soil to that of a standard material. The method covers evaluation of the relative quality of subgrade soils but is applicable to sub-base and some base course materials.

Note. — *The Standard Test Method for CBR of Laboratory-Compacted Soils is an ASTM standard (ASTM D1883).*

Flexible pavement. A pavement structure that maintains intimate contact with and distributes loads to the subgrade and depends on aggregate interlock, particle friction, and cohesion for stability.

Lateral wander. The path of a given aircraft will deviate relative to the path centered on the longitudinal axis of the pavement in question in a statistically predictable pattern. This phenomenon is referred to as lateral wander.

Modulus of elasticity. The modulus of elasticity of a material is a measure of its stiffness. It is equal to the stress applied to it divided by the resulting elastic strain.

Overlay. An additional surface course placed on existing pavement either with or without intermediate base or sub-base courses, usually to strengthen the pavement or restore the profile of the surface.

Pavement classification number (PCN). A number expressing the bearing strength of a pavement.

Pavement classification rating (PCR). A number expressing the bearing strength of a pavement for unrestricted operations.

Pavement structure (or pavement). The combination of sub-base, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the subgrade.

Poisson's ratio. The ratio of transverse to longitudinal strains of a loaded specimen.

Portland cement concrete (PCC). A mixture of graded aggregate with Portland cement and water.

Rigid pavement. A pavement structure that distributes loads to the subgrade having as its surface course a Portland cement concrete slab of relatively high bending resistance, also referred as concrete pavement.

Sub-base course. The layer or layers of specified selected material of designed thickness placed on a subgrade to support a base course.

Subgrade. The upper part of the soil, natural or constructed, which supports the loads transmitted by the pavement, also referred as the formation foundation.

Surface course. The top course of a pavement structure, also referred as wearing course.

1.2 Acronyms

The acronyms and abbreviations used in this AC are listed below.

| Acronym | Description |
|---------|---|
| 2D | Dual tandem |
| 2D/2D | Multiple dual-tandem landing gear |
| AC | Advisory Circular |
| ACAP | Airplane Characteristics for Airport Planning |
| ACN | Aircraft Classification Number |
| ACR | Aircraft Classification Rating |
| ADIP | Airport Data and Information Portal |

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| AIP | Aeronautical Information Publication |
|-----------|---|
| AIS | Aeronautical Information Service |
| AMR | Airport Master Record |
| ASTM | ASTM International |
| CBR | California Bearing Ratio |
| CDF | Cumulative Damage Factor |
| CG | Centre of Gravity |
| cm | Centimeter |
| D | Dual wheel landing gear |
| DSWL | Derived Single Wheel Load |
| E | Elastic modulus |
| FAA | United States Federal Aviation Administration |
| FAARFIELD | FAA Rigid and Flexible Iterative Elastic Layer Design |
| HMA | Hot Mix Asphalt |
| HWD | Heavy Weight Deflectometer |
| ICAO | International Civil Aviation Organization |
| LEA | Layered Elastic Analysis |
| MAGW | Maximum Allowable Gross Weight |
| MPa | Megapascal |
| P/TC | Passes to Traffic Cycles |
| PCC | Portland Cement Concrete (also Hydraulic Cement Concrete or |
| | Cement Concrete) |
| PCN | Pavement Classification Number |
| PCR | Pavement Classification Rating |
| S | Single wheel landing gear |
| SCI | Structural Condition Index |

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CHAPTER 2. ACR-PCR METHOD

2.1 Concept of the ACR-PCR method

- 2.1.1 The ACR-PCR method is meant only for the publication of pavement strength data in aeronautical information publications (AIPs). It is not intended for the design or evaluation of pavements, nor does it contemplate the use of a specific method by the aerodrome operator for either the design or evaluation of pavements.
- 2.1.2 There is no mathematical correlation between the previous ICAO pavement strength reporting ACN-PCN and the new ICAO ACR-PCR system.
- 2.1.3 The ACR-PCR system is structured so a pavement with a particular PCR value can support an aircraft that has an ACR value equal to or less than the pavement's PCR value. This is possible because ACR and PCR values are computed using the same technical basis.
- 2.1.4 The use of the standardized method of reporting pavement strength applies only to pavements at public and private use airports with bearing strengths of 5,700 kg or more. The method of reporting pavement strength for pavements of less than 5,700 kg is to only report the gross weight and gear configuration of the aircraft that can be accommodated.
- 2.1.5 The ACR-PCR method also envisages the reporting of the following information in respect of each pavement:
 - a) pavement type;
 - b) subgrade category;
 - c) maximum allowable tire pressure; and
 - d) Pavement evaluation method used.
- 2.1.6 The data obtained from the characteristics listed above are primarily intended to enable aircraft operators to determine the permissible aircraft types and operating masses, and the aircraft manufacturers to ensure compatibility between airport pavements and aircraft under development.
- 2.1.7 The airport authority should, whenever possible, report pavement strength based on a technical evaluation of the pavement. Details of the technical evaluation process are included in 3.6. If, due to financial or engineering constraints, a technical evaluation is not feasible, then using the aircraft method must be used for reporting pavement strength.

2.2 Determination ACR-PCR Values

2.2.1 The sole mathematical model used in the ACR-PCR method is the layered elastic analysis (LEA). The LEA model assumes that the pavement structure, whether flexible or rigid, can be represented by homogeneous, elastic, isotropic layers arranged as a stack. Each layer in the system is characterized by an elastic modulus Ei, Poisson's ratio vi, and a uniform layer thickness ti. Layers are assumed to be of infinite horizontal extent and the bottom or subgrade layer is assumed to extend vertically to infinity (i.e. the subgrade is modelled as an elastic half-space). Due to the linear elastic nature of the model, individual wheel loads can be summed to obtain the combined stress and strain responses for a complex, multiple-wheel aircraft gear load. The use of the LEA model permits the maximum correlation to worldwide pavement design methods.

2.3 Determination of ACR

- 2.3.1 The ACR of an aircraft is numerically defined as two times the derived single wheel load, where the derived single wheel load is expressed in hundreds of kilograms. Single wheel tire pressure is standardized at 1.50 MPa.
- 2.3.2 ACRs of aircraft are computed under the ACR-PCR method as shown in Figure 2-1.
- 2.3.3 ACRs can be obtained from these relevant document and software:
 - a) Aircraft characteristics for airport planning (published by the aircraft manufacturers); and
 - b) ICAO-ACR computer program (current version).
- 2.3.4 The aircraft manufacturer provides the official computation of an ACR value. Computation of the ACR requires detailed information on the operational characteristics of the aircraft, such as maximum aft center of gravity, maximum ramp weight, wheel spacing, and tire pressure.
- 2.3.5 Appendix 2 of the ICAO Aerodrome Design Manual, Part 3, Pavements, Third Edition, provides procedures for determining the Aircraft Classification Rating (ACR). FAA developed ICAO-ACR 1.4 to calculate ACRs in accordance with the ICAO standards. ICAO-ACR 1.3 is used internally by FAARFIELD 2.0 to calculate ACR's.



Figure 2-1. ACR Computations

2.3.6 Rigid and Flexible ACR

For rigid and flexible pavements, the aircraft landing gear support requirements are determined by the layer elastic method for each subgrade support category.

2.3.6.1 <u>Rigid Pavements</u>

To standardize the ACR calculation for rigid pavements, a standard stress is stipulated as σ = 399 psi (2.75 Mpa). Note the working stress used for the design has no relationship to the standard stress used for pavement strength reporting.

2.3.6.2 Flexible Pavements

To standardize the ACR calculation for flexible pavement the derived single wheel load is calculated at a constant pressure of 218 psi (1.50 Mpa) relative to a total thickness t computed for 36,500 passes of the aircraft.

2.3.7 <u>Subgrade Category</u>

The ACR-PCR method adopts four standard levels of subgrade strength for rigid and flexible pavements. These standard categories

| Subgrade Strength Category | Subgrade Support E (Elastic Modulus) psi (MPa) | Represents E (Elastic Modulus) psi (MPa) | Code Designation |
|----------------------------------|--|--|---------------------|
| High | 29008 (200) | E≥21,756 (≥150) | А |
| Medium | 17405 (120) | E≥14,504 <21,756 (≥100 <150) | В |
| Low | 11603 (80) | E≥8,702 <14,504 (≥60 <100) | С |
| Ultra Low | 7252 (50) | E < 8,702 (< 60) | D |

are used to represent a range of subgrade conditions as shown in Table 2-1.

Table 2-1. Standard Subgrade Conditions for ACR Calculations

2.4 Determination of PCR

ICAO Document 9157 Part 3 provides a model procedure for PCR determination and publication, using the CDF concept (refer to 1.1.4 in ICAO Doc 9157 Part 3). States may develop their own methods for PCR determination, consistent with the overall parameters of the ACR-PCR method.

The strength of a pavement is reported in terms of the load rating of the aircraft which the pavement can accept on an unrestricted basis. The term unrestricted operations in the definition of PCR does not mean unlimited operations. Unrestricted refers to the relationship of PCR to the aircraft ACR, and that it is permissible for an aircraft to operate without weight restriction when the PCR is greater than or equal to the ACR. The term unlimited operations do not take into account pavement life. The PCR to be reported is such that the pavement strength is sufficient for the current and future traffic analyzed, and should be reevaluated if traffic changes significantly. A significant change in traffic would be indicated by the introduction of a new aircraft type or an increase in current aircraft traffic levels not accounted for in the original PCR analysis.

The PCR value should not be used for pavement design or as a substitute for evaluation. Pavement design and evaluation are complex engineering problems that require detailed analysis. They cannot be reduced to a single number. The PCR rating system uses a continuous

scale to compare pavement capacity where higher values represent pavements with larger load capacity.

<u>CDF Concept</u>

The CDF is the amount of the structural fatigue life of a pavement that has been used up. It is expressed as the ratio of applied load repetitions to allowable load repetitions to failure, or, for one aircraft and constant annual departures where a coverage is one application of the maximum strain or stress due to load on a given point in the pavement structure.

Note 1.— When CDF = 1, the pavement subgrade will have used all of its fatigue life.

Note 2.— When CDF < 1, the pavement subgrade will have some remaining life and the value of CDF will give the fraction of the life used.

Note 3.— When CDF > 1, all of the fatigue life will have been used and the pavement subgrade will have failed.

2.4.1 <u>Reporting the PCR</u>

The PCR system uses a coded format to maximize the amount of information contained in a minimum number of characters and to facilitate computerization. The PCR is reported as a five-part code where the following codes are ordered and separated by forward slashes: Numerical PCR value / Pavement type / Subgrade category / Allowable tire pressure / Method used to determine the PCR.

2.4.1.1 <u>Pavement Type</u>

The PCR system uses a coded format to maximize the amount of information contained in a minimum number of characters and to facilitate computerization. The PCR is reported as a five-part code where the following codes are ordered and separated by forward slashes: Numerical PCR value / Pavement type / Subgrade category / Allowable tire pressure / Method used to determine the PCR.

| Pavement Type | Pavement Code |
|---------------|---------------|
| Flexible | F |
| Rigid | R |

Table 2-2. Pavement Codes for Reporting PCR

2.4.1.1.1 Flexible Pavement

Flexible pavements support loads through bearing rather than flexural action. They comprise several layers of select materials designed to gradually distribute loads from the surface to the layers beneath. The design ensures that load transmitted to each successive layer does not exceed the layer's load-bearing capacity.

2.4.1.1.2 <u>Rigid Pavement</u>

Rigid pavements employ a single structural layer, which is very stiff or rigid in nature, to support the pavement loads. The rigidity of the structural layer and resulting beam action enable rigid pavement to distribute loads over a large area of the subgrade. The load-carrying capacity of a rigid structure is highly dependent upon the strength of the structural layer, which relies on uniform support from the layers beneath.

2.4.1.1.3 <u>Composite Pavement</u>

Various combinations of pavement types and stabilized layers can result in complex pavements that could be classified as between rigid or flexible. A pavement section may comprise multiple structural elements representative of both rigid and flexible pavements. Composite pavements are most often the result of pavement surface overlays applied at various stages in the life of the pavement structure. If a pavement is of composite construction, the pavement type should be reported as the type that most accurately reflects the structural behavior of the pavement. FAARFIELD will consider a rigid pavement overlaid with flexible to be a rigid pavement until the overlay thickness matches the rigid thickness. It is good practice to include a note stating that the pavement is of composite construction, and to note what the wearing surface is.

2.4.1.2 <u>Subgrade Strength Category</u>

As discussed in paragraph 2.3.7, there are four standard subgrade strengths identified for calculating and reporting ACR or PCR values. Table 2-1 lists the values for rigid and flexible pavements.

2.4.1.3 <u>Allowable Tire Pressure</u>

Table 2-3 lists the allowable tire pressure categories identified by the ACR-PCR system. The tire pressure codes apply equally to rigid or flexible pavement sections; however, the application of the allowable tire pressure differs substantially for rigid and flexible pavements.

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| Category | Code | Tire Pressure Range |
|-----------|---|--|
| Unlimited | w | No pressure limit |
| High | х | Pressure limited to 254 psi (1.75 MPa) |
| Medium | Medium Y Pressure limited to 181 psi (1.25 MPa) | |
| Low | Z | Pressure limited to 73 psi (0.50 MPa) |

Table 2-3. Tire Pressure Codes for Reporting PCR

2.4.2 <u>Method Used to Determine PCR</u>

The PCR system recognizes two pavement evaluation methods. If the evaluation represents the results of a technical study, the evaluation method should be coded T. If the evaluation is based on "Using Aircraft" experience, the evaluation method should be coded U. Technical evaluation implies that some form of technical study and computation were involved in the determination of the PCR. Using Aircraft evaluation means the PCR was determined by selecting the highest ACR among the aircraft currently using the facility and not causing pavement distress.

2.4.2.1 Using Aircraft Experience

The Using Aircraft Experience is a procedure where ACR values for all aircraft currently permitted to use the pavement facility are determined and the largest ACR value is reported as the PCR. This method is easy to apply and does not require detailed knowledge of the pavement structure. The subgrade support category is not a critical input when reporting PCR based on the Using Aircraft Experience. The recommended subgrade support category when information is not available should be Category B. See Appendix B, paragraph B.1 for an example of the Using Aircraft Experience.

The accuracy of this method is dependent upon having records of past aircraft traffic. 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 PCR. Likewise, significant under-estimation of the pavement capacity can lead to uneconomic use of the pavement by preventing acceptable traffic from operating. Although there are no minimum limits on frequency of operation before an aircraft is considered part of the normal traffic, the reporting agency must use a rational approach to avoid overstating or understating the pavement capacity. Use a consistent method based on a design period minimum frequency of 250 annual departures. Use of the Using Aircraft Experience is discouraged on a long-term basis due to the concerns listed above.

2.4.2.2 <u>Technical Evaluation Method</u>

The accuracy of a technical evaluation is better than that produced with the Using Aircraft procedure but requires additional information. Pavement evaluation may require a combination of on-site inspections, load-bearing tests, and engineering judgment. It is common to think of pavement strength rating in terms of ultimate strength or immediate failure criteria. However, pavements are rarely removed from service due to instantaneous structural failure. A decrease in the serviceability of a pavement is commonly attributed to increases in surface roughness or localized distress, such as rutting or cracking. Determination of the adequacy of a pavement structure must not only consider the magnitude of pavement loads but the impact of the accumulated effect of traffic over the intended life of the pavement. To determine a technical PCR requires information on: (1) aircraft traffic composition and frequency, (2) thickness, material type and strength of each layer of pavement structure and (3) elastic modulus of subgrade. For examples on technical evaluation to determine PCR see Appendix B paragraph B.4.

2.4.3 Example PCR Reporting

An example of a PCR code is 800/R/B/W/T—with:

- a) 800 expressing the PCR numerical value;
- b) R for rigid pavement;
- c) B for medium strength subgrade;
- d) W for high allowable tire pressure; and
- e) T for a PCR value obtained by a technical evaluation.

CHAPTER 3. COMPUTER PROGRAMMES (ICAO-ACR 1.4 and FAARFIELD 2.1)

To facilitate the use of the ACR-PCR system, the FAA developed a software application, ICAO-ACR 1.4, that calculates ACR values using the procedures and conditions specified by ICAO and can be used to determine PCR values following the procedures in this AC. The application is included within FAARFIELD 2.1 the FAA pavement design program.

These public domain programs ICAO-ACR and FAARFIELD are available at:

- 1) <u>https://www.airporttech.tc.faa.gov/Products/Airport-Safety-Papers-</u> <u>Publications/Airport-Safety-Detail/icao-acr-14</u>
- 2) <u>https://airporttech.tc.faa.gov/Products/Airport-Safety-Papers-</u> <u>Publications/Airport-Safety-Detail/faarfield-21</u>

3.1 Using the ICAO-ACR Program to Calculate ACR

Using the ICAO-ACR program to calculate ACR values is visually interactive and intuitive, see Figure 3-1.

- 1) The user selects:
 - a) Pavement Type, Flexible or Rigid.
 - b) Airplane Group and Airplane (adjusting weight and percent GW if necessary.
- 2) Calculate ACR

The program then calculates ACR values for the 4 subgrade categories.

| Pave | ement Type Weicht (bur) | Field Pigd 365.1 | 447 | Select | t Arplane Group Arbus Arblane A300-84 | (atd v) | |
|----------|----------------------------|--|-----|----------------------|--|-----------------------|------------------------|
| P | ercent GW 0.540 | | | Calculate ACR * | | | |
| Numbe | er of Wheels | | | | | | |
| Tire Pr | essure \$00 | 216 | 31 | C Darlay Sele | d Wheels (SW) | 177 Matrice | |
| | Wheel Co | oordinates (in) | _ | | 5270530474 | 1.546.00773 | |
| No | K | Y | ^ | Subgrade Category | Subgrade Modulua ipe] | Rexière ACR Number | ACR Thickness t an) |
| 1 | 197.23 | 0.00 | | D | 7.251.89 | 737.81 | 35.71 |
| - | -160.72 | 55.00 | | c | 11,603.02 | 545.79 | 27,21 |
| - | 160.73 | 55.00 | | 6 | 17,404.53 | 496.68 | 22.04 |
| 4 | 197.23 | 0.00 | | A | 29.007.55 | 413.29 | 16.82 |
| - | | | | | | | |
| 100 | Cort 2 | | | Calculati | on time: 2.42 sec. | | |
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| Parmet | eGW.2 | | | | | | |
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| _ | | | | | | | |
| | | | | | | | |

Figure 3-1. Screen Shot ICAO-ACR

3.2 FAARFIELD 2.1

3.2.1 Internal Aircraft Library

FAARFIELD 2.1 contains an internal library of aircraft covering most large commercial and U.S. military aircraft currently in operation. The internal library is based on aircraft information provided directly by aircraft manufacturers or obtained from Aircraft ACAP Manuals. The default characteristics of aircraft in the internal library represent the ICAO standard conditions for calculation of ACR. These characteristics include center of gravity at the maximum aft position for each aircraft. Changes to characteristics of internal library aircraft are not permanent unless the internal library aircraft is added to an external library.

3.2.2 External Aircraft Library

FAARFIELD 2.0 allows for an external aircraft library where characteristics of the aircraft can be changed and additional aircraft added as desired. Functions permit users to modify the characteristics of an aircraft and save the modified aircraft in the external library. There are no safeguards in the FAARFIELD 2.0 program to assure that aircraft parameters in the external library are feasible or appropriate. The user is responsible for assuring all data is correct.

When saving an aircraft from the internal library to the external library, the FAARFIELD 2.0 program will calculate the tire contact area based upon the gross load, maximum aft center of gravity, and tire pressure. This value is recorded in the external library and is used for calculating the pass-to-coverage (P/C) ratio in the pavement thickness mode. Since the tire contact area is constant, the P/C ratio is also constant in the pavement thickness mode. This fixed P/C ratio is used for converting passes to coverages for pavement thickness determination and equivalent aircraft operations.

3.2.3 Procedure for Technical Evaluation (T) PCR

The PCR procedure considers the actual pavement characteristics at the time of the evaluation — considering the existing pavement structure, and the aircraft traffic forecast to use the pavement over its design structural life (for new pavement construction) or estimated remaining structural life (for in service pavements). The PCR should be valid only for this usage period. In case of major pavement rehabilitation or significant traffic changes compared to the initial traffic, a new evaluation should be performed.

The technical evaluation should be used when pavement characteristics and aircraft mix are consistently known and documented.

The PCR procedure involves the following steps:

- 1. Collect all relevant pavement data (layer thicknesses, elastic moduli and Poisson's ratio of all layers, using projected aircraft traffic) using the best available sources;
- 2. Define the aircraft mix by aircraft type, number of departures (or operations consistent with pavement design practices), and aircraft weight that the evaluated pavement is expected to experience over its design or estimated remaining structural life;
- 3. Compute the ACRs for each aircraft in the aircraft mix at its operating weight and record the maximum ACR aircraft;
- 4. Compute the maximum CDF of the aircraft mix and record the value;
- 5. Select the aircraft with the highest contribution to the maximum CDF as the critical aircraft. This aircraft is designated AC(i), where i is an index value with an initial value 1. Remove all aircraft other than the current critical aircraft AC(i) from the traffic list;
- 6. Adjust the annual departures of the critical aircraft until the maximum aircraft CDF is equal to the value recorded in (4). Record the equivalent annual departures of the critical aircraft;
- 7. Adjust the critical aircraft weight to obtain a maximum CDF of 1.0 for the number of annual departures obtained at step (6). This is the Maximum Allowable Gross Weight (MAGW) for the critical aircraft;
- 8. Compute the ACR of the critical aircraft at its MAGW. The value obtained is designated as PCR(i);
- 9. If AC(i) is the maximum ACR aircraft from step 3, then skip to step 13. If not continue to Step 10;
- Remove the current critical aircraft AC(i) from the traffic list and reintroduce the other aircraft not previously considered as critical aircraft. The new aircraft list, which does not contain any of the previous critical aircraft, is referred to as the reduced aircraft list. Increment the index value (i = i+1);
- 11. Compute the maximum CDF of the reduced aircraft list and select the new critical aircraft AC(i);
- 12. Repeat steps 5-9 for AC(i). In step 6, use the same maximum CDF as computed for the initial aircraft mix to compute the equivalent annual departures for the reduced list; and
- 13. The PCR to be reported is the maximum value of all computed PCR(i). The critical aircraft is the aircraft associated with this maximum value of PCR(i).

A flowchart of the above procedure is shown in Figure 3-2. The purpose of steps 10 to 13 is to account for certain cases with a large number of departures of a short/medium-range aircraft (such as the B737) and a relatively small number of departures of a long-range aircraft (e.g. the A350). Without these steps, the smaller aircraft would generally be identified as critical, with the result that the PCR would require unreasonable operating weight restrictions on larger aircraft (unreasonable because the design traffic already included the large aircraft). Note that if the initial critical aircraft is also the aircraft in the list with the maximum ACR at operating weight, then the procedure is completed in one iteration, with no subsequent reduction to the traffic list.



Figure 3-2. Flowchart of recommended PCR computation procedure

CHAPTER 4. OVERLOAD OPERATIONS

4.1 ICAO Pavement Overload Evaluation Guidance

- 4.1.1 In the life of a pavement, it is possible that either the current or the future traffic will load the pavement in such a manner that the assigned pavement rating is exceeded. ICAO provides a simplified method to account for minor pavement overloading in which the overloading may be adjusted by applying a fixed percentage to the existing PCR.
- 4.1.2 The ICAO procedure for overload operations is based on minor or limited traffic having ACRs that exceed the reported PCR. Loads that are larger than the defined PCR will shorten the pavement design life, while smaller loads will use up the life at a reduced rate. With the exception of massive overloading, pavements do not suddenly or catastrophically fail. As a result, occasional minor overloading is acceptable with only limited loss of pavement life expectancy and relatively small acceleration of pavement deterioration.
- 4.1.3 The following guidelines are recommended when evaluating overloads:
 - 1. For flexible or rigid pavements, occasional traffic by aircraft with an ACR not exceeding 10 percent above the reported PCR should not adversely affect the pavement. For example, a pavement with PCR=600 can support some limited traffic of aircraft with ACR=660.
 - 2. The annual number of overload traffic should not exceed approximately 5 percent of the total annual aircraft traffic. There is no exact guidance for choosing a number of operations that represents 5 percent.
 - 3. Overloads should not normally be permitted on pavements already exhibiting signs of structural distress, during periods when the strength of the pavement or its subgrade could be weakened by water.
 - 4. When overload operations are conducted, the airport owner should regularly inspect the pavement condition. Periodically the airport owner should 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.
- 4.1.4 These criteria provide a consistent, repeatable process the airport owner can use to monitor the impact of these overload operations on the pavement in terms of pavement life reduction or increased maintenance requirements. This discusses methods for making overload allowances for both flexible and rigid pavements that will clearly indicate these effects and will give the authority the ability to determine the impact both economically and in terms of pavement life.

4.2 Overload technical analysis

- 4.2.1 Overloads in excess of 10 per cent may be considered on a case-by-case basis when supported by a more detailed technical analysis. When overload operations exceed allowances, a pavement analysis is required for granting the proposed additional loads, which was not scheduled in the initial pavement design. In those cases, the pavement analysis should determine how the overload operation contributes to the maximum CDF when it is mixed with the actual aircraft mix. Indeed, the ACR as a relative indicator, even if exceeding the reported PCR, cannot predict how the overload aircraft will affect the pavement structural behavior and/or its design life, since it will be strongly dependent of its offset to the location of the maximum CDF produced by the aircraft mix (critical offset).
- 4.2.2 The pavement analysis would then mean determining the number of permitted overload operations so that the CDF of the entire aircraft mix, including the overload aircraft, remains in the tolerances agreed by the relevant authority.

4.3 Overload Guidance

- 4.3.1 The overload evaluation guidance in this section applies primarily to flexible and rigid pavements that have PCR values that were established by the technical method. Pavements that have ratings determined by the Using Aircraft Method can use the overload guidelines provided very frequent pavement inspection procedures are followed.
- 4.3.2 The adjustments for pavement overloads start with the assumption that some of the aircraft in the traffic mix have ACRs that exceed the PCR. If a technical analysis was performed, then most of the necessary data already exists to perform an examination of overloading.
- 4.3.3 The recommended PCR is not adequate for the traffic mix when the Total CDF>1. Airports have three options when evaluating what pavement strength rating to publish:
 - 1. Let the PCR remain as derived from the technical evaluation method, but retain local knowledge that there are some aircraft in the traffic mix that can be allowed to operate with ACRs that exceed the published PCR or at a reduced weight to not exceed the PCR.
 - 2. Provide for an increased PCR by adding an overlay or by reconstruction to accommodate aircraft with higher ACRs.
 - 3. Adjust the PCR upward to that of the aircraft with the highest ACR but recognize the need to expect possible severe maintenance. This will

result in earlier and increased costs for reconstruction or overlay projects. This is in essence changing the PCR rating to a using rating, and potentially reducing the remaining pavement life.

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CHAPTER 5. PAVEMENTS FOR LIGHT AIRCRAFT

Light aircraft are those having a mass of 5 700 kg or less. These aircraft have pavement requirements less than that of many highway trucks. Technical evaluations of those pavements can be made but an evaluation based on using aircraft is satisfactory. It is worth noting that, at some airports, service vehicles such as fire trucks, or fuel trucks may be more critical than aircraft. Since nearly all light aircraft have single-wheel undercarriage legs, there is no need for reporting subgrade categories. However, since some helicopters and military trainer aircraft within this mass range have quite high tire pressures, limited quality pavements may need to have tire pressure limits established.

In evaluating pavements meant for light aircraft — 5 700 kg mass and less — it is unnecessary to consider the geometry of the undercarriage of aircraft or how the aircraft load is distributed among the wheels. Thus, subgrade class and pavement type need not be reported, and only the maximum allowable aircraft mass and maximum allowable tire pressure need to be determined and reported. For these, the foregoing guidance on techniques for "using aircraft" evaluation should be followed.

Because the 5 700 kg limit for light aircraft represents pavement loads only two-thirds or less of common highway loads, the assessment of traffic using pavements should extend to consideration of heavy ground vehicles, such as fuel trucks, fire trucks, service vehicles, etc. These must also be controlled in relation to load limited pavements.

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APPENDIX A – EQUIVALENT TRAFFIC

A.1 Equivalent Traffic

- A.1.1 A detailed method based on the cumulative damage factor (CDF) procedure allows the calculation of the combined effect of multiple aircraft in the traffic mix for an airport. This combined traffic is brought together into the equivalent traffic of a critical aircraft. This is necessary since the procedure used to calculate ACR allows only one aircraft at a time. By combining all of the aircraft in the traffic mix into an equivalent critical aircraft, calculation of a PCR that includes the effects of all traffic becomes possible. The methodology used to determine ACR/PCR does not consider the critical design aircraft used to determine airport dimensional requirements.
- A.1.2 The assessment of equivalent traffic, as described in this section, is needed only in the process of determining PCR using the technical method and may be disregarded when the Using Aircraft Method is employed.
- A.1.3 In order to arrive at a technically derived PCR, it is necessary to determine the maximum allowable gross weight of each aircraft in the traffic mixture, which will generate the known pavement structure. This in turn requires that the pavement cross-section and aircraft loading characteristics be examined in detail. Consequently, the information presented in this appendix appears at first to apply to pavement design rather than a PCR determination. However, with this knowledge in hand, an engineer will be able to arrive at a PCR that will have a solid technical foundation.

A.2 Equivalent Traffic Terminology

In order to determine a PCR, based on the technical evaluation method, it is necessary to define common terms used in aircraft traffic and pavement loading. The terms arrival, departure, pass, coverage, load repetition, operation, and traffic cycle are often used interchangeably by different organizations when determining the effect of aircraft traffic operating on a pavement. It is important to determine which aircraft movements need be counted when considering pavement stress and how the various movement terms apply in relation to the pavement design and evaluation process. For the purposes of this document, they are differentiated as follows:

A.2.1 Arrival (Landing) and Departure (Takeoff)

Typically, aircraft arrive at an airport with a lower amount of fuel than is used at takeoff. As a consequence, the stress loading of the wheels on the runway pavement is less when landing than at takeoff due to the lower weight of the aircraft as a result from the fuel used during flight and the lift on the wings. This is true even at the touchdown impact in that there is still lift on the wings, which alleviates the dynamic vertical force. Because of this, the FAA pavement design procedure only considers departures and ignores the arrival traffic count. However, if the aircraft do not receive additional fuel at the airport, then the landing weight will be substantially the same as the takeoff weight (discounting the changes in passenger count and cargo), and the landing operation should be counted as a takeoff for pavement stress loading cycles. In this latter scenario, there are two equal load stresses on the pavement for each traffic count (departure), rather than just one. Regardless of the method of counting load stresses, a traffic cycle is defined as one takeoff and one landing of the same aircraft, subject to a further refinement of the definition in the following text.

A.2.2 <u>Pass</u>

A pass is a one-time movement of the aircraft over the runway pavement. It could be an arrival, a departure, a taxi operation, or all three, depending on the loading magnitude and the location of the taxiways. Figure A-1 shows typical traffic patterns for runways having either parallel taxiways or central taxiways. A parallel taxiway requires that none or very little of the runway be used as part of the taxi movement. A central taxiway requires that a large portion of the runway be used during the taxi movement.

Figure A-1. Traffic Load Distribution Patterns



A.2.2.1 Parallel Taxiway Scenario

In the case of the parallel taxiway, shown as Figure A1-1a in Figure A-1, two possible loading situations can occur. Both of these situations assume that the passenger count and cargo payload are approximately the same for the entire landing and takeoff cycle:

1. If the aircraft obtains fuel at the airport, then a traffic cycle consists of only one pass since the landing stress loading is considered at a reduced level, which is a fractional equivalence. For this condition only

the takeoff pass is counted, and the ratio of passes to traffic cycles (P/TC) is 1.

- 2. If the aircraft does not obtain fuel at the airport, then both landing and takeoff passes should be counted, and a traffic cycle consists of two passes of equal load stress. In this case, the P/TC ratio is 2.
- A.2.2.2 Central Taxiway Scenario

For a central taxiway configuration, shown as Figure A1-1b in Figure A-1, there are also two possible loading situations that can occur. As was done for the parallel taxiway condition, both of these situations assume that the payload is approximately the same for the entire landing and takeoff cycle:

- 1. If the aircraft obtains fuel at the airport, then both the takeoff and taxi to takeoff passes should be counted since they result in a traffic cycle consisting of two passes at the maximum load stress. The landing pass can be ignored in this case. It is recognized that only part of the runway is used during some of these operations, but it is conservative to assume that the entire runway is covered each time a pass occurs. For this situation, the P/TC ratio is 2.
- 2. If the aircraft does not obtain fuel at the airport, then both the landing and takeoff passes should be counted, along with the taxi pass, and a traffic cycle consists of three passes at loads of equal magnitude. In this case, the P/TC ratio is 3.
- A.2.2.3 A simplified, but less conservative, approach would be to use a P/TC ratio of 1 for all situations. Since a landing and a takeoff only apply full load to perhaps the end third of the runway (opposite ends for no shift in wind direction), this less conservative approach could be used to count one pass for both landing and takeoff. However, the FAA recommends conducting airport evaluations on the conservative side, which is to assume any one of the passes covers the entire runway.
- A.2.2.4 Table A-1 summarizes the standard P/TC ratio discussion.

| Taxiway Serving the Runway | P/TC Fuel Obtained at the Airport (i.e. departure gross weight more than arrival gross weight.) | P/TC No Fuel Obtained at the Airport (i.e. departure gross weight same as arrival gross weight.) | |
|----------------------------------|--|---|--|
| Parallel | 1 | 2 | |
| Central | 2 | 3 | |

| Table A-1 | Standard | P/TC Rat | tio Summar | y (see note) |
|-----------|----------|----------|------------|--------------|
|-----------|----------|----------|------------|--------------|

Note: - The standard P/TC ratios are whole numbers 1, 2, and 3. The range of values that can be entered in the software is 0.001 thru 10.0. This feature allows flexibility in those instances where a fraction of the total traffic may use different runways or other pavements. For example, a P/TC ratio of 0.5 multiplies the coverages of each aircraft by 0.5, which will increase the PCR of the pavement.

A.2.3 <u>Coverage</u>

- A.2.3.1 When an aircraft moves along a runway, it seldom travels in a perfectly straight line or over the exact same wheel path as before. It will wander on the runway with a statistically normal distribution. One coverage occurs when a unit area of the runway has been traversed by a wheel of the aircraft main gear. Due to wander, this unit area may not be covered by the wheel every time the aircraft is on the runway. The number of passes required to statistically cover the unit area one time on the pavement is expressed by the pass to coverage (P/C) ratio.
- A.2.3.2 Although the terms coverage and P/C ratio have commonly been applied to both flexible and rigid pavements, the P/C ratio has a slightly different meaning when applied to flexible pavements as opposed to rigid pavements. This is due to the manner in which flexible and rigid pavements are considered to react to various types of gear configurations. For gear configurations with wheels in tandem, such as dual tandem (2D) and triple dual tandem (3D), the ratios are different for flexible and rigid pavements, and using the same term for both types of pavements may become confusing.
- A.2.3.3 Aircraft passes can be determined (counted) by observation but coverages are used by the FAARFIELD program. The P/C ratio is necessary to convert passes to coverages for use in the program. This ratio is different for each aircraft because of the different number of wheels, main gear configurations, tire contact areas, and load on the gear. Fortunately, the P/C ratio for any aircraft is automatically determined by the FAARFIELD program and the user only need be concerned with passes.

A.2.4 <u>Operations</u>

The meaning of this term is unclear when used in pavement design or evaluation. It could mean a departure at full load or a landing at minimal load. It is preferable to use the more precise terms of departure or landing.

APPENDIX B – PCR DETERMINATION EXAMPLES

B.1 The Using Aircraft Method

- B.1.1 The Using Aircraft Method for determining PCR is presented in the following steps. This procedure can be used when there is limited knowledge of the existing traffic and runway characteristics. It is also useful when engineering analysis is neither possible nor desired. Because the rating has not been determined rigorously, airport authorities should exercise more care when applying a Using Aircraft PCR than they would with a Technical PCR.
- B.1.2 The basic procedure to arrive at a Using Aircraft PCR is:
 - 1. Determine the ACR for each aircraft in the traffic mix currently using the pavement.
 - 2. Assign the highest ACR value as the PCR.
- B.1.3 The examples in paragraphs B.2 and B.3 show the steps needed to perform the ACR calculations using ICAO-ACR, and the results. For both flexible and rigid pavement surfaces, the detailed steps are as follows:
 - 1. Assign the pavement surface type as code F or R.
 - 2. From available records, determine the strength of the pavement subgrade. If the subgrade strength is not known use Medium.
 - 3. Determine which aircraft has the highest ACR from the list of aircraft that regularly use the pavement, based on the surface type code assigned in Step 1 and the subgrade code in Step 2. ACR values may be determined from the ICAO-ACR program, or from ACR graphs found in the manufacturer's published ACAP manuals. Use the same subgrade code for each of the aircraft when determining the maximum ACR. Base ACRs on the highest operating weight of the aircraft at the airport if the data are available; otherwise, use an estimate or the published maximum allowable gross weight of the aircraft in question. Report the ACR from the aircraft with the highest ACR that regularly uses the pavement as the PCR for the pavement.
 - 4. Note: The FAA recommends that an aircraft be considered to "regularly use" an airport if they have 250 annual departures. Use engineering judgement for seasonal or occasional use aircraft
 - 5. The PCR is the highest ACR of all Using Aircraft, with appropriate tire pressure and evaluation codes added. The numerical value of the PCR may be adjusted up or down at the preference of the airport authority. Adjustments are not considered standard practice but reasons for adjustment may include local restrictions, allowances for certain aircraft, or pavement conditions.

- 6. The tire pressure code (W, X, Y, or Z) should represent the highest tire pressure of the aircraft fleet currently using the pavement. For flexible pavements, code X should be used if no higher tire pressure is evident from among the existing traffic. It is commonly understood that concrete can tolerate substantially higher tire pressures, so the rigid pavement rating should normally be given as W.
- 7. The evaluation method for the Using Aircraft Method is reported as U.

B.2 Using Aircraft Example for Flexible Pavements

- B.2.1 The following example illustrates the Using Aircraft PCR process for flexible pavements:
- B.2.2 An airport has a runway with the known traffic mix shown in Table B-1. The runway has a flexible (asphalt-surfaced) pavement with an estimated subgrade strength of CBR 9. Applying the conversion E = 1500 × CBR gives estimated E = 13,500 psi, which places it in subgrade category C.

| No. | Aircraft Name | Gross Weight, lbs. | Annual Departures | Tire Pressure, psi |
|-----|---------------|-----------------------|----------------------|-----------------------|
| 1 | A300-B4 Std | 365,747 | 1,500 | 216.1 |
| 2 | A319-100 Std | 141,978 | 1,200 | 172.6 |
| 4 | B737-300 | 140,000 | 6,000 | 201.0 |
| 5 | B747-400 | 877,000 | 1,000 | 200.0 |
| 6 | B767-200 ER | 396,000 | 2,000 | 190.0 |
| 7 | B777-200 ER | 657,000 | 1,000 | 205.0 |
| 8 | DC8-63 | 330,000 | 3,000 | 194.0 |

Table B-1. Using Aircraft Traffic for a Flexible Pavement

B.2.3 Determine flexible ACR values for each airplane listed in Table B-1 using ICAO-ACR. Figure B-1 shows a sample ICAO-ACR computation for the A300-B4, the first airplane on the list. For subgrade category C, the flexible ACR number is 545.79. Table B-2 lists computed ACR values for all the operating aircraft. Note that the number of annual departures is not required to determine ACR; however, check to ensure that the number of annual operations qualifies the aircraft as being in "regular use".

| No. | Aircraft Name | ACR/F/C |
|-----|---------------|---------|
| 1 | A300-B4 Std | 545.79 |
| 2 | A319-100 Std | 326.02 |
| 4 | B737-300 | 345.93 |

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| 5 | B747-400 | 606.91 |
|---|-------------|--------|
| 6 | B767-200 ER | 507.86 |
| 7 | B777-200 ER | 585.58 |
| 8 | DC8-63 | 523.07 |

Table B-2. Flexible ACR Values for Using Aircraft in Table B-1

| Pave | ement Type Weight (hs) | Flexible Rigid 365.74 | 17 | Selec Selec | t Airplane Group Airbus t Airplane A300-B | 4 std 🗸 | |
|--------------------|---------------------------|-------------------------------|----|----------------------|--|------------------------|-----------------|
| P | ercent GW | 0.94 | 0 | | Calculate | ACR * | |
| Numbe | er of Wheels | 210.1 | 8 | | | | _ |
| lire Pr | essure (psi) Wheel Ca | 215.1 ordinates (in) | | Display Sele | ct Wheels (SW) | Metric | |
| No | X | Y | ^ | Subgrade Category | Subgrade Modulus [psi] | Flexible ACR Number | ACR Thickness t |
| 1 | -19/23 | 0.00 | | D | 7,251,89 | 737,81 | 35.71 |
| 2 | +160.73 | 0.00 | | С | 11,603.02 | 545.79 | 27.21 |
| 3 | -197.23 | 00.00 | | В | 17,404.53 | 456.68 | 22.04 |
| 5 | 197.23 | 0.00 | ~ | A | 29,007.55 | 413.29 | 16.82 |
| out Deta Percer | s - Gear-2 t GW 2 | | | Calculati | on time: 2.42 sec. | | |
| mber o | f Wheels 2 | | | | | | |
| re Prost | are 2 (pei) | | | | | | |
| | Wheel Coord | inates (in) | | | | | |
| No | х | Y | | | | | |
| | | | | | | | |

Figure B-1. Sample ICAO-ACR Computation for A300-B4 Std (Flexible)

- 1. Since this is a flexible pavement, the pavement type code is F.
- 2. The subgrade strength category is Low, so the appropriate code is C.
- 3. The highest tire pressure of any aircraft in the traffic mix is 216.1 psi, so the tire pressure code is X.
- 4. From Table B-2, the critical aircraft is the B747-400, because it has the highest ACR of the group at the operational weights shown (607/F/B). Additionally, it has regular service.

- 5. Since there was minimal engineering analysis done in this example, and the rating was determined simply by examination of the current aircraft using the runway, the evaluation code is U.
- 6. Based on the results of the previous steps, the runway pavement should tentatively be rated as PCR 610/F/C/X/U, assuming that the pavement is performing satisfactorily under the current traffic.
- 7. If this pavement was a taxiway, the airport could rate this taxiway as the same PCR.
- B.2.4 If the pavement shows obvious signs of distress, this rating should be adjusted downward by the airport authority. If the rating is lowered, then one or more of the aircraft will have ACRs that exceed the assigned rating. This may require the airport to restrict the allowable gross weight for those aircraft or consider pavement strengthening.

B.3 Using Aircraft Example for Rigid Pavements

An airport has a runway with the known traffic mix shown in Table B-1. The runway has a rigid (concrete-surfaced) pavement. The subgrade soil has an estimated modulus E = 15,000 psi, which places it in subgrade category B.

B.3.1 Determine rigid ACR values for each airplane listed in Table B-1 using ICAO-ACR. Figure B-2 shows a sample ICAO-ACR computation for the A300-B4, the first airplane on the list. For subgrade category B, the rigid ACR number is 600.2. Table B-3 lists computed ACR values for all the operating aircraft. Note that the number of annual departures is not required to determine ACR; however, check to ensure that the number of annual operations qualifies the aircraft as being in "regular use." Also note that no information on in-situ concrete strength or thickness is needed to perform the ACR computations.

| No. | Aircraft Name | ACR/R/B |
|-----|---------------|---------|
| 1 | A300-B4 Std | 600.02 |
| 2 | A319-100 Std | 380.09 |
| 4 | B737-300 | 403.48 |
| 5 | B747-400 | 685.56 |
| 6 | B767-200 ER | 563.26 |
| 7 | B777-200 ER | 739.73 |
| 8 | DC8-63 | 552.47 |

Table B-3. Rigid ACR Values for Using Aircraft in Table B-1

1. Since this is a rigid pavement, the pavement type code is R.
- 2. The subgrade strength category is Medium, so the appropriate code is B.
- 3. Concrete surfaces can tolerate high tire pressures, so use tire pressure code W for rigid pavement.
- 4. The B777-200 has the highest ACN of the group at the operational weights shown (740/R/B).
- 5. Since there was no engineering analysis done in this example, and the rating was determined simply by examination of the current aircraft using the runway, the evaluation code is U.
- 6. Based on these steps, the pavement should tentatively be rated as PCR 740/R/B/W/U in order to accommodate all of the current traffic.
- B.3.2 If the pavement shows obvious signs of distress, this rating should be adjusted downward by the airport authority. If the rating is lowered, then one or more of the aircraft will have ACRs that exceed the assigned rating. This may require the airport to restrict the allowable gross weight for those aircraft or consideration of pavement strengthening. The rating could also be adjusted upward, depending on the performance of the pavement under the current traffic.

| Pavement Type O Fi | | Flexible Image: Pigid 365,74 | 7 | Select | Amplane Group Amplase A300-84 | 4 std ~ | |
|--------------------|--------------|--------------------------------------|---|----------------------|-------------------------------|---------------------|-----------------|
| | | 0.47 | 0 | | Calculate | ACR * | |
| | | - | 4 | | | | |
| Tire Pre | essure (psi) | 216.1 | 1 | Display Selev | z Wheels (SW) | Metric | |
| | Wheel Co | ordinates (in) | | Sector State State | al contract line of | | |
| No | X | Y | ^ | Subgrade Category | Subgrade Modulus | Rigid ACR Number | ACR Thickness t |
| 1 | -18.25 | 0.00 | | D | 7,251.89 | 738.49 | 16.83 |
| 2 | 18.25 | 0.00 | | с | 11,603.02 | 666.66 | 15.36 |
| 3 | 10.23 | 55.00 | | В | 17,404.53 | 600.02 | 14.02 |
| | 10.2.5 | 33.00 | | A | 29,007.55 | 514.92 | 12.30 |
| ut Data Percen | Gear 2 | | | Calculati | on time: 1.47 sec. | | |
| nber d | Wheels 2 | | | | | | |
| Press | ure 2 (psi) | | | | | | |
| | Wheel Coord | inates (in) | | | | | |
| No | × | Y | | | | | |

Figure B-2. Sample ICAO-ACR Computation for A300-B4 Std (Rigid)

B.4 The Technical Evaluation Method

Use the Technical evaluation method of determining PCR when there is reliable knowledge of the existing traffic and pavement characteristics. Layer thickness and cross-sectional data, and accurate traffic counts, are needed to perform the evaluation. The following examples illustrate the use of the FAARFIELD 2.0 computer program to determine Technical PCR for flexible and rigid pavements.

B.5 Technical Evaluation for Flexible Pavements

The following list summarizes the steps for using the technical evaluation method for flexible pavements:

- 1. Determine the type of aircraft and number of annual departures of each aircraft type that the pavement will experience over its life.
- 2. Determine the subgrade elastic modulus. The modulus may be determined from test data or converted from the CBR value using $E = 1,500 \times CBR$ (for E in psi).
- 3. Determine the pavement layer characteristics. In FAARFIELD, each layer above the subgrade is characterized by its thickness and elastic modulus E. For materials meeting an FAA specification, FAARFIELD will assign the E-value automatically, or allow the user to select it from an allowable range.
- 4. Determine the P/TC ratio for the pavement using the criteria in Appendix A.
- 5. Enter all information in FAARFIELD and run the PCR evaluation.

B.6 Technical Evaluation Examples for Flexible Pavements

The following three examples demonstrate the technical evaluation method of determining a PCR for flexible pavements.

- 1. Example 1 is a pavement with excess strength relative to the using traffic volume (Total CDF < 1).
- 2. Example 2 has a thickness approximately equal to the structural requirement for the 20-year traffic (Total CDF \approx 1).
- 3. Example 3 demonstrates how to report PCR when the pavement under consideration contains significant excess structural capacity relative to the forecast traffic (Total CDF << 1).

B.6.1 <u>Flexible Pavement Example 1</u>

B.6.1.1 An airport has a flexible (asphalt-surfaced) runway pavement with a subgrade CBR of 8 and a total thickness of 32.0 inches. The structure is: 4-inch asphalt

surface layer (Item P-401), 5 inches cement-treated stabilized base (Item P-304), 6-inch standard base layer (Item P-209) and 17 inches standard subbase layer (Item P-154). The traffic mix is the same as in the Using Aircraft example (Table B-1). It is assumed for the purposes of this example that the traffic level is constant over the 20-year time period. Additional fuel is generally obtained at the airport before departure, and the runway has a parallel taxiway (P/TC ratio = 1). The pavement was designed for a life of 20 years.

B.6.1.2 Enter the data in FAARFIELD. After opening FAARFIELD, select "PCR" from the drop-down function list at the top of the screen. Select the New Flexible pavement type from the drop-down Pavement Type list. Enter or modify the structure layers directly in the Pavement Layers table, or by clicking on the image of the pavement cross section. Using the aircraft library, enter the aircraft list from Table B-3, and modify the gross weights and annual departures as necessary. The default value of P/TC is 1, and does not need to be changed. Figure B-3 shows the FAARFIELD user screen with all data entered for this example.

| JOpen 300 (+) New Sector | Biere int B | Sace As Bis | ne 41 X Clear | time Stored A | arcrait Min 👲 Cra | ate 1 Edk | | | | | () r | Rest |
|--|---|---|---|--|---|--|---|--|---|---|--|------|
| Section | | | | | | | | | | | | |
| Job Name: PCR Ever | mples | PCR | 5 | + | Ran | Status | Gear Struct | ute | | | | |
| Section Name: Republe I | Example 1 | 1 | nclude in sumr | nary report | Run Batch | | | | | | | |
| Payment www. | | | | | | | | | | | | |
| Pavement Type: N | lew Flexible | | | | | D.M.L | 0.4723844.5 | rina 19 | Tel I in | - BOOT | -10000 | |
| Material | | Thickness | (m) Eg | ai) (7 | 8R | | | ana ana | | | | |
| P-401/P-403 HMA | Surface | 4.0 | 200 | 000 | | 000000 | Cement Fresh | d Sale | 1+5.0 inc | | *500000 psi | |
| P-304 Cement Trea | ated Base | 5.0 | 500 | 000 | | 1999 | | | | | | |
| P-209 Crushed Ag | gregate | 6.0 | 750 | 00: | | P-209 (| Crushed Appr | 75-5-5 | T-6.0 inc | ten PGE | =75000 ptr | |
| > P-154 Uncrushed / | Aggregate | 17.0 | 400 | 00 | | 1 48 | LALE | LARA. | a a | A.A.S | 2 age | |
| Subotade | | | 120 | 00 B | | P-1541 | Uncrushed Ap | pregate L | 11=17.0 in | ches 100 E | =40000 psi | |
| Design Life: 20 Results Calculated Life: | Total thic | Select As The | Design Layer P/ op of the subg | Delete TC Ratio: 1 rade: 32.0 r | Selected Layer | | | | CSR-EX | | =12000 ps | |
| Design Life: 20 Results Calculated Life: | Total thic | Select As The | Design Layer P/ top of the subg | Delete | Selected Layer | | đ | | (88-8.0 | | =12000 ps | |
| Design Life: 20 Results Calculated Life | Total the | Select As The | Design Layer P/ top of the subg | Delete TC Ratio: 1 prade: 32.0 v | Selected Layer | Subgra | a | Copy Stru | CSR-6.0 | | -1200 ps | |
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| Design Life: 25 Results Calculated Life Traffic: Stored Ancraft Mis: Ap Arplane Name | Total thic pendix C PCR Exa Gross Taxi Weight (bid | Select As The kness to the t mple + Armual Departures | Design Layer P/ top of the subg Save Air Armual Growth (%) | Delete TC Ratio: 1 yrade: 12.0 m roraft Mox to 1 Total Departures | File Clea | e Al Ancraît 6 | de rom List P(C Ratio | Copy Stru Remove Sele Tite Pressure (pr) | CBF-60 chare to Clipbo ched Aircraft Fr Percent GW on Gear | and DailTine Sacong (n) | <12000 ps Delete Aircraft W Tandem Tire Spacing (in) | * |
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| Design Life: 20 Results Calculated Life: Italic: Stored Ancraft Mis: AP Arplane Name A300-54/C4 5td Boge A3151-00 md | pendix C PCR Eas Gross Taxi Weight [bbi] 365747 141576 | Select As The kness to the b mple + Armus Departures 1500 1200 | Design Layer P/ top of the subg Save Ait Annual Growth (%) 0 | Delete TC Ratio: 1 prade: 32.0 m recart Mor to 1 Total Departures 50000 24000 | File Clea CDF Contributions 0 | All Aircraft 6 CDF Max for Airptime 0 | de rom List PIC Ratio 0 | Copy Sea Remove Sele Tite Pressure (pol) 216 173 | ctare to Clipbo chare to Clipbo | on Section Dual Tite Seating (n) 365 | +12000 ps Delete Aircraft M Tandem Tire Spacing (n.) 55.0 0.0 | * |
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| Design Life: 20 Results Calculated Life Stored Ancraft Mis: Ap Arptane Name A300-84/C4 Std Boge A319-100 std E737-300 E747-400 Belly | Total thic pendix C PCR Eaa Gross Tao Weight (but 365747 141578 140000 077000 877000 | mple + Armusi Departures 1500 1200 1000 | Design Layer P/ top of the subg Save Ait Armual Growth (%) 0 0 0 0 0 0 0 | Delete TC Ratio: 1 prade: 12.0 m Intraft Mix to 1 Total Departures 30000 20000 20000 | File Clear Contributions 0 0 0 | Al Arcest 6 CDF Max for Argune 0 0 0 0 | or List PyC Rasie 0 0 0 0 0 | Copy Sev Remove Sele Tite Pressure (pre) 215 173 201 200 | cell-60 chare to Clipto ted Arcraft Fr Procest GW on Geler 94.005 92.605 92.605 94.605 | and om Section Daal The Sectors (in) 36.5 36.5 36.5 36.5 36.5 36.5 36.5 36.5 | Delete Aircraft M Delete Aircraft M Tandem Tire Spacing (n) 55.0 0.0 0.0 56.0 56.0 | * |
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| Design Life: 20 Results Calculated Life Stored Ancraft Mis: Ap Arcplane Name A300-54/C4 5td Bogle A315-100 std E1737-200 E1747-400 E1747-400 E8 | Total thic pendix C PCR Eau Gross Taxi Weight (Iba) 365747 141976 14000 677000 677000 677000 677000 677000 677000 | ngle Annual Departures 1500 1000 1000 1000 1000 | Design Layer P/ Rop of the subg Save An Annual Growth (%) 0 0 0 0 0 0 0 0 0 0 0 0 0 | Delete: TC Ratio: 1 prade: 32.0 m mode: 3 | File Clea CDF Contributions 0 0 0 0 0 0 0 0 | All Aircraft 0 CDF Max for Airplane 0 0 0 0 0 0 0 | on List P/C Ratio 0 0 0 0 0 0 0 0 0 0 0 0 0 | Copy Stru Copy Stru Remove Sele Trie Pressure Lovi 216 173 201 202 200 200 200 200 200 200 200 200 | teel Aircraft Fr Percent GW 94.005 92.605 46.665 46.665 90.625 91.805 | and Our Section Dual Tre Sector 365 305 440 440 450 550 | -12000 ps -12000 ps Delete Aircraft M Tandem Tire Spacing (in.) 55.0 0.0 56.0 56.0 56.0 56.0 56.0 56.0 | * |

Figure B-3. Screen Shot of FAARFIELD in PCR Mode with Data for Flexible Example 1

| lies | tats 🗂 Open tats 🕀 New Sectors 🔒 Save 700 | Bine Ar Bine Al | X Cose too Ron | ed Annah Mar 🛓 Gra | en teor | (inter X to |
|------|--|---|----------------|--|-----------------------|-------------|
| E. | Section | | | | | x |
| | Job Name PCR Examples | PCR | | Bure | Status Gear Structure | |
| | Section Name Resible Example 1 | Resible Example 1 Include in summary report Run Batch Run Time: 8 seconds PCR calculation Completed Run Time: 8 seconds PCR = 681/6/C/WT | | PCR Calculation Completed Run Time: 8 seconds Bridl 645 GC/017 | | |
| | Pavement Layers Pavement Type: New Flexible | | + | | 101-00300001 | |
| | Material | Thickness (in.) | E (pol) | CBR | | |
| | P-304 Cement Treated Base | 50 | 500000 | | - | |
| | P-209 Crushed Aggregate | 6.0 | 75000 | | - | |
| | > P-154 Uncrushed Aggregate | 17.0 | 40000 | | | |
| | Subgrade | | 12000 | B | | |
| | | Select As The Design | Layer Dele | ete Selected Layer | | |
| | Design Ute: 20 Results | | P/IC Ratio: | 1 | | |
| | Calculated Life Total | thickness to the top of t | he subgrade: 💷 | 10 in. | | |



| | 100 | | | | | | | | | | | | E |
|--|---|---|--|---|--|---|--|--|---|---|--|--|-------|
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| Section | | | | | | | | | | | | | |
| Job Name | PCR Examples | | PCR | | - | Rum | Status | Gear Struct | ute | | | | |
| Section Name | Flexible Example | 1 | | nclude in sum | mary report | Ruo Batch | PCR C Run T | alculation Co met 8 second | mpleted s | | | | |
| Pavement Lay | 85 | | | | | | PCR = | 681/F/C/X/T | | | | | |
| Pavement Ty | pe: New Rex | ible | | | 8 | | | | | | | | |
| Materia | E. | | Thickness | (m) Ep | pa) C | BR . | | | | | | | |
| P-491/P | -403 HMA Surface | E. | 4.0 | 390 | 2000 | | | | | | | | |
| P-304 Cement Treated Base | | ie - | 5.0 | 500 | 0000 | | | | | | | | |
| P-209 Crushed Aggregate | | 5 | 6.0 | 150 | 100 | | | | | | | | |
| > F-154 U | > F-154 Unclushed Aggrégate 17.0 | | 17.0 | 400 | 300 | | | | | | | | |
| | | | | | | | | | | | | | |
| Traffic | | | | _ | | | | | | | | | |
| Traffic Stored Aircraft | Mic Appendix (| C PCR Exan | nple 🔻 | Save A | ecraft Mix to | File Clea | ir Alt Aircraft (| tom List | Remove Sele | cted Aircraft Fi | ion Section | Delete Avroatt Mi | x Fi |
| Traffic Stored Aincraft Airplane Name | Miz: Appendix (Gro We | C PCR Exan Xsz Tani kght (Rxi) | t ple - Arnuai Departures | Save A Annual Growth (%) | vcraft Mix to Total Departures | File Clea CDF Contributions | r All Aircraft 1 CDF Max fo Airplane | from List ^r P/C Ratio | Remove Sele Tire Pressure (psi) | cted Aircraft P Percent GW on Gear | on Section Dual Tire Spacing (in.) | Delete Aircraft Mi Tandem Tire Spacing (in.) | x Fi |
| Traffic Stored Ancraft Airplane Name A300-84/C4 St | Miz: Appendix (Gro Me d Bogie 365 | C PCR Exan tes Tani ight (boi) 747 | nple + Armuai Departures 1500 | Save A Annual Growth (%) 0 | Foraft Mix to Total Departures 30000 | File Clea CDF Contributions 0.01 | r Al: Aircraft 1 CDF Max to Airplane 0.04 | from List P/C Ratio 1.22 | Remove Sele Tire Pressure (psi) 216 | cted Aircraft Fi Percent GW on Gear 94.00% | Dual Tire Spacing (in.) 36.5 | Delete Arcraft Mi Tandem Tire Spacing (n.) 55.0 | хЯ |
| Stored Ancraft Airplane Name A300-84/C4 Sh A319-100 std | Max Appendix (e Gro We d Bogie 365 141 | C PCR Exan Issi Tani Hght (Ibs) 747 978 | nple (* Armuai Departures 1500 1200 | Save A Annual Growth (%) 0 0 | ecraft Mix to Total Departures 30000 24000 | File Clea CDF Contributions 0.01 0 | r All Aircraft 1 CDF Mas fo Airplane 0.04 0 | from List F P/C Ratio 1.22 1.23 | Remove Sele Tire Pressure (psi) 256 173 | cted Arcoaft F Percent GW on Gear 94.00% 92.60% | Dual Tire Specing (in.) 36.5 36.5 | Delete Aircraft Mi Tandem Tine Spacing (in.) 55.0 0.0 | x F |
| Traffic Stored Aincraft Aisplane Name A300-84/C4 So A319-150 std 8737-300 | Max Appendix (e Geo d Bogie 365 141 140 | C PCR Exan Issa Taxi Hght (Ibs) 1747 1976 1000 | nple (* Annual Departures 1500 1200 6000 | Save A Annual Growth (%) 0 0 0 | accraft Mia to Total Departures 30000 24000 120000 | File Clea CDF Contributions 0.01 0 0 | r AR Aircraft CDF Mas fo Airplane 0.04 0 0 | from List P/C Ratio 1.22 1.23 1.3 | Remove Sete Tire Pressure (psi) 216 173 201 | cted Arcoaft Fr Percent GW on Gear 94,00% 92,60% 90,88% | Dual Tire Specing (in.) 36.5 38.5 30.5 | Delete Arcraft Mi Tandem Tine Spacing (in.) 55.0 0.0 0.0 | хĤ |
| Tinfic Stored Ancraft Airplane Name A300-84/C4 50 A319-100 std 8717-300 8747-400 | Max Appendix (Gitt d Bogie 365 141 140 877 | C PCR Exan Iss: Taxi Hght (Ibs) 1747 1975 1000 1000 | nple (* Annual Departures 1500 1200 6000 1000 | Save A Annual Growth (%) 0 0 0 0 0 | Perraft Mia to Total Departures 30000 24000 120000 25000 | File Clear CDF Contributions 0.01 0 0 0.05 | r All Aircraft 1 CDF Mas fo Airplane 0.04 0 0 0.029 | tom List P/C Ratio 1.22 1.23 1.3 1.16 | Remove Sele Tire Pressure (pol) 215 173 201 200 | cted Arcoaft P Percent GW on Geor 94.00% 92.50% 90.85% 45.56% | Dual Tire Specing (in.) 36.5 36.5 30.5 44.0 | Delete Arout We Tandem Tine Spacing (in.) 55.0 0.0 0.0 0.0 55.0 0.0 55.0 | хЯ |
| Tristic Stored Akcraft Airplane Name A300-54/C4 50 A319-100 std 8737-300 8747-400 8747-400 belly | Misc Appendix (F Get d Bogie 365 141 140 877 077 | C PCR Evan tes Taxi ight (Bol) i747 1978 1900 1900 1900 | Annual Departures 1500 1200 5000 1000 1000 | Save A Annual Growth (%) 0 0 0 0 0 0 | acraft Mis to Total Departures 30000 24000 120000 25000 25000 25000 | File Clear CDF Contributions 0.07 0.08 0.08 0.08 | r All Aircraft 1 CDF Mas fo Airplane 0.04 0 0.09 0.05 | tom List P/C Ratio 1.22 1.23 1.3 1.16 1.17 | Remove Sele Tine Pressure (pni) 216 173 201 200 200 200 | cted Arrowth P Percent GW on Gear 94.00% 92.50% 90.88% 45.56% 45.56% | Dual Tire Specing (in.) 36.5 36.5 30.5 44.0 44.0 | Delete Arout Mi Tardem Tire Spacing (in) 55.0 0.0 0.0 58.0 58.0 58.0 | x F |
| Highlic Stored Ancraft Arglane Name A300-54/C4 50 A319-100-ste 8737-300 8747-400 8747-400 8747-200 E8 | Max Appendix (| C PCR Evan ses Tani ight (bo) i747 1978 1900 1900 1900 1900 1900 | Arrtual Departures 1500 5000 1000 5000 1000 2000 | Save A Annual Growth (%) 0 0 0 0 0 0 0 0 0 | ecraft Mis to Total Departures 30000 24000 120000 25000 25000 45000 | File Clear CDF Contributions 0.07 0 0 0.08 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | e All Aircraft I CDF Mee fo Airplane 0.04 0 0.09 0.05 0.05 0 | from List P/C Ratio 1.22 1.23 1.3 1.36 1.17 1.16 | Remove Sele Tire Pressure (pni) 215 173 201 200 200 190 | cted Arcoaft F Percent GW on Gear 94.00% 92.60% 90.88% 45.66% 45.66% 90.82% | ont Section Dual Tire Specing (in.) 36.5 36.5 46.0 44.0 45.0 | Detete Arout Mi Spacing (n.) 55.0 0.0 56.0 56.0 56.0 56.0 | ix Fr |
| Tratic Stored Aincraft Airglane Name A300-84/C4 St A319-100-std 8737-300 8747-400 8747-400 Belly 8747-400 Belly 8747-400 Belly 8747-200 ER | Muz Appendix (| C PCR Exar set Tati ight (bs) 747 978 000 7000 000 000 000 000 | Annual Departures 1500 1200 5000 1000 2000 1000 2000 | Save A Annual Growth (%) 0 0 0 0 0 0 0 0 0 | ecraft Mix to Total Departures 30000 24000 120000 25000 45000 25000 25000 | File Clear CDF Contributions 0.07 0.08 0.08 0.08 0.091 | ar All Aircsaft CDF May fo Airplane 0.04 0 0.09 0.05 0 0.05 | Form List P/C Ration 1.22 1.23 1.3 1.16 1.17 1.16 1.28 | Remove Sele Tine Pressure (psi) 215 173 201 200 200 190 205 | cted Arrowth P Percent GW on Gear 94.005 92.605 90.825 45.605 45.605 90.825 90.825 90.825 90.825 90.825 90.825 90.825 91.805 | om Section Dual Tire Specing (in.) 36.5 36.5 44.0 44.0 45.0 55.0 | Delete Arout Mi Tandem Tine Spacing (in.) 55.0 0.0 0.0 56.0 56.0 56.0 56.0 56.0 5 | x F |
| Franke Stoned Ancraft Anglane Name A300-54/C4 50 A319-100-58 B737-300 B747-400 B747-400 B9 B767-200 ER B777-200 ER DCB-63/73 | Mis: Appendix (e Get d Bogie 365 141 140 877 877 877 877 877 359 657 330 | C PCR Exar les Taal ight (Bol) 747 1978 1000 1000 1000 1000 1000 1000 | nple (*) Annual Departures 1500 1200 2000 1000 2000 1000 2000 | Sane A Annual Growth (%) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | acraft Min to Total Departures 30000 24000 120000 25000 25000 45000 56000 | File Clear CDF Contributions 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | r All Aircraft 1 CDF Max fo Airplane 0.04 0 0 0.05 0.05 | tom List P/C Ratio 122 123 13 136 1.16 1.17 1.16 1.28 1.27 | Remove Sele Tine Pressure (psi) 215 173 201 200 200 190 205 196 | cted Arcoaft F Percent GW on Geor 94.005 90.855 45.555 90.825 91.805 91.805 96.125 | Dual Tire Specing (in.) 36.5 36.5 36.5 36.5 44.0 44.0 45.0 55.0 32.0 | Delete Arout Mi Iandem Tire Spacing (in) 55.0 0.0 0.0 58.0 58.0 58.0 56.0 57.0 55.0 | ×F |

Figure B-5. FAARFIELD Traffic Table – Flexible Example 1

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|-------|--------------------------------|--------------------|-------------------|----------------------|--|---------------------------|------------------------------|--|----------------------------|---------------------------|----------------------|-----------|
| Sec | horr | | | | | | | | | | | |
| Job | Name. | PCR Exemples | | POR. | | - R. | Status | Gear Structur | ŧ | | | |
| Sec | tor Name | Flexibile Transple | et)(| 🖉 Nitude | n wimilarly rep | of 🗍 Rut Br | tuty PCR (Run 1 PCR (| Calculation Com lime: 8 seconds + 681/5/12/8/1 | plated | | | |
| 1 | wenent Typ | el New Res | et la | | + | | | | | | | |
| F | Material F-423/P-4 | ICE HMA Surface | _ | Thickness (m.) | E (pre) | CM. | | | | | | |
| | P-384 Car | ment Treated Ba | ii) | 52 | 40000E | | 1 | | | | | |
| 16- | P-209 Cn | uhed Aggregate | | 60 | 10000 | _ | | | | | | |
| + | Subgrack | ormanin Aggrege | 19 | 17.0 | 12000 | 8 | | | | | | |
| Rock | - 1)+} | Dear All Ainmet | frem(List) | famore betw | ited Anoralt fo | un Seption | Delete Ansraft Mi | a File | | | | |
| | CDF Contribute | CDF Max h | " IVC Rate | Ten Presson Seni) | Persent GW Im Gear | Dual Tire Specing (m.) | Tandam Tire Spacing (NJ | Tee Contact Woth Sec. | Tire Contact Jumpth SnJ | Tre Callor Area (n.*.) | ACR Thick (m) ICI | ACIL//K/C |
| 1100 | 0.01 | 0.04 | 1.22 | 216 | 94.00% | \$63 | 35.0 | 14.8 | .23.7 | 3763 | 372 | 545.9 |
| 10.66 | 8 | 0 | 1.23 | 175 | \$2.60% | 365 | 8.0 | 18.8 | 23.7 | 2762 | 22.0 | 326.1 |
| | 1 | 0 | 13 | 201 | 90.86% | 30.5 | 8.0 | 112 | 18.0 | 158.2 | 32.5 | 345.6 |
| aree | | 0.08 | 1.16 | 200 | 46,88% | 44.0 | 58,0 | 143 | 32.8 | 255.8 | 28.6 | 607.5 |
| - | 0.06 | 0.08 | 1.11 | 200 | 40.00% | 44.0 | 58.0 | 14.5 | 32.8 | 255.8 | 0.0 | 0 |
| | 0 | | 1.56 | 190 | 90.82% | 45.0 | 56.0 | 13.7 | 12.0 | 136.6 | 36.1 | 507,9 |
| | 0 DB- 0 U | 0 | | | and the second s | 344.0 | 200 | 14.0 | 324 | 345.2 | 18.1 | A DECK |
| | 0.06 U 0.07 | 0.01 | 1,28 | 205 | 91,00% | | | 110 | 112.1 | 1000 | | 10000 |
| | 0.06 0 0 0.01 0.05 | 0 0.01 0.09 | 1,38 1,37 | 205 196 | 95.12% | \$2.0 | \$5.0 | 12.7 | 20.5 | 1983 | 26.7 | 524.1 |

Figure B-6. FAARFIELD Traffic Table – Flexible Example 1 (ACR Values)

- B.6.1.3 Click "Run." FAARFIELD will perform the PCR computations automatically. When the calculation is complete, the computed PCR value will appear in the "Status" screen at upper right (Figure B-4). For this example, the computed PCR is 681/F/C/X/T. Note that FAARFIELD automatically identifies the correct subgrade category based on the entered subgrade properties. FAARFIELD selects X as the default tire pressure category, but the user may choose to report a different category based on information about the surface asphalt mixture.
- B.6.1.4 The Traffic table provides additional information about the PCR calculation (Figure B-5). Columns "CDF Contributions" and "CDF Max for Airplane" show the CDF contribution of each aircraft in the mix at the critical offset for the traffic mix, and for the individual aircraft, respectively. The total CDF for this example is 0.180. The total CDF for this example is less than 1.0, indicating that the flexible pavement has excess structural capacity for the using traffic. Note that the CDF values may differ from the values computed for the same traffic mix in Design mode. This is due to the different gear characteristics (percent of gross weight on the main gear and tire pressure) used for PCR calculations and design calculations.
- B.6.1.5 Scrolling to the right of the FAARFIELD traffic table shows the computed ACR values of the Using Aircraft at their operating weights (Figure B-6). ACR thicknesses and flexible ACR values are displayed for each aircraft for the subgrade category of the pavement being evaluated. In this example, all ACRs are less than the computed PCR. Therefore, all aircraft can operate on the pavement without restriction.

- B.6.1.6 From the explorer bar, select "PCR Graph." FAARFIELD displays a bar graph showing visually the ACR values of the six most demanding aircraft in the list. The horizontal black bar represents the calculated PCR value. This graph shows that all ACR values are less than the PCR, hence all aircraft can operate with no restrictions. The PCR value appears in the table in the column associated with the critical aircraft. In this example, the critical aircraft for PCR calculations is the B747-400, which is also the aircraft with the highest ACR at operating weight.
- B.6.1.7 From the explorer bar, select "PCR Report." FAARFIELD displays details of the PCR computation, in the form of three tables:
 - 1. Results Table 1 reports input traffic data for all using aircraft. Percent gross weight on the main gear and tire pressure values are those applicable to ACR calculations, and may differ from the values used for design.
 - 2. Results Table 2 gives information on the critical aircraft: critical aircraft equivalent annual departures (which should be equal to or greater than the actual annual departures for that aircraft in Results Table 1); the computed MAGW of the critical aircraft (which will be greater than the operating gross weight if ACR < PCR); the ACR thickness for the critical aircraft at the MAGW, and the PCR, which is defined as the ACR of the critical aircraft at the MAGW.
 - 3. Results Table 3 lists calculated ACR information for the Using Aircraft.

Clicking "Save as PDF" at the top of the screen saves a copy of the generated report (Figure B-8).



Figure B-7. FAARFIELD PCR Graph – Flexible Example 1

Figure B-8a. FAARFIELD PCR Report - Flexible Example 1

| Federal Aviation Administration FAARFIELD 2.0 PCR Report |
|--|
| FAARFIELD 2.0.0.f Beta 07/13/2020 |
| Working directory is C:\Users\David Brill\Documents\Wy FAARFIELD |
| Job Name: PCR Examples |
| Section: Flexible Example 1 |
| This file name = PCR Results for Flexible 2020-07-15 11:34:46.txt |
| Evaluation pavement type is flexible and design program is FAARFIELD. |
| Section name: Flexible Example 1 in job file: C:\Users\David Brill\Documents\My FAARFIELD\PCR Examples.JOB.xml |
| Units = US Customary |
| Analysis Type: New Flexible |
| Subgrade Modulus =12000psi (Subgrade Category is C(11k)) |
| Evaluation Pavement Thickness = 32.0 in. |
| Pass to Traffic Cycle (PtoTC) Ratio = 1.00 |
| Maximum number of wheels per gear = 6 |
| CDF = 0.180 |
| At least one aircraft has 4 or more wheels per gear. |

Results Table 1. Input Traffic Data

| No. | Aircraft Name | Gross Weight Ibs | Percent Gross Weight | Tire Pressure psi | Annual Departure | 20 Years Coverage |
|-----|----------------------|---------------------|----------------------|----------------------|------------------|-------------------|
| 1 | A300-B4/C4 Std Bogie | 365747 | 94.00 | 216.1 | 1500 | 24508 |
| 2 | A319-100 std | 141978 | 92.60 | 173.0 | 1200 | 19573 |
| 3 | 8737-300 | 140000 | 90.86 | 201.0 | 6000 | 92631 |
| 4 | 8747-400 | 877000 | 46.66 | 200.0 | 1000 | 17187 |
| 5 | 8747-400 Belly | 877000 | 46.66 | 200.0 | 1000 | 17156 |
| 6 | 8767-200 ER | 396000 | 90.82 | 190.0 | 2000 | 34480 |
| 7 | B777-200 ER | 657000 | 91.80 | 205.0 | 1000 | 15661 |
| 8 | DC8-63/73 | 330000 | 96.12 | 196.0 | 3000 | 47172 |

Figure B-8b. FAARFIELD PCR Report – Flexible Example 1 (continued)

|--|

Results Table 2. ACR Value

| No. | Aircraft Name | Critical aircraft Total equiv. departures | Max allowable Gross Weight of critical aircraft | ACR Thick at max. MGW (in.) | PCR//F/C |
|-----|------------------|--|--|--------------------------------|----------|
| 1 | B747-400 | 1790 | 947124 | 30.06 | 681.1 |

Results Table 3. Flexible ACR at Indicated Gross Weight and Strength

| No. | Aircraft Name | Gross Weight Ibs | Percent Gross Weight on Main Gear | Tire Pressure psi | ACR Thick (in.)(C) | ACR//F/C |
|-----|----------------------|---------------------|-----------------------------------|----------------------|--------------------|----------|
| 1 | A300-B4/C4 Std Bogie | 365747 | 94.00 | 216.1 | 27.2 | 545.9 |
| 2 | A319-100 std | 141978 | 92.60 | 173.0 | 22 | 326.1 |
| 3 | B737-300 | 140000 | 90.86 | 201.0 | 22.5 | 345.6 |
| 4 | B747-400 | 877000 | 93.32 | 200.0 | 28.6 | 607.5 |
| 6 | B767-200 ER | 396000 | 90.82 | 190.0 | 26.3 | 507.9 |
| 7 | B777-200 ER | 657000 | 91.80 | 205.0 | 28.1 | 585.6 |
| 8 | DC8-63/73 | 330000 | 96.12 | 196.0 | 26.7 | 524.1 |

B.6.2 <u>Flexible Pavement Example 2</u>

B.6.2.1 The second example has the same traffic and subgrade CBR as Example 1, but with a reduced cross section that results in a total CDF approximately equal to 1. The structure is as shown in Figure B-9, and the other input data are as shown in Figure B-3. As in Flexible Example 1, the airport has a parallel taxiway configuration (Figure A1-1a) such that the P/TC ratio = 1. After running PCR, the PCR Graph and PCR Report are shown in Figures B-10 and B-11, respectively. For this example, the computed PCR is 617/F/C/X/T and the total CDF = 0.990. Figure B-10 shows that all operating aircraft have ACR < PCR. Hence, no weight restrictions are required on the operating fleet, which is consistent with CDF <

1.0. In general, CDF > 1.0 indicates that at least one aircraft in the fleet will have ACR > PCR.



Figure B-9. Flexible Pavement Structure for Flexible Example 2



Figure B-10. PCR Graph for Flexible Example 2

Figure B-11. FAARFIELD PCR Report - Flexible Example 2

| Federal Aviation Administration FAARFIELD 2.0 PCR Report FAARFIELD 2.0.0.f Beta 07/13/2020 Working directory is C:\Users\David Brill\Documents\My FAARFIELD | | | | | | |
|---|--|--|--|--|--|--|
| Job Name: PCR Examples | | | | | | |
| Section: Flexible Example 2 | | | | | | |
| This file name = PCR Results for Flexible 2020-07-15 12:42:08.txt | | | | | | |
| Evaluation pavement type is flexible and design program is FAARFIELD. | | | | | | |
| Section name: Flexible Example 2 in job file: C:\Users\David Brill\Documents\Wy FAARFIELD\PCR Examples.JOB.xml | | | | | | |
| Units = US Customary | | | | | | |
| Analysis Type: New Flexible | | | | | | |
| Subgrade Modulus =12000psi (Subgrade Category is C(11k)) | | | | | | |
| Evaluation Pavement Thickness = 29.7 in. | | | | | | |
| Pass to Traffic Cycle (PtoTC) Ratio = 1.00 | | | | | | |
| Maximum number of wheels per gear = 6 | | | | | | |
| CDF = 0.990 | | | | | | |
| At least one aircraft has 4 or more wheels per gear. | | | | | | |

| Results Table | 1. Input | Traffic Data |
|----------------------|----------|--------------|
|----------------------|----------|--------------|

| No. | Aircraft Name | Gross Weight Ibs | Percent Gross Weight | Tire Pressure psi | Annual Departure | 20 Years Coverage |
|-----|----------------------|---------------------|----------------------|----------------------|------------------|-------------------|
| 4 | A300-B4/C4 Std Bogie | 365747 | 94.00 | 216.1 | 1500 | 24126 |
| 2 | A319-100 std | 141978 | 92.60 | 173.0 | 1200 | 19266 |
| 3 | B737-300 | 140000 | 90.86 | 201.0 | 6000 | 90850 |
| 4 | B747-400 | 877000 | 46.66 | 200.0 | 1000 | 16970 |
| 5 | 8747-400 Belly | 877000 | 46.66 | 200.0 | 1000 | 16938 |
| 6 | 8767-200 ER | 396000 | 90.82 | 190.0 | 2000 | 33248 |
| 7 | 6777-200 ER | 657000 | 91.80 | 205.0 | 1000 | 14912 |
| 8 | DC8-63/73 | 330000 | 96.12 | 196.0 | 3000 | 46328 |

Figure B-11. FAARFIELD PCR Report – Flexible Example 2 (continued)

| No. | Aircraft Name | Gross Weight Ibs | Percent Gross Weight | Tire Pressure psi | Annual Departure | 20 Years Coverage |
|-----|---------------|---------------------|----------------------|----------------------|------------------|-------------------|
|-----|---------------|---------------------|----------------------|----------------------|------------------|-------------------|

| Results Tuble L. Ach fulue | Results | Table | 2. | ACR | Value |
|----------------------------|---------|-------|----|-----|-------|
|----------------------------|---------|-------|----|-----|-------|

| No. | Aircraft Name | Critical aircraft Total equiv. departures | Max allowable Gross Weight of critical aircraft | ACR Thick at max. MGW (in.) | PCR//F/C |
|-----|------------------|--|--|--------------------------------|----------|
| 1 | B747-400 | 1875 | 886680 | 28.76 | 617.4 |

Results Table 3. Flexible ACR at Indicated Gross Weight and Strength

| No. | Aircraft Name | Gross Weight Ibs | Percent Gross Weight on Main Gear | Tire Pressure psi | ACR Thick (in.)(C) | ACR//F/C |
|-----|----------------------|---------------------|-----------------------------------|----------------------|--------------------|----------|
| 1 | A300-B4/C4 Std Bogie | 365747 | 94.00 | 216.1 | 27.2 | 545.9 |
| z | A319-100 std | 141978 | 92.60 | 173.0 | 22 | 326.1 |
| 3 | B737-300 | 140000 | 90.86 | 201.0 | 22.5 | 345.6 |
| 4 | B747-400 | 877000 | 93.32 | 200.0 | 28.6 | 607.5 |
| 6 | 8767-200 ER | 396000 | 90.82 | 190.0 | 26.3 | 507.9 |
| 7 | 8777-200 ER | 657000 | 91.80 | 205.0 | 28.1 | 585.6 |
| 8 | DC8-63/73 | 330000 | 96.12 | 196.0 | 26.7 | 524.1 |

B.6.2.2 Assuming that the airport has a central taxiway configuration rather than parallel effectively doubles the number of coverages on the runway and reduces the PCR. In Figure B-12, the only change is that the P/TC ratio has been increased from 1 to 2, reflecting the central taxiway configuration in Fig. A1-1b. With this change, the computed PCR is now 589/F/C/X/T, and the total CDF is 1.52. Because the total CDF > 1.0, we expect that at least one of the listed aircraft has ACR > PCR. Figure B-13 shows that this is in fact the case, that the ACR of the B747-400 exceeds the PCR by approximately 3%. Following ICAO guidance that allows occasional overload operations by aircraft with ACR up to 10% above the reported PCR, operations of the B747-400 would still be allowed on this pavement, but the number of such operations at full weight would be limited to 5% of total operations on the taxiway. In addition, the taxiway pavement should be monitored for damage after each overload operation.

Figure B-12. FAARFIELD PCR Output – Flexible Example 2 (with P/TC = 2)

| | the Constant G | Sem for Other | e All 🗙 Cose I | uti - Stored Airun | aft Min 👲 Great | * 1 EEK | | | | | | 0 |)Help 🖍 |
|--|--|---|--|--|--|---|--|---|---|---|---|--|---|
| Section Section Report | t COF Graph PCR | Report PCR | Graph Form ! | 5010 | | | | | | | | | |
| Job Name: PCR E | amples | PCR | | * | Run | Status Gen | Structure | | | | | | |
| Section Name: Fields | e Example 2 | 2 In | clude in summ | ary report | Run Satuh | PCR Calcula Bun Time: 1 PCR = 589/ | etion Compl 13 seconds /F/C/X/T | leted. | | | | | |
| Pavement Type: | New Resible | | | | | | | | | | | | |
| Maturial | | Thickness 5 | n) Eam | 0 CBR | | | | | | | | | |
| P-401/P-403 HM | A Surface | 4.0 | 2500 | 00 | i. | - | | _ | | | | | |
| P-304 Cement 3 | eated Base | 5.0 | 5000 | 00 | | | | | | | | | |
| P-205 Crushed A | ggregate. | 6.0 | 2500 | 0 | | | | | | | | | |
| > P-154 Uncrushe | Aggregate | 14.7 | 4000 | 9 - | | | | | | | | | |
| Subgrade | | | 1200 | 0 8 | | | | | | | | | |
| Design Life: 20 Results | Total Print | inges to the tr | P/Ti | C Ratio: 2 | | | | | | | | | |
| Design Life: 20 Results Calculated Life: | Sotal thic | kness to the to | P/Ti | C Ratio: 2 | | | | | | | | | |
| Design Life: 20 Results Calculated Life: Inaffic Stored Aircraft Max 3 | Sotal thick | kness to the to mple - | P/Ti op of the subgo | C Ratio: 2 auter 29.7 m. | Cierri | 40 Aircraft Irom | Griff | Remove Selecter | d Aircraft From | Section Del | ete Aircraft Mis Fil | | 2 |
| Design LHe: 20 Results Calculated LHe Institic Stored Aircraft Misc 2 Austane Name | Sotal thic Appendix C PCR Exam Gross Tak Weight Obs) | mple - | PyTr p of the subgr Save Arr Armual Growth (%) | C Ratio: 2 ade: 29.7 m. raft Mix to File Total Departures | Clear A | 40 Aircraft from CDF Max for Airplace | Gitt P/C Ratio | Remove Selecter Tre Pressure Qm0 | d Aircraft From Percent GW ps Gear | Section Dela Dual Trie Spoong (in) | ete Aircraft Mix Fili Tandem Tire Specing (m) | e Tire Contact, Width (Iin.) | Tire Co Length |
| Design Life: 20 Results Calculated Life: Institic Stored Aircraft Mis: 2 Augtane Name A100-84/C4 Std Bogle | Total thick oppendix C PCR Equil Gross Taul Weight (Day) 365747 | kness to the to mple - Annual Departures 1500 | P/T p of the subgr Save Arr Growth (%) 0 | C Ratio: 2 aute: 29.7 m. craft Mix to File Departures 10000 | Ctear / CDF Combutions 0.05 | 40 Aircraft from CDF Max for Airplace 0.43 | Unit P/C Ratio 1.24 | Remove Selecter Tre Pressure 0x0 216 | d Aircraft From Percent GW Ion Gear 94.00% | Deat Trie Spoong (in) 36.3 | ete Aircraft Mix Fili Tandem Tiro Specing (m.) 55.0 | e Tire Contact Widts (in.) 14.1 | Tire Co Length 224 |
| Denige Life: 20 Results Calculated Life: Stored Ancraft Max: 2 Anglane Name A100-B4/C4 Stot Boge A219-100 cd | Sotal thick appendix C PCR Equi Gross Tael Weight Obo 360/1471 | kness to the to mple - Annual Departures 1500 1200 | P/T p of the subgr Seve Am Annual Growth (%) 0 | C Ratio: 2 ade: 29.7 m. oraft Mis to File Total Departmen 30000 24000 | Clear A CDF Correlations 0.04 0 | W Aircraft from CDF Max for Angulate D | Unt P/C Ratio 1.24 1.25 | Remove Selecte Tre Presure Qm0 216 173 | d Aircraft From Percent GAV on Gear 94.00% 92.60% | lection Del Dual Tire Spoong (in) 563 263 | ete Aircraft Mis Fili Tandom Tire Specing (m) 558 0.0 | e Tire Contact Wides (in.) 14.1 14.1 | Tire Co Length 22.6 |
| Design Life: 20 Resids Calculated Life: Stored Annost! Max: 2 Arcplane Name Anton-PACE Stot Bogle A319-100 col 8757-300 | Sotal thick appendix C PCR Equi Gross Taxi Weight Obio 365747 141978 140005 | mple - Annual Departures 1500 6000 | P/Ti p of the subgr Seve Arr Annual Growth (%) 0 0 0 | C Ratio: 2 ante: 29.7 m. Total Departures 10000 120000 | Clear / CDF Correlations 0.09 0 | 40 Aircraft Imm. CDF Max for Airplase 0 0 0 | Greet P/C Ratios 1.24 1.25 1.32 | Remove Selecter Tre Pressure (pm) 216 173 201 | d Aircraft From Percent GW ps. Gear 94.00% 92.60% 90.86% | lection Del Dual Tile Spoong Un) 363 365 303 | ete Aircraft Mix Fili Tandem Tire Specing (m) 55.0 0.0 0.0 | e Tire Contact Wides (in.) 14.1 14.1 14.1 11.2 | Tire Co Length 22.6 16.0 |
| Design Life: 20 Results: Calculated Life: Stored Arcoaft Mar: 2 Aeptane Name A100-54545 50 Bogle A119-100 rol 8787-400 | Setal thick appendix C PCR base Giross Taxii Weight Obo 365747 141978 141978 14200 107000 | Annual Departures 1500 6000 1000 | P/Ti p of the subgro Seve Arr Annual Growth (%) 0 0 0 0 | C Ratio: 2 adde 29.7 m. Total Departures 30000 120000 20000 | Clear / CDF Combutions 0,04 0,042 | 40 Aircraft from CDF Max for Angilate 0.43 0 0. 0.042 | 0nt P/C Rator 1.24 1.25 1.32 1.18 | Remove Selecter Tre Pressure Qie0 216 173 201 201 201 | d Aircraft From Percent GW on Gear 94.00% 92.60% 93.08% 46.65% | Section Del Dual Trie Spoong (in) 563 365 305 440 | ete Aircraft Mis Fil Tandem Tire Specing (m) 95/0 0.0 8.0 58.0 | r Tire Contact. Width (in.) 14.1 14.1 11.2 14.3 | Tire Co Length 22.6 16.0 22.8 |
| Design Life: 20 Results: Calculated Life: Stored Ancatt Mar: 2 Arctane Name A100-B4/C4 Stol Bogte A190-B4/C4 Stol Bogte S157-300 S157-400 Belly | Total thick Appendix C.PCR, Ease Gross Tabl Weight Obo) 360747 141978 141978 142000 877000 877000 | Annual Departures 1500 1200 6000 1000 | P/Ti p of the subgr Seve Arr Commit (%) 0 0 0 0 0 | C Ratio: 2 adde 29.7 m. 20.7 | Clear A CDF Combusies 0.05 0 0 0.042 0 0 | All Aircraft from CDF Max for Angilene 0.43 0 0 0 0.42 0.42 0.42 0.42 | Unt P/C Ratur 1.24 1.32 1.18 1.18 | Remove Selecter Trac Pressure (amo) 216 173 201 200 200 200 | F Aircraft From Percent GW on Gear 94.00% 92.60% 93.66% | lection Dele Dual Tite Spoong (in) 56.5 36.5 30.5 44.0 44.0 | ete Airozaft Mis Fili Tardem Tire Specing (m.) 55/8 0.0 53.0 58.0 58.0 59.0 | r Tire Contlact Width (in.) 14.1 14.3 14.3 14.3 | Tire Co Length 22.6 22.6 16.0 22.8 22.8 22.8 |
| Design Life: 20 Results Calculated Life: Stored Annost Max: 4 Anghane Name A100-54/CL4 Stol Biogle A119-100 rol 8747-400 8747-400 Bioly 8767-300 Els | Socal third Appendix C PCR East Gross Tail Weight Obo 3565747 141978 14000 877000 376000 376000 | Annual Departures 1500 1500 1500 1500 1500 | P/Tr p of the subgroup of the | C Ratio: 2 ade: 29.7 m. Total Departures 30000 20000 20000 20000 20000 20000 | Clear J CDF Combusies 0.04 0 0 0.042 0 0.001 | U Ancret hom CDF Max for Analysis 0.45 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. | Unt P/C Ratio 1.24 1.25 1.18 1.18 1.18 1.21 | Remove Selecter 0m0 216 173 201 200 200 190 190 | d Aircraft From Percent GW 95.00% 92.60% 93.00% 93.00% 94.00% 94.00% 95.00% | Destinant Dest Dual Tire Spoong (m) 98.5 30.5 30.5 44.0 45.0 77.0 | ete Arccaft Mix Fib Specing (m) S5/8 0.0 0.0 0.0 58/0 58/0 58/0 58/0 58/0 | r Tire Contact Wides (in) 14.1 14.3 14.3 14.3 14.3 14.3 13.7 | Tire Co Length 22.6 22.8 22.8 22.8 22.8 22.8 |
| Design Life: 20 Results: Calculated Life: Stored Ancraft Min: 2 Anphane Name A100-B4/C4 Stof Bogle A119-100 rol 8/37-300 6/37-400 6/37-400 8/37-30 | Tetal thick appendix C PCR base Gross Tael Weight Obo 365/71 141978 140905 177006 877006 877006 877006 376000 537000 | Resis to the to mple + Annual Departures 1500 1500 1500 1500 2000 2000 2000 2000 | P/Tr p of the subgro Save Arr Annual Growth (%) 0 0 0 0 0 0 0 0 | C Ratio: 2 ade: 29.7 m. Total Department 10000 24600 120000 40000 40000 20000 | Clear A CD# Combustiens 0.04 0 0.042 0 0.042 0 0.001 0.05 0.001 | U Anzah hun. CDF Max for 0.45 0 0.42 0.42 0.62 0.62 0.62 0.62 | Unt P/C Rates 1.24 1.25 1.32 1.16 1.2 1.34 1.3 | Remove Selecte Tre Pressure (pro). 216 173 200 200 200 200 200 200 200 200 200 20 | 4 Arcoaft From Percent GW 94.00% 92.60% 46.66% 46.66% 91.80% 91.80% | lection Deal Tile Specing (in) 16,5 26,5 30,5 44,0 44,0 55,0 55,0 55,0 | ete Aircraft Mis Fib Tandem Tire Secting (m.) 550 0.0 580 580 580 560 560 560 560 560 560 560 560 560 56 | e Tire Contact Wides in) 14.1 14.1 14.3 14.3 14.3 13.7 14.0 13.7 14.0 13.7 | Tire Co Length 22.6 22.8 22.8 22.8 22.8 22.8 22.8 22.4 22.0 22.4 22.4 22.4 |

Figure B-13. FAARFIELD PCR Graph – Flexible Example 2 (with P/TC = 2)



B.7 Technical Evaluation for Rigid Pavements

The following list summarizes the steps for using the technical evaluation method for rigid pavements:

- 1. Determine the type of aircraft and number of annual departures of each aircraft type that the pavement will experience over its life.
- Determine the subgrade elastic modulus. The modulus may be determined from test data or converted from the CBR value using E = 1,500 × CBR (for E in psi).
- 3. Determine the concrete thickness and flexural strength. The flexural strength is an estimate of the concrete strength that would be obtained from a four-point beam break test following ASTM C 78. If current beam break test data are unavailable, the engineer should estimate the insitu flexural strength from design records, correlations of flexural strength to split cylinder tensile strength, or correlations of flexural strength to in-situ concrete modulus E (e.g., from HWD tests).
- 4. Determine the other pavement layer characteristics. In FAARFIELD, each layer above the subgrade and below the concrete is characterized by its thickness and elastic modulus E. For materials meeting an FAA specification, FAARFIELD will assign the E-value automatically, or allow the user to select it from an allowable range.
- 5. Determine the P/TC ratio for the pavement using the criteria in Appendix A.
- 6. Enter all information in FAARFIELD and run the PCR evaluation.

B.8 Technical Evaluation Examples for Rigid Pavements

The following three examples demonstrate the technical evaluation method of determining a PCR for flexible pavements.

- Example 1 is under designed relative to the using traffic volume (Total CDF > 1). The computed PCR requires operating weight restrictions on the using traffic.
- 2. Example 2 has a thickness approximately equal to the structural requirement for the 20-year traffic (Total CDF \approx 1).
- 3. Example 3 demonstrates how to report PCR when an existing pavement has a thin asphalt overlay, but is structurally a rigid pavement.

B.8.1 <u>Rigid Pavement Example 1.</u>

B.8.1.1 An airport has a rigid (concrete-surfaced) runway pavement. The in-situ flexural strength is 650 psi. The structure is: 16 inches concrete surface layer (Item P-501), 8 inches asphalt stabilized base (Item P-403), and 6 inches standard base layer (Item P-209) placed directly on a prepared subgrade. From HWD tests on the runway, the subgrade modulus is estimated at E = 7,800 psi. The traffic mix

is the same as in the Using Aircraft example (Table B-1). It is assumed for the purposes of this example that the traffic level is constant over the 20-year time period. Additional fuel is generally obtained at the airport before departure, and the runway has a parallel taxiway (P/TC ratio = 1). The pavement was designed for a life of 20 years.

- B.8.1.2 Enter the data in FAARFIELD. After opening FAARFIELD, select "PCR" from the drop-down function list at the top of the screen. Select the New Rigid pavement type from the drop-down Pavement Type list. Enter or modify the structure layers directly in the Pavement Layers table, or by clicking on the image of the pavement cross section. Using the aircraft library, enter the aircraft list from Table B-1, and modify the gross weights and annual departures as necessary. The default value of P/TC is 1 and does not need to be changed. Figure B-17 shows the FAARFIELD user screen with all data entered for this example.
- B.8.1.3 Click "Run." FAARFIELD will perform the PCR computations automatically. When the calculation is complete, the computed PCR value will appear in the "Status" screen at upper right (Figure B-18). For this example, the computed PCR is 917/R/D/W/T. Note that FAARFIELD automatically identifies the correct subgrade category based on the entered subgrade properties. FAARFIELD selects 'W' as the default tire pressure category for rigid pavements, because it is assumed that concrete surfaces will tolerate high tire pressures.
- B.8.1.4 The Traffic table provides additional information about the PCR calculation (Figure B-19). Columns "CDF Contributions" and "CDF Max for Airplane" show the CDF contribution of each aircraft in the mix at the critical offset for the traffic mix, and for the individual aircraft, respectively. The total CDF for this example is 4.84. Total CDF for this example is greater than 1.0, indicating that the rigid pavement has insufficient structural capacity for the using traffic. Note that the CDF values may differ from the values computed for the same traffic mix in Design mode. This is due to the different gear characteristics (percent of gross weight on the main gear and tire pressure) used for PCR calculations and design calculations.
- B.8.1.5 Scrolling to the right of the FAARFIELD traffic table shows the computed ACR values of the Using Aircraft at their operating weights (Figure B-20). ACR thicknesses and rigid ACR values are displayed for each aircraft for the subgrade category of the pavement being evaluated. In this example, the computed ACR for the B777-200 ER (ACR 1040/R/D) exceeds the computed PCR. If the airport publishes the computed PCR, then operating weight restrictions on the B777-200 ER will be necessary. Possible alternatives to restricting the operating weight are (a) providing an overlay to increase the structural capacity of the runway; or (b) allowing occasional overload operations of the B777-200 ER on the runway, subject to the limitation that the number of such overload operations does not exceed 5 percent of total operations. The latter option is

possible because the ACR of the B777-200ER at it maximum operating weight does not exceed the PCR by more than 10 percent.

- B.8.1.6 From the explorer bar, select "PCR Graph." FAARFIELD displays a bar graph showing visually the ACR values of the six most demanding aircraft in the list (Fig. B-21). The horizontal black bar represents the calculated PCR value. This graph shows that ACR values are less than the PCR, except for the aforementioned B777-200 ER. The PCR value appears in the table in the column associated with the critical aircraft. In this example, the critical aircraft for PCR calculations is also the B747-400.
- B.8.1.7 From the explorer bar, select "PCR Report." FAARFIELD displays details of the PCR computation, in the form of three tables:
 - 1. Results Table 1 reports input traffic data for all Using Aircraft. Percent gross weight on the main gear and tire pressure values are those applicable to ACR calculations, and may differ from the values used for design.
 - 2. Results Table 2 gives information on the critical aircraft: critical aircraft equivalent annual departures (which should be equal to or greater than the actual annual departures for that aircraft in Results Table 1); the computed MAGW of the critical aircraft (which will be greater than the operating gross weight if ACR < PCR); the ACR thickness for the critical aircraft at the MAGW, and the PCR, which is defined as the ACR of the critical aircraft at the MAGW.
 - 3. Results Table 3 lists calculated ACR information for the Using Aircraft. If the CDF is greater than 1.0, at least one of the listed aircraft will have ACR > PCR.
- B.8.1.8 Clicking "Save as PDF" at the top of the screen saves a copy of the generated report (Figure B-22).

Figure B-17. Screen Shot of FAARFIELD in PCR Mode with Data for Rigid Example 1

| Octament Grant and | mon 🔒 Save Jub 🔒 | Sam An Prine | 44 X Cose In | a Dored Alia | which the County | 🛣 tai | | | | | 10000=00 |
|---|--|--|--|--|--|---|--|---|--|--|--|
| Section | | | | | | | | | | | |
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| Section Name: Bush | Foimule 1 | V Ind | ude in summa | ry moon | Rue Batch | | | 1 | | | 8 |
| | Protection 1 | 1.000 0000 | 10.000 | | C 1 0 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 | | | | | | |
| Perernent Layers | | | | | | | | | | | |
| Pavement Type: | New Rigid | | | | | EAG BCC | Lotace | - | 1=16.0 in thes | DULE-650 m | |
| Matterial | | Thickness (m |) Egin) | k ipci | R (pail) | | | A | | 1 de nev | 1 |
| | ace | 16.0 | 400000 | 0 | 650 | | | - | 12 | | |
| P-401/P-403 H | MA Stabilized | 8.5 | 402000 | | 104 | 100 | 1.12 | 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1 | 1 5 1 | 2.00 | |
| P-209 Crushed | Aggregate | 6.0 | 25/000 | | _ | 17121 ¹¹ | | | | | 1.0 |
| Subgrade | | | 7900 | 103.6 | | | æ : 👘 | | | n (n) | 45 |
| Design Life: 20 Results Calculated Life: | S Totai thic | intest for the top | ligh Layw θ/TC of the subgra | Dalatha Sel Ration 1 de 30.0 m | ested Läyer | P308 Crass | T EI | | Triad inches Paralel Kentolik pol | | |
| Design Life: 20 Results Calculated Life | S Total thick | where As The De | aign Layw P/TC of the subgra | Delete Sel Ratio: 1 de 30.0 m | | Patri Cran | | | THE DEFENSION | E-33000 | |
| Design Life: 20 Results Calculated Life | 5 Total theo | where the top | eign Layw P/TC of the subgra | Deletre Sel | under state of the | Public Cran | | Copy Structure | To Cipboard | | |
| Design Life: 20 Results Calculated Life Inaffic: Stored Aincraft Max | Totar thick | whees to the top | P/TC of the subgra | Delene Sal Ration 1 de 30.0 in. | ected Layer | Public Cran | | Copy Structure | To Cipboard | ector Prein | e Aeroat M |
| Design Life: 20 Results Calcolated Life Traffic: Shored Aincraft Mic: Airguane Name | Total the Appendix C PCR Eaa Gross Tax Weight (Iba) | Intent As The De Intensis to the top | B/TC B/TC of the subgra Soon Alext Admust Growth (N) | Delene Sal Retin: 1 de: 30.0 m aft Mix to File Total Departures | ected Layer | Averaft from I | Lor J/C Rate: | Copy Structure Innove Triesched / Taro Pressure (pa) | This Contract Contrac | ection Delet | e Aeroath M Sparing |
| Design Life: 20 Results Calcolated Life Traffic: Shored Aincraft Mic: Airglane Nama A300-54/C4 Std Bogs | Appendix C PCR Eaa Gross Tan Weight (Ba) | Interest As The De Interest to the top Mpte + Atmual Departures 1500 | B/TC B/TC of the subgra Save Alext Admual Growth (%) 0 | Delene Sal Ration 1 de 30.0 m. aft Mix to File Departures 20000 | ected Layer | Averaft from CCPF Max for Avglane | Lot 0 | Copy Structure Innove Telected / Two Pressure (pail) 216 | The Distance of Control of Contro | ector Delet Source (n) 365 | e Aerraft M Sparing 55.0 |
| Design Life: 20 Results Calculated Life Traffic: Stored Amorath Mac. Applane Mama A300-84/C4 Sto Bogs A315-100 and | Appendix C PCR Eas Groat Tan Weight (bin) 1 141078 | mple + Annual Disponse | Byte Byte Save Alec Save Alec Growth (N) 0 | Delene Sal Ration 1 de 30.0 in. att Mix to File Total Departures 20000 24000 | ected Layer | Alexaff Born CDF Marshare D | Let 0 0 | Copy Structure Two Pressure (pei) 216 172 | Tel.2 Inches Sci. 10.1.6 per 10 CSpboard Vecraft From Se Petrant GW S420% S226% | ecton Delet Dual Tre Searce (n1) 365 363 | e Airoath M Spaining Spaining Spaining S5.0 E0 |
| Design Life: 20 Results Calculated Life: 20 Traffic: 20 Stored Ancraft Mic: 20 Active Name Actor Barca Stations Actor 100 and 8757-300 | Appendie C PCR Eau Group Tan Weight Uba) • 355747 14107/8 140000 | Intert As The De Intersis to the top Intersis to the top Annual Departments 1500 6000 | B/TC B/TC of the subgro Save Alect Growth (NJ) 0 0 0 | Delene Sal Ratim 1 de 30.0 in de 30.0 in de 30.0 in de 20.0 in Departures 20000 120000 | Clear A Cost during Cost during 0 0 | Alexaft from 1 CDF Max for Argiane U | Lee 0 0 0 0 0 0 | Copy Structure Innove Telected / Two Pressure (psi) 216 172 201 | to Clyboard Herory From Se Parcent GW m Gaar 92,40% 92,40% | ection Delet Dual Tre Searing 0n1 36:5 30:3 | e Aircraft M Sparen Sparen Sparen S550 600 9.0 |
| Design Life: 20 Results Calculated Life: 20 Traffic: 20 Stored Ancraft Mic: Acquare filame A305-5100 and 6373-500 8737-500 | Appendix C PCR Eas Gross Tarl Weight Usa) 555747 141078 14000 877000 | Rippe + Annual Departures 1300 6000 1000 | ByTC ByTC of the subgra Steen Alexa Admusi Growth (Ni) 0 0 0 0 | Antim 1 Antim 1 de 30.0 in. att Mix to File Total Departures 20000 20000 20000 | CDF Controluctions 0 0 0 0 | Averaft from CDF Max for Argane | Let 0 0 0 | Copy Structure Immore Selected / Two Pressure (sel) 216 172 201 200 | Tel. 2 Inches Re-103.6 pci to Chybonard Percard From Se Percard GW Im Guar S4.00% 92.40% 46.00% | ector Delet Dual Trie Seeing (m) 365 365 365 44.0 | e Arcost M Spring Spring Spring Spring Spring Spring Spring Spring Spring Spring Spring Spring Spring Spring Spring Spring |
| Denign Life: 20 Results Calculated Life: Stored Ancraft Mis: Acquare Name A305-84/C4 Sto Bogs A355-84/C4 Sto Bogs A355-800 atd B737-300 B747-400 Belly | Appendix C PCN Esa Gross Tan Weight (Es) 141078 141078 141078 147000 877000 877000 | Interest As The De Interest to the top Annual Department 1550 1300 6300 1000 1000 | Bync Lawy Bync of the subgra Saen Alece Annual Growth (Nij 0 0 0 0 0 | Delene Sal Ratim 1 de 30.0 H. de 30.0 H. att Mix to File Total Departures 20000 20000 20000 | Chear Al Control Layer Control | Averaft from CCF Max for Acplane | Appropriate Processing 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | Copy Structure (pel) 216 172 201 200 200 | Tel. 2 Inches Rev 103.6 pci to CSpboard To CSpboard Percent From Se Percent GW on Gear S4.00% 90.85% 46.05% | ection Defin Spacing (m) 36.5 36.3 30.5 36.4 30.5 36.4 44.0 | e Aecraft M Sandam Spanng 55.0 60 90 58.0 |
| Denign Life: 20 Results Calcolated Life Stored Ancraft Max Acquare flame Actor 64/C4 Std Bogs ASTS-100 atd 8737-300 8747-400 8747-400 8747-400 8747-400 8757-200 ER | Appendix C PCR Ease Groat Tan Weight (bit) # 385747 141978 140000 #77000 #77000 #77000 #77000 | Interest Aa The De Interest to the top Interest to the top Annual Department 1500 1300 6000 1000 2000 | ByTC ByTC of the subgra Steen Alexa Acrosal Growth (NJ) 0 0 0 0 0 0 0 0 | Delene Sal Ratim 1 de 30.0 H. de 30.0 H. aff Mix to File Total Department 30000 24000 30000 20000 20000 20000 20000 | ctiel Layer Clear A CDF Contributions 0 0 0 0 0 | Averally born CDF Max for Averally born CDF Max for Averally 0 0 0 0 0 0 0 0 0 | P/C flatic 0 0 0 0 0 0 | Copy Structure Copy Structure (pai) 216 172 281 200 200 190 | Tel. 2 Inches Rev 101.6 pcs 10 CSpboard 10 | ection Defet Dual Trip Spacing (m) 36.5 36.5 36.5 36.5 36.5 36.5 36.5 36.5 | e Alecath M Spaining 55.0 6.0 9.0,0 58.0 56.0 |
| Design Life: 20 Results Calculated Life Stored Amoralt Max Action Marcalt Max Action Marcalt Max Action 100 and 8737-300 8747-400 Belly 6747-400 Belly 6757-200 EB 8777-200 EB | Appendix C PCR Eaa Groat Tan Weight (bin) 141078 140780 877000 877000 838000 657000 | mple + Annual Dispon 1300 6000 1000 1000 1000 1000 | Byrrc Byrrc Save Aler Save Aler Growth (Ni) C C C C C C C C C C C C C C C C C C C | Delene Sal Ratim 1 de 30.0 in. de 30.0 in. de 30.0 in. de 30.0 in. de 20.0 in. de 20.0 in. 20000 20000 20000 20000 20000 20000 20000 20000 | cted Layer Clear A CDF Contributions 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | Averaff Born CDF Max for Areplane 0 0 0 0 0 0 0 0 0 0 0 | Approximation of the second seco | Copy Structure (pai) 216 216 216 216 216 216 210 210 210 210 210 210 210 210 210 210 | The D locker Here D | ector Delet Dual Tro Searing (m) 36.5 36.5 36.5 36.5 36.5 36.5 36.5 36.5 | e Akrosth Mi Sparing 55.0 640 56.0 56.0 57.0 |

| in | the Class and Other Sector B Section F | Law in Charles | X-Class tob D | Sceni Amonth. | Me & Cente | 1.m | (Direct States X to |
|----|--|-------------------------|--------------------------|---------------|----------------|---|---------------------|
| | Section Section Report | | | | | | × |
| | Job Name PCR Examples | PCIL | | | Rom | Status Gear Structure | |
| | Section Name: Rigid Example 1 Pavement Lavers | 🕑 include | in summary tep | wrt [] Au | in Batch | PCR Calculation Completed Run Timel 435 seconds PCR = 917/R/D/W/T | |
| | Pavement Type: New Rigid | | | | | | |
| | Moterial | Thickness (in.) 16.0 | £ (pe) 4000000 | R (pc) | # (pel) 650 | | |
| | P-401/P-401 HMA Stabilized P-209 Crushed Appreciate | 8.0 | 480808- 25080 | | 1 | | |
| | Subgrade | | 7800 | 103.6 | | | |
| | Design Life: 20 | Select As The Design | n Layer Dr P/TC Ratio | dete Select | ed Layer | | |

Figure B-18. FAARFIELD PCR Output – Rigid Example 1



| 1 | action Section Report | PCR Report | 0000 | | | | | | | | | |
|---|---|--------------------------------------|------------------------------|----------------------|----------------------------------|------------------------|------------------------------|------------------------------|-----------------------|----------------------------|--------------------------|--|
| | lob Names PCR Econ | rgibes : | PCR | | | mun - | Status Gear | Structure | | | | |
| | Section Name: Rigid Eur | ngie 1 | 🕑 Ind | ude in summa | ry report | Run Botch | PCR Calcula Run Times A | ition Complete U9 seconds | id | | | |
| | Pavement Layers | | | | | | POR = 917/ | R/D/W/T | | | | |
| | Pavement Type: N | ew Rigid | | | | | | | | | | |
| Moterial | | Thickness (M | Thickness (InJ E Ipsi) | | pci) = (psi | | | | | | | |
| | P-401/P-403 HMA | Stabilized | 0.8 | -400000 | | 11 | 1 | | | | | |
| | P-201 Crushed Aggregate | | 6.0 | 25000 | | | 1 | | | | | |
| | Subgrade | | | 7800 | 10 | 3.6 | | | | | | |
| | Stored Aircraft Miz: 100 | ientia C PCR Exar | aple - | Save Ains | aft Mis to | file Ora | All Arcraft from 1 | Lat B | move Selected A | rcraft From Sec | tion Delete | Arrenañ Mo |
| | Airplane Name | Gross Taos Weight Shu) | Annual Departures | Annual Glowth (%) | Total Departs | CDF Contributi | CDF Max for Arglane | F/C Ratio | Ten Pressure (psi) | Persant GW on Gear | Dual Tim Spacing (in) | Tanslern Spacing |
| - 12 | A300-64/C4 Ski Bogie | 365747 | 1500 | 0 | 30000 | 0.1 | 0.11 | 3.65 | 216 | 94.00% | 36.5 | 55.0 |
| 12 | A319-100 std | 141978 | 1200 | 0 | 24000 | 0 | 0 | \$.73 | 173 | 92.62% | 36.5 | 0.0 |
| | | 140000 | 6000 | 0 | 120000 | 0 | 0 | 3.60 | 201 | 90.06% | 30.5 | 0.0 |
| | 8737-300 | Trees of the | | | | | | 100 | 200 | 46.65% | 440 | and the second sec |
| | 8737-300 8747-430 | 877000 | 1900 | 0 | 20000 | 0.66 | 0,66 | 22 | | | | 580 |
| | 8717-300 8747-430 8747-439 Bely | 877000 | 1990 1000 | 0 | 20000 29000 | 0.66 | 0,66 | 3.51 | 200 | 46.66% | 44.0 | 58.0 58.0 |
| A CONTRACTOR OF | 8737-360 8747-400 8747-400 Belly 8767-200 EH | 877000 877000 396000 | 1900 1000 2900 | 0 | 20000 20000 40000 | 0.66 0 0.07 | 0.66 0.66 0.08 | 3.51 3.60 | 200 190 | 46.66% 90.52% | 44.0 45.0 | 58.0 58.0 56.0 |
| | 8737-300 8747-400 8747-406 BeBy 8767-200 EH 8777-200 EH | 877000 877000 396000 657000 | 1900 1000 2900 1000 | 0 0 0 0 | 20000 20000 40000 20000 | 0.66 0 0.07 4 | 0.66 0.66 0.08 4.01 | 3.51 3.68 4.12 | 200 190 205 | 46.66% 90.82% 91.00% | 44.0 45.0 35.0 | 58.0 58.0 56.0 57.0 |



Figure B-20. FAARFIELD Traffic Table - Rigid Example 1 (ACR Values)





Figure B-22a. FAARFIELD PCR Report - Rigid Example 1

| F | ederal Aviation Administration FAARFIELD 2.0 PCR Report |
|-----------------------|--|
| | FAARFIELD 2.0.0.f Beta 07/13/2020 |
| | Working directory is C:\Users\David Brill\Documents\My FAARFIELD |
| Job Name: PCR | Examples |
| Section: Rigid Exan | iple 1 |
| This file name = PCR | Results Rigid 2020-07-16 17:52:37.txt |
| Evaluation pavemen | t type is rigid and design program is FAARFIELD. |
| Section name: Rigid | Example 1 in job file: C:\Users\David Brill\Documents\Wy FARFIELD\PCR Examples.JOB.xml |
| Units = US Customar | |
| Analysis Type: New | Rgid |
| Subgrade Modulus = | 7800psi (Subgrade Category is D(7k)) |
| Evaluation Pavemen | t Thickness = 30.0 in. |
| Pass to Traffic Cycle | (PtoTC) Ratio = 1.00 |
| Maximum number of | wheels per gear = 6 |
| CDF = 4.840 | |

| No. | Aircraft Name | Gross Weight Ibs | Percent Gross Weight | Tire Pressure psi | Annual Departure | 20 Years Coverage |
|-----|----------------------|---------------------|----------------------|----------------------|------------------|-------------------|
| 1 | A300-B4/C4 Std Bogie | 365747 | 94.00 | 216.1 | 1500 | 8225 |
| 2 | A319-100 std | 141978 | 92.60 | 173.0 | 1200 | 6435 |
| 3 | B737-300 | 140000 | 90.86 | 201.0 | 6000 | 30892 |
| 4 | 8747-400 | 877000 | 46.66 | 200.0 | 1000 | 5717 |
| 5 | 8747-400 Belty | 877000 | 46.66 | 200.0 | 1000 | 5705 |
| 6 | 8767-200 ER | 396000 | 90.82 | 190.0 | 2000 | 10883 |
| 7 | 8777-200 ER | 657000 | 91.80 | 205.0 | 1000 | 4853 |
| 8 | DC8-63/73 | 330000 | 96.12 | 196.0 | 3000 | 17124 |

Results Table 1. Input Traffic Data

Figure B-22b. FAARFIELD PCR Report - Rigid Example 1 (continued)

| No. | Aircraft Name | Critical aircraft Total equiv. departures | Max allowable Gross Weight of critical aircraft | ACR Thick at max. MGW (in.) | PCR//R/D |
|-----|------------------|--|--|--------------------------------|----------|
| 1 | B777-200 ER | 1202 | 606255 | 18.77 | 917.5 |

Results Table 2. ACR Value

Results Table 3. Flexible ACR at Indicated Gross Weight and Strength

| No. | Aircraft Name | Gross Weight Ibs | Percent Gross Weight on Main Gear | Tire Pressure psi | ACR Thick (in.)(D) | ACR//R/D |
|-----|----------------------|---------------------|-----------------------------------|----------------------|--------------------|----------|
| 1 | A300-B4/C4 Std Bogie | 365747 | 94.00 | 216.1 | 16.8 | 738.6 |
| 2 | A319-100 std 141978 | | 92.60 | 173.0 | 12.5 | 412.4 |
| 3 | 8737-300 140000 | | 90.86 | 201.0 | 12.8 | 429.3 |
| 4 | B747-400 | 877000 | 93.32 | 200.0 | 18.1 | 855.2 |
| 6 | 8767-200 ER | 396000 | 90.82 | 190.0 | 16.6 | 714.9 |
| 7 | 8777-200 ER | 657000 | 91.80 | 205.0 | 20 | 1040.2 |
| 8 | DC8-63/73 | 330000 | 96.12 | 196.0 | 16.2 | 683.6 |

B.8.2 <u>Rigid Pavement Example 2</u>

B.8.2.1 The second example has the same traffic and rigid pavement structure as Example 1, but the estimated concrete strength is increased to 720 psi. The structure is as shown in Figure B-23, and the other input data are as shown in Figure B-17. As in Rigid Example 1, the airport has a parallel taxiway configuration (Figure A1-1a) such that the P/TC ratio = 1. After running PCR, the PCR Graph and PCR Report are shown in Figures B-24 and B25, respectively. For this example, the computed PCR is 1089/R/D/W/T and the total CDF = 0.540. Following the practice of reporting PCR to the nearest even multiple of ten, publish PCR 1090/R/D/W/T. Figure B-10 shows that all operating aircraft have ACR < PCR. Hence, no weight restrictions are required on the operating fleet, which is consistent with CDF < 1.0. (In general, CDF > 1.0 indicates that at one aircraft in the fleet will have ACR > PCR).







Figure B-24. FAARFIELD PCR Graph – Rigid Example 2

Figure B-25. FAARFIELD PCR Report - Rigid Example 2

| Federal Aviation Administration FAARFIELD 2.0 PCR Report FAARFIELD 2.0.0.f Beta 07/13/2020 Working directory is C:\Users\David Brill\Documents\My FAARFIELD | | | | | | | |
|---|--|--|--|--|--|--|--|
| Job Name: PCR Examples | | | | | | | |
| Section: Rigid Example 2 | | | | | | | |
| This file name = PCR Results Rigid 2020-07-17 13:24:42.txt | | | | | | | |
| Evaluation pavement type is rigid and design program is FAARFIELD. | | | | | | | |
| Section name: Rigid Example 2 in job file: C:\Users\David Brill\Documents\My FAARFIELD\PCR Examples.JOB.xml | | | | | | | |
| Units = US Customary | | | | | | | |
| Analysis Type: New Rigid | | | | | | | |
| Subgrade Modulus +7800psi (Subgrade Category is D(7k)) | | | | | | | |
| Evaluation Pavement Thickness = 30.0 in. | | | | | | | |
| Pass to Traffic Cycle (PtoTC) Ratio = 1.00 | | | | | | | |
| Maximum number of wheels per gear = 6 | | | | | | | |
| CDF = 0.540 | | | | | | | |

Results Table 1. Input Traffic Data

| No. | Aircraft Name | Gross Weight Ibs | Percent Gross Weight | Tire Pressure psi | Annual Departure | 20 Years Coverage |
|-----|----------------------|---------------------|----------------------|----------------------|------------------|-------------------|
| 1 | A300-B4/C4 Std Bogie | 365747 | 94.00 | 216.1 | 1500 | 8225 |
| 2 | A319-100 std | 141978 | 92.60 | 173.0 | 1200 | 6435 |
| 3 | B737-300 | 140000 | 90.86 | 201.0 | 6000 | 30892 |
| 4 | 8747-400 | 877000 | 46.66 | 200.0 | 1000 | 5717 |
| 5 | 8747-400 Belly | 877000 | 46.66 | 200.0 | 1000 | 5705 |
| 6 | 8767-200 ER | 396000 | 90.82 | 190.0 | 2000 | 10883 |
| 7 | 8777-200 ER | 657000 | 91.80 | 205.0 | 1000 | 4853 |
| 8 | DC8-63/73 | 330000 | 96.12 | 196.0 | 3000 | 17124 |

Figure B-25. FAARFIELD PCR Report - Rigid Example 2 (continued)

Results Table 2. ACR Value

| No. | Aircraft Name | Critical aircraft Total equiv. departures | Max allowable Gross Weight of critical aircraft | ACR Thick at max. MGW (in.) | PCR//R/D |
|-----|------------------|--|--|--------------------------------|----------|
| 1 | 8777-200 ER | 1157 | 676972 | 20.46 | 1089.4 |

Results Table 3. Flexible ACR at Indicated Gross Weight and Strength

| No. | Aircraft Name | Gross Weight Ibs | Percent Gross Weight on Main Gear | Tire Pressure psi | ACR Thick (in.)(D) | ACR//R/D |
|-----|----------------------|---------------------|-----------------------------------|----------------------|--------------------|----------|
| 1 | A300-B4/C4 Std Bogie | 365747 | 94.00 | 216.1 | 16.8 | 738.6 |
| 2 | A319-100 std 141978 | | 92.60 | 173.0 | 12.5 | 412.4 |
| 3 | 8737-300 | 140000 | 90.86 | 201.0 | 12.8 | 429.3 |
| 4 | 8747-400 | 877000 | 93.32 | 200.0 | 18.1 | 855.2 |
| 6 | 8767-200 ER | 396000 | 90.82 | 190.0 | 16.6 | 714.9 |
| 7 | 8777-200 ER | 657000 | 91.80 | 205.0 | 20 | 1040.2 |
| 8 | DC8-63/73 | 330000 | 96.12 | 196.0 | 16.2 | 683.6 |

B.8.2.2 Assuming that the airport has a central taxiway configuration rather than parallel effectively doubles the number of coverages on the runway and reduces the PCR. In Figure B-26, the only change is that the P/TC ratio has been increased from 1 to 2, reflecting the central taxiway configuration in Fig. A1-1b. With this change, the computed PCR is now 1034/R/D/W/T, and the total CDF is 1.07. Following the practice of reporting PCR to the nearest even multiple of ten, publish PCR 1030/R/D/W/T. Because the total CDF > 1.0, we expect that at least one of the listed aircraft has ACR > PCR. Figure B-27 shows that this is in fact the case, that the ACR of the B747-400 (1040/R/D) now exceeds the published PCR just slightly (by less than 1%). Following ICAO guidance that allows occasional overload operations by aircraft with ACR up to 10% above the reported PCR, operations of the B747-400 would still be allowed on this pavement, but the number of such operations at full weight would be limited to 5% of total operations on the taxiway. In addition, the taxiway pavement should be monitored for damage after each overload operation.

| - | | 1. | | | C 0000 200 | | | | | | | |
|---|---|--|--|--|--|---|--|---|---|--|--|---|
| Dopen Job (+) Nei | w Section 🗃 Save Job 🛃 | Seve As Bise | ve All 🗙 Oose | stob Stored A | ircraft Min 👲 Cra | inte 🏦 Edit | | | | | ()Help mil | 2 |
| Section CDF Grag | oh PCR Report PCR G | aph | | | | | | | | | | |
| Job Name: P | CR Examples | PCR | PCR + | | Run | Status Gear Structure | | ure | | | | |
| Section Name: R | igid Example 2 | V in | nclude in sum | nary report | Run Batch | PCR Ca Run Tu | ilculation Cor | mpleted | | | | |
| Pavement Layers | | | | | | | 1034/R/D/W | /π | | | | |
| Pavement Type | New Rigid | | | | | _ | | | | | | |
| Material | | Thickness (| in.) E (pr | i) k (p | nci) R (ps | 0 | | | | | | |
| > P-501 PCC | Surface | 16.0 | 4000 | 000 | 720 | | | | | | | |
| P-401/P-40 | 3 HMA Stabilized | 8.0 | 4000 | 00 | | | | | | | | |
| P-209 Crust | hed Aggregate | 6.0 | 7500 | 0 | | | | | | | | |
| Subgrade | | | 7800 | 103 | .6 | | | | | | | |
| Design Life: 20 Results | 3 | Select As The E | Design Layer P/ | Delete : | Selected Layer | 0 | | | | | | |
| Design Life: 20 Results Calculated Life: | Total thic | Select As The E kness to the to | Design Layer P/ op of the subg | TC Ratio: 2 rrade: 30.0 in | Selected Layer | | | | | | | |
| Design Life: 20 Results Calculated Life: | Total thic | Select As The E kness to the to | Design Layer P/ op of the subg | Delete : TC Ratio: 2 prade: 30,0 in | Selected Layer | | | | | | | |
| Design Life: 20 Results Calculated Life: 4 Traffic Stored Aircraft Min | Total thic | Select As The E kness to the to | Design Layer P/ Dop of the subg | C Ratioi 2 TC Ratioi 2 grade: 30.0 in | Selected Layer | e All Aircraft fr | om List | Remove Sele | cted Aircraft Fr | om Section | Delete Aircraft | |
| Design Life: 20 Results Calculated Life: Traffic Stored Avcraft Mi Amplane Name | Total thic Total thic as Appendix C PCR Exa Gross Taxi Weight (Ibs) | kness to the to mple - Annual Departures | Design Layer P/ Dop of the subg Save Al Annual Growth (%) | Delete : TC Ratio: 2 grade: 30.0 in rcraft Mix to 1 Total Departures | File Clear CDF Contributions | e All Aircraft fr CDF Max for Airplane | rom List P/C Ratio | Remove Sele | cted Aircraft Fr Percent GW en Gear | om Section Dual Time Spacing (in.) | Delete Aircraft Tandem Tirr Spacing (in.) | |
| Design Life: 20 Results Calculated Life: Traffic: Stored Aircraft Mir Airplane Name A300-B4/C4 Std B | a: Appendix C PCR Exa Gross Taul Weight (Ibs) ogje 355747 | Select As The C kness to the to mple - Annual Departures 1500 | Design Layer P/ pp of the subg Save Ai Annual Growth (%) 0 | TC Ratio: 2 TC Ratio: 2 arade: 30.0 in recaft Mix to 1 Departures 30000 | File Clea COF Contributions 0.01 | e All Aircraft fr CDF Max for Airptane 0.02 | rom List P/C Ratio 3.65 | Remove Sele Tine Pressure (psi) 215 | cted Aircraft Fr Percent GW on Gear 94.00% | om Section Dual Time Spacing (in.) 36.5 | Delete Aircraft Tandem Tire Spacing (in.) SS.0 | |
| Design Life: 20 Results Calculated Life: 4 Traffic Stored Ancraft Mit Amplane Name A300-B4/C4 Std B | a: Appendix C PCR Exa Gross Taxi Weight (Dis) 365747 141978 | Select As The E kness to the to mple - Annual Departures 1500 1200 | Design Layer P/ Dop of the subg Save Al Annual Growth (%) 0 0 | rcraft Mia to i Departures Departures 30000 24000 | File Clear COF Contributions 0.01 0 | r All Aircraft fr CDF Max for Airplane 0.02 0 | rom List P/C Ratio 3.65 3.73 | Remove Sele Tire Pressure (psi) 216 173 | cted Aircraft Fr Percent GW on Gear 94.00% 92.60% | om Section Dual Tim Spacing (in) 36.5 36.5 | Delete Aircraft Tandem Tirc Spacing (in: SS.0 0.0 | |
| Design Life: 20 Results Calculated Life: Traffic Stored Aircraft Mi Airplane Name A300-B4/C4 Std B A319-100 atd B737-300 | a: Appendix C PCR Exa Gross Taxi Weight (ba) ogie 365747 141978 140000 | Select As The E kness to the tr mple - Annual Departures 1500 1200 6000 | Design Layer P/ Dop of the subg Save Al Annual Growth (%) 0 0 0 | TC Ratio: 2 TC Ratio: 2 TC Ratio: 2 TC Ratio: 2 30.0 in reraft Mix to 1 Total Departures 30000 120000 | File Clear CDF Contributions 001 0 | e All Aircraft fr CDF Max for Airptane 0.02 0 0 | rom List P/C Ratio 3.65 3.73 3.88 | Remove Sele Tire Pressure (psi) 215 173 201 | Cled Aircraft Fr Percent GW on Gear 94.00% 92.60% | Dual Tire Spacing (in.) 36.5 36.5 36.5 | Delete Aircraft Tandem Tirr Spacing (in. 55.0 0.0 0.0 0.0 | |
| Design Life: 20 Results Calculated Life: Traffic Stored Aircraft Mi Airplane Name A300-Ba/C4 Std B A319-100 std B737-300 B747-400 | a: Appendix C PCR Exa Gross Taxi Weight (Jbs) ogie 365747 141978 140000 87700 | Select As The E kness to the to Annual Departures 1500 1200 6000 1000 | Design Layer P/ Dop of the subg Save Al Annual Growth (%) 0 0 0 | TC Ratio 2 TC Ratio 2 reraft Mia to 1 Total Departures 30000 24000 120000 | File Clear CDF Contributions 0.01 0 0.12 | e All Aircraft fr Airptane 0.02 0 0 0.13 | rom List P/C Ratio 3.65 3.73 3.88 3.5 | Remove Sele Tire Pressure (psi) 216 173 200 200 | cted Aircraft FP Percent GW on Gest 94,00% 92,60% 90,15% | om Section Dual Tire Spacing (in.) 36.5 36.5 36.5 30.5 44.0 | Delete Aircraft Tandem Tirr Spacing (m. SS.0 0.0 0.0 S8.0 | |
| Design Life: 20 Results Calculated Life: Traffic Stored Ancraft Mil Airplane Name A300-B4/C4 Std B A319-100 std B747-400 B747-400 Belly | as Appendix C PCR Exa Gross Taxi Weight (Jbs) 141978 140000 877000 | Select As The E siness to the to mple • Annual Departures 1500 1200 6000 1000 | Design Layer P/ Dop of the subg Sidve Ai Annual Growth (%) 0 0 0 0 0 | TC Ration 2 TC Ra | File Clear COF Contributions 0.01 0 0.12 0 | r All Aircraft fr CDF Max for Aurptane 0.02 0 0 0.13 | rom List P/C Ratio 3.65 5.73 3.86 3.5 3.51 | Remove Sele Tire Pressure (pai) 216 173 200 200 200 | cted Aircraft Fr Percent GW on Gear 94.00% 92.60% 90.85% 45.66% | om Section Dual True Spacing (in.) 36.5 36.5 36.5 36.5 44.0 44.0 | Delete Aircraft Tandem Tire Spacing (in: SS.0 0.0 0.0 0.0 58.0 58.0 | |
| Design Life: 20 Results Calculated Life: 4 Traffic Stored Aircraft Mit Airplane Name A319-100 std 8737-300 8747-400 Beily 8747-400 Beily 8767-200 ER | at Appendix C PCR Exa Gross Taxi Weight (ba) 141978 141978 1419700 877000 877000 396000 | Select As The E kiness to the to mple - Annual Departures 1500 1000 1000 2000 | Design Layer P/ Dop of the subc Save Ai Annual Growth (%) 0 0 0 0 0 0 0 0 0 0 0 0 | TC Ratio: 2 TC Ra | File Clear COF Contributions 0.01 0 0.01 | r All Aircraft fr CDF Max for Airplane 0.02 0 0.13 0.13 0.01 | rom List P/C Ratio 3.65 3.73 3.88 3.51 3.51 3.68 | Remove Sele Tire Pressure (psi) 216 173 201 200 200 190 | Cted Aircraft Fr Percent GW on Gear 94.00% 90.85% 46.66% 90.82% | om Section Dual Time Spacing (in.) 36.5 30.5 30.5 30.5 44.0 45.0 | Delete Aircraft Tandem Tint Spacing (in.) SS.0 0.0 0.0 0.0 SB.0 SB.0 SB.0 SB.0 SB | |
| Design Life: 20 Results Calculated Life: Traffic Stored Aircraft Mi Airplane Name A300-B4/C4 Std B A319-100 atd B737-300 B747-400 Belly B747-400 Rel B747-200 ER | a: Appendix C PCR Exa Gross Taxi Weight (ba) a 55747 141978 140000 877000 396000 657000 | Select As The C kness to the tr mple - Annual Departures 1500 1200 6000 1000 1000 | Design Layer P/ Save Al Annual Growth (%) 0 0 0 0 0 0 0 0 0 0 0 0 | TC Ratio: 2 TC Ratio: 2 TC Ratio: 2 TC Ratio: 2 30.0 in Total Departures 30000 24000 20000 20000 20000 | File Clear CDF Contributions 0.01 0 0.12 0 0.01 0.01 0.01 0.02 | e All Aircraft fr CDF Max for Airptane 0.02 0 0 0.13 0.13 0.13 0.01 0.03 0.031 | rom List P/C Ratio 3.65 3.73 3.86 3.5 3.51 3.68 4.12 | Remove Sele (psi) 216 173 200 200 200 200 200 205 | cted Aircraft Fr Percent GW on Gear 94,00% 92,60% 46,66% 90,82% 91,80% | om Section Dual Tire Spacing (in.) 36.5 36.5 36.5 36.5 36.5 36.5 36.5 36.5 | Delete Aircraft Tandem Tire Späcing (in.) 55.0 0.0 0.0 0.0 56.0 56.0 56.0 57.0 | |

Figure B-26. FAARFIELD PCR Output – Rigid Example 2 (P/TC = 2)



Figure B-27. FAARFIELD PCR Chart – Rigid Example 2 (P/TC = 2)

B.8.3 <u>Rigid Pavement Example 3.</u>

- B.8.3.1 The third example has the same traffic as Examples 1 and 2, but in this case the existing concrete pavement has been overlaid at some point with a thin asphalt wearing surface. The ICAO ACR-PCR system does not include separate ratings for composite or overlay pavements. All pavements are assigned either "R" or "F" in the pavement type element of the PCR code. In general, the letter code should reflect the primary structural behavior of the pavement. In other words, if the pavement primarily resists loads through bending action in the panel, then the pavement should be given an R rating, Otherwise, use F. As illustrated in this example, FAARFIELD can help make this determination based on the entered pavement characteristics.
- B.8.3.2 Assume the pavement structure as shown in Figure B-28. Enter the data in FAARFIELD. After opening FAARFIELD, select "PCR" from the dropdown function list at the top of the screen. Select the "HMA on Rigid" pavement type from the drop-down Pavement Type list. Enter or modify the structure layers directly in the Pavement Layers table, or by clicking on the image of the pavement cross section. By default, the concrete later is assigned a Structural Condition Index (SCI) value of 80 prior to overlay. Given the difficulty of determining the in-situ structural condition of the concrete layer in an overlay structure, it is generally sufficient to retain the default value of SCI when determining PCR. However,

the engineer should ensure that the value of flexural strength R is representative of the actual in-situ flexural strength, as concrete flexural strength has a significant effect on PCR. Using the aircraft library, enter the aircraft list from Table B-1, and modify the gross weights and annual departures as necessary. The default value of P/TC is 1 and does not need to be changed.

B.8.3.3 Click "Run." FAARFIELD will perform the PCR computations automatically. When the calculation is complete, the computed PCR value will appear in the "Status" screen at upper right (Figure B-29). For this example, the computed PCR is 774/R/B/W/T. Despite the fact that the pavement has an asphalt overlay, FAARFIELD reports rigid PCR because the primary resistance to load comes from the 16-inch PCC slab. Note that FAARFIELD automatically identifies the correct subgrade category based on the entered subgrade properties. FAARFIELD selects W as the default tire pressure category for rigid pavements. However, in this case it may be necessary to report a lower tire pressure category depending on the quality of the asphalt surface later. Following the practice of reporting PCR to the nearest even multiple of ten, and after determining that the surface asphalt can tolerate tire pressures up to 254 psi, publish PCR 770/R/B/X/T.





| Job Name: PCR Examples PCR Run Status Gear Structure Section Name: Rigid Example 3 Include in summary report Run Batch Pavement Layers Pavement Type: HMA on Rigid PCR = 774/R/B/W/T Pavement Type: HMA on Rigid Include in summary report R (psi) P-209 Crushed Aggregate 5.0 400000 650 P-209 Crushed Aggregate 6.0 75000 172.4 Design Life: 20 SCI: 80 Percent CDFU: 100 Pavesults Procent CDFU: 100 P/TC Ratio: 1 | Section PCR Gr | aph | | | | | | | | × | ľ |
|--|---------------------------|--------------------|-----------|----------------------|--------------|---------------------|---------------|--------------------------------|--|----|---|
| Section Name: Rigid Example 3 Include in summary report. Run Batch Pavement Layers Pavement Type: HMA on Rigid Include in summary report. Run Batch Material Thickness (in.) E (psi) k (pci) R (psi) > P-401/P-403 HMA Overlay 2.5 200000 F (psi) R (psi) P-501 PCC Surface 16.0 4000000 650 F (psi) R (psi) R (psi) P-209 Crushed Aggregate 6.0 75000 1 1 Select As The Design Layer Delete Selected Layer Delete Selected Layer Design Life: 20 SCI: 80 Percent CDFU: 100 Results Results Results Results Results Results | Job Name: | PCR Examples | | PCR | | * | Run | Status G | ear Structure | 1- | |
| Pavement Type: HMA on Rigid Material Thickness (in.) E (psi) k (pci) R (psi) > P-401/P-403 HMA Overlay 2.5 200000 650 P-501 PCC Surface 16.0 4000000 650 P-401/P-403 HMA Stabilized 5.0 400000 650 P-401/P-403 HMA Stabilized 5.0 400000 650 P-209 Crushed Aggregate 6.0 75000 1 Subgrade 15000 172.4 1 | Section Name: | Rigid Example 3 | | ✓ Include | in summary r | eport | Run Batch | PCR Calo Run Tim PCR = 7 | culation Completed e: 711 seconds 74/R/B/W/T | | |
| Material Thickness (in.) E (psi) k (pci) R (psi) > P-401/P-403 HMA Overlay 2.5 200000 650 P-501 PCC Surface 16.0 400000 650 P-401/P-403 HMA Stabilized 5.0 400000 100 P-209 Crushed Aggregate 6.0 75000 12.4 Subgrade 15000 172.4 100 Design Life: 20 SCI: 80 Percent CDFU: 100 P/TC Ratio: 1 Results | Pavement Typ | HMA on Rigid | | | ~ | | | - | | | |
| > P-401/P-403 HMA Overlay 2.5 200000 650 P-501 PCC Surface 16.0 4000000 650 P-401/P-403 HMA Stabilized 5.0 400000 9 P-209 Crushed Aggregate 6.0 75000 9 Subgrade 15000 172.4 9 | Material | | Thick | ness (in.) | E (psi) | k (pc | i) R (psi) | | | | |
| P-501 PCC Surface 16.0 4000000 650 P-401/P-403 HMA Stabilized 5.0 400000 1 P-209 Crushed Aggregate 6.0 75000 1 Subgrade 15000 172.4 1 Select As The Design Layer Delete Selected Layer Design Life: 20 SCI: 80 Percent CDFU: 100 P/TC Ratio: 1 Results | > P-401/P-4 | 403 HMA Overlay | 2.5 | | 200000 | 0 | | | | | |
| P-401/P-403 HMA Stabilized 5.0 400000 P-209 Crushed Aggregate 6.0 75000 Subgrade 15000 172.4 Select As The Design Layer Delete Selected Layer Design Life: 20 SCI: 80 Percent CDFU: 100 P/TC Ratio: 1 Results | P-501 PC | P-501 PCC Surface | | | 4000000 | | 650 | | | | Ĺ |
| P-209 Crushed Aggregate 6.0 75000 Subgrade 15000 172.4 Select As The Design Layer Design Life: 20 SCI: 80 Percent CDFU: 100 P/TC Ratio: 1 Results | P-401/P-4 | 403 HMA Stabilized | 5.0 | | 400000 | j. | | | | | |
| Subgrade 1500 172.4 Select As The Design Layer Design Life: 20 SCI: 80 Percent CDFU: 100 P/TC Ratio: 1 Results | P-209 Cri | ushed Aggregate | 6.0 | | 75000 | | | | | | |
| Select As The Design Layer Delete Selected Layer Design Life: 20 SCI: 80 Percent CDFU: 100 P/TC Ratio: 1 Results | Subgrade | 2 | | | 15000 | 172.4 | | | | | |
| Calculated Life: Total thickness to the top of the subgrade: 29.5 ID | Design Life: 2 Results | 0 SCI: 80 Pr | Select As | The Design U: 100 | P/TC Rat | Delete Se tio: 1 | elected Layer | | | | |

Figure B-29. FAARFIELD PCR Output – Rigid Example 3

APPENDIX C - REPORTING CHANGES TO CERTAIN AIRPORT RUNWAY DATA ELEMENTS

This Advisory Circular affects the following airport runway data.

C.1 Allowable Gross Weight

Aircraft weight data are reported using this AC based upon the PCR calculated for the pavement being evaluated.

C.1.1 <u>Source of Data</u>

Runway weight bearing capacity data may be input by the airport owner or State Aviation Agency. Information is submitted electronically to the FAA Air Traffic Aeronautical Information Services for publication in FAA Flight Information manuals using the Airport Master Record (AMR). Airport Sponsors may update the AMR data elements in the Airport Data and Information Portal (ADIP). Currently this data base accepts gross aircraft weight data for single wheel landing gear (S), dual wheel landing gear (D), dual tandem landing gear (2D) and multiple dual-tandem landing gear (2D/2D2). All other gear types may be reported only with the PCR. The PCR reported must contain all five elements, e.g. 573/F/C/W/T.

C.1.2 <u>Reporting Allowable Gross Weight</u>

The allowable gross aircraft weight for each gear configuration that may utilize the subject runway is published in the Airport Master Record. In addition, a PCR number should also be published for each Runway at the airport. Note the PCR "number" to report is the entire PCR string of five elements: PCR number, pavement type, subgrade category, tire pressure, and method of calculation. The FAARFIELD computer program calculates PCR based maximum gross weights for reporting Runway Weight Bearing Capacity Data as part of the PCR calculation procedure. Alternatively, or if only the PCR is known, a list of PCRbased maximum gross weights for reporting Runway Weight Bearing Capacity Data has been developed and is contained in Appendix D of this AC. Local experience can be considered to report a lower weight, but higher weights are not recommended.

C.2 Pavement Classification Rating (PCR)

C.2.1 <u>Source of Data</u>

The source for Pavement Classification Rating (PCR) data is the airport operator. FAA Part 139 airport certification safety inspectors and State non-Part 139 airport inspectors are instructed to request PCR data from the airport manager as part of the manager interview before an airport inspection or as soon as practical from airport sponsors requesting Part 139 certification.

C.2.2 <u>Reporting PCR</u>

For purposes of airport runway data elements generally published in the Airport Master Record (AMR), the PCR is a number that expresses the load-carrying capacity of a pavement based on all aircraft traffic that regularly operates on the pavement.

C.3 Assigning Aircraft Gross Weight Data

- C.3.1 Tables D-1 and D-2 summarize the process used to assign allowable aircraft gross weight. Tables D-1 and D-2 shows the flexible and rigid ACRs used to assign allowable aircraft gross weight. Allowable gross weight is based on the aircraft gear configuration as issued in FAA Order 5300.7, Standard Naming Convention for Aircraft Landing Gear Configurations, coupled with tire pressure and wheel spacing ranges. The ACR for these standard aircraft results in a recommended maximum gross weight for Runway Weight Bearing Capacity
- C.3.2 The data in Tables D-1 and D-2 were used to develop a list of maximum gross weights for Runway Weight Bearing Capacity Data. These lists (Appendix D) correlate known PCR values for flexible and rigid pavement to maximum allowable gross weights for the four gear types: S, D, 2D, and 2D/2D2.
- C.3.3 The aircraft listed in Tables E-1, E-2, E-3 and E-4 represent generic gear types and typical ranges of weights and tire pressures. There will be cases where the gross weight of an operating aircraft exceeds the allowable gross weight for the relevant gear category as determined from Tables D-1 and D-2, although the operating ACR is less than the reported PCR determined using the procedures in Chapter 4 and in the examples in Appendix B. The values in the tables are not as accurate as the gross weights associated with the ACR assigned by the aircraft manufacturer. The reported PCR is the basis for data in the tables, and the airport manager should rely on the reported PCR, rather than the gross weight data in Tables E-1, E-2, E-3 and E-4 when the ACR of the departing or landing aircraft is known.
- C.3.4 Enter the appropriate table for the subgrade category and read down to the PCR number. Then read across to find the allowable weight values, which are listed in thousands of pounds. Note that, regardless of PCR, the following gross weight values are considered the maximum allowable for each gear category:

| Gear Type | Gross Weight (Thousands of Pounds) | | | |
|-----------|------------------------------------|--|--|--|
| S | 120 | | | |
| D | 250 | | | |
| 2D | 550 | | | |
| 2D/2D2 | 1220 | | | |

The first example, shown in the table, is for a flexible pavement that supports single (S), dual (D), and dual tandem (2D) gear aircraft. The airport can report a PCR of 300 with subgrade category B support. Refer to Table E-2 for subgrade category B. At the intersection of the PCR value with the gear types S, D, and 2D, find 79 kips (79,000 pounds) is the maximum allowable gross weight for S aircraft, 127 kips (127,000 pounds) is the maximum allowable gross weight for D aircraft, and 215 kips (215,000 pounds) is the maximum allowable gross weight for D aircraft. Local experience can be considered to use a lower weight, but higher weights are not recommended. The field for 2D/2D2 does not contain a value, therefore gross aircraft weight data for 2D/2D2 (Field 38 in the AMR) should be left blank.



FAA Order 5300.7- Standard Naming Convention for Aircraft Landing Gear Configurations

Figure C-1: Aircraft Gear Configuration

- C.3.5 The second example in the table is for a pavement that supports aircraft with single and dual wheel gear configurations. The pavement has a PCR of 430/R/B/W/T. The gross weights at the intersection of the PCR value for a B category subgrade with each gear type is between PCR values 400 and 450. Straight line interpolation between values is recommended. Single wheel gross weight is 108 kips (108,000 pounds). Dual wheel gross weight is 179 kips (179,000 pounds). Local experience can be considered to use.
- C.3.6 lower weights, but higher weights are not recommended. D.3.6 The procedures used to create Tables D-1 and D-2 have been implemented in FAARFIELD 2.0 and are automatically executed when PCR computation is run. In a given case there may be minor inconsistencies between the values in Tables E-1, E-2, E-3 and E-4 and those output by FAARFIELD. In case of a discrepancy, the FAARFIELD values should take precedence.

| | Aircraft | Gross | % GW on | Tire | | Flexib | le ACR | ē |
|-----|----------|-----------------|--------------|------------------|---------------|--------|--------|--------|
| No. | Name | Weight, lbs. | Main Gear | Pressure, psi | A | В | С | D |
| 1 | S-7.5std | 7,500 | 95.00 | 52.5 | 18.9 | 20.4 | 22.8 | 26.6 |
| 2 | S-15std | 15,000 | 95.00 | 60.0 | 29.9 | 41.9 | 49.6 | 54.9 |
| 3 | S-30std | 30,000 | 95.00 | 75.0 | 70.2 | 95.0 | 105.9 | 113.8 |
| 4 | S-45std | 45,000 | 95.00 | 90.0 | 125.9 | 153.9 | 166.4 | 175.2 |
| 5 | S-60std | 60,000 | 95.00 | 105.0 | 188.2 | 216.8 | 229.6 | 238.5 |
| 6 | S-75std | 75,000 | 95.00 | 120.0 | 255.2 | 282.6 | 294.7 | 303.0 |
| 7 | S-90std | 90,000 | 95.00 | 135.0 | 325.4 | 350.3 | 361.1 | 368.5 |
| 8 | S-105std | 105,000 | 95.00 | 150.0 | 398.0 | 419.4 | 428.3 | 434.9 |
| 9 | S-120std | 120,000 | 95.00 | 165.0 | 472.3 | 489.5 | 496.4 | 502.2 |
| 10 | D-37.5 | 37,500 | 95.00 | 65.0 | 34.7 | 57.6 | 71.5 | 88.2 |
| 11 | D-50 | 50,000 | 95.00 | 80.0 | 63.0 | 89.2 | 108.0 | 131.9 |
| 12 | D-75 | 75,000 | 95.00 | 110.0 | 128.4 | 160.5 | 189.4 | 230.9 |
| 13 | D-100 | 100,000 | 95.00 | 140.0 | 197.4 | 231.4 | 272.1 | 320.9 |
| 14 | D-125 | 125,000 | 95.00 | 150.0 | 252.9 | 294.9 | 340.7 | 395.7 |
| 15 | D-150 | 150,000 | 95.00 | 160.0 | 307.0 | 346.9 | 396.8 | 455.6 |
| 16 | D-175 | 175,000 | 95.00 | 180.0 | 375.2 | 419 | 471.3 | 539.6 |
| 17 | D-200 | 200,000 | 95.00 | 200.0 | 442.9 | 491.7 | 544.3 | 622.3 |
| 18 | D-225 | 225,000 | 95.00 | 220.0 | 511.7 | 562.0 | 616.3 | 701.5 |
| 19 | D-250 | 250,000 | 95.00 | 240.0 | 580.9 | 630.0 | 690.9 | 778.6 |
| 20 | 2D-100 | 100,000 | 95.00 | 120.0 | 89.2 | 106.7 | 124.4 | 158.0 |
| 21 | 2D-150 | 150,000 | 95.00 | 140.0 | 153.6 | 187.6 | 232.1 | 301.0 |
| 22 | 2D-200 | 200,000 | 95.00 | 160.0 | 223.3 | 277.9 | 355.7 | 447.6 |
| 23 | 2D-250 | 250,000 | 95.00 | 170.0 | 284.7 | 353.5 | 454.8 | 577.5 |
| 24 | 2D-300 | 300,000 | 95.00 | 190.0 | 346.6 | 425.9 | 549.7 | 708.6 |
| 25 | 2D-350 | 350,000 | 95.00 | 190.0 | 412.1 | 509.5 | 655.7 | 843.6 |
| 26 | 2D-400 | 400,000 | 95.00 | 200.0 | 478.0 | 588.9 | 759.1 | 975.3 |
| 27 | 2D-450 | 450,000 | 95.00 | 210.0 | 533. B | 635.7 | 802.4 | 1061.7 |

Table D-1. Flexible ACR Data Used to Establish Allowable Gross Weight

| N | Aircraft | Gross | % GW on | Tire Pressure, | | Flexib | le ACR | |
|-----|-----------|-----------------|---------|-------------------|---------------|--------|--------------------|--------------|
| No. | Name | Weight, lbs. | Gear | Pressure, psi | A | В | С | D |
| 28 | 2D-500 | 500,000 | 95.00 | 220.0 | 588.0 | 678.2 | 833.0 | 1118.4 |
| 29 | 2D-550 | 550,000 | 95.00 | 230.0 | 641.0 | 706.5 | 844.3 | 1118.2 |
| 30 | 2D/2D2-40 | 640,000 | 95.00 | 210.0 | 351.5 | 368.6 | 401.6 | 490.5 |
| 31 | 2D/2D2-50 | 800,000 | 95.00 | 220.0 | 449.3 | 480.8 | 550.4 | 727.7 |
| 32 | 2D/2D2-60 | 960,000 | 95.00 | 230.0 | 553.4 | 610.1 | 721.9 | 1028.9 |
| 33 | 2D/2D2-70 | 1,120,000 | 95.00 | 240.0 | 663.9 | 758.3 | 935.2 | 1395.2 |
| 34 | 3D-40 | 480,000 | 95.00 | 210.0 | 355.7 | 367.02 | 395.9 | 509.0 |
| 35 | 3D-50 | 600,000 | 95.00 | 220.0 | 451.8 | 474.8 | 541.5 | 785.3 |
| 36 | 3D-60 | 720,000 | 95.00 | 230.0 | 553.1 | 596.3 | 729.5 | 1130.1 |
| 37 | 3D-70 | 840,000 | 95.00 | 240.0 | 659.4 | 783.7 | 979.8 | 1537.0 |
| 38 | 2D/3D2-40 | 800,000 | 95.00 | 210.0 | 349.3 | 356.0 | 371.5 | 421.8 |
| 39 | 2D/3D2-50 | 1,000,000 | 95.00 | 220.0 | 44 2.5 | 455.0 | <mark>487.6</mark> | 599.4 |
| 40 | 2D/3D2-60 | 1,200,000 | 95.00 | 230.0 | 539.4 | 561.1 | 619.6 | 847.7 |
| 41 | 2D/3D2-70 | 1,400,000 | 95.00 | 240.0 | 639.9 | 677.6 | 772.9 | 1187.0 |

| | Aircraft | Gross | % GW on | Tire | | Rigid | ACR | |
|-----|----------|-----------------------|--------------|------------------|-------|--------------------|-------|-------|
| No. | Name | Weight, lbs. | Main Gear | Pressure, psi | A | в | С | D |
| 1 | S-7.5std | 7,500 | 95.00 | 52.5 | 12.7 | 13.6 | 14.4 | 16.6 |
| 2 | S-15std | 15,000 | 95.00 | 60.0 | 28.4 | 33.6 | 37.1 | 40.4 |
| 3 | S-30std | 30,000 | 95.00 | 75.0 | 74.6 | 82.6 | 87.7 | 92.6 |
| 4 | S-45std | 45 <mark>,0</mark> 00 | 95.00 | 90.0 | 128.7 | 138.3 | 144.4 | 150.3 |
| 5 | S-60std | 60,000 | 95.00 | 105.0 | 189.0 | 199.3 | 205.9 | 212.0 |
| 6 | S-75std | 75 <mark>,0</mark> 00 | 95.00 | 120.0 | 254.0 | 264.3 | 270.8 | 277.3 |
| 7 | S-90std | 90,000 | 95.00 | 135.0 | 323.0 | 332.6 | 338.8 | 344.8 |
| 8 | S-105std | 105,000 | 95.00 | 150.0 | 394.8 | 403.4 | 409.0 | 414.7 |
| 9 | S-120std | 120,000 | 95.00 | 165.0 | 469.3 | 476.5 | 481.2 | 485.7 |
| 10 | D-37.5 | 37,500 | 95.00 | 65.0 | 57.0 | 69.5 | 78.2 | 86.8 |
| 11 | D-50 | 50,000 | 95.00 | 80.0 | 96.4 | 110.9 | 120.6 | 130.2 |
| 12 | D-75 | 75,000 | 95.00 | 110.0 | 185.5 | 201.9 | 212.7 | 223.3 |
| 13 | D-100 | 100,000 | 95.00 | 140.0 | 276.6 | 294.1 | 305.5 | 317.0 |
| 14 | D-125 | 125,000 | 95.00 | 150.0 | 351.6 | 372.0 | 385.8 | 399.8 |
| 15 | D-150 | 150,000 | 95.00 | 160.0 | 420.3 | 444.0 | 460.0 | 476.3 |
| 16 | D-175 | 175,000 | 95.00 | 180.0 | 509.0 | 533.7 | 550.5 | 567.8 |
| 17 | D-200 | 200,000 | 95.00 | 200.0 | 598.4 | 623.9 | 640.9 | 659.4 |
| 18 | D-225 | 225,000 | 95.00 | 220.0 | 688.3 | 713.8 | 731.6 | 750.7 |
| 19 | D-250 | 250,000 | 95.00 | 240.0 | 785.8 | 811.4 | 829.2 | 848.4 |
| 20 | 2D-100 | 100,000 | 95.00 | 120.0 | 98.4 | 110.7 | 126.0 | 147.6 |
| 21 | 2D-150 | 150,000 | 95.00 | 140.0 | 177.6 | <mark>210.8</mark> | 240.9 | 274.3 |
| 22 | 2D-200 | 200,000 | 95.00 | 160.0 | 274.9 | 325.9 | 365.7 | 407.8 |
| 23 | 2D-250 | 250,000 | 95.00 | 170.0 | 361.6 | 426.7 | 475.6 | 526.7 |
| 24 | 2D-300 | 300,000 | 95.00 | 190.0 | 449.7 | 527.5 | 585.4 | 645.7 |
| 25 | 2D-350 | 350,000 | 95.00 | 190.0 | 547.0 | 637.3 | 703.1 | 771.3 |
| 26 | 2D-400 | 400,000 | 95.00 | 200.0 | 641.6 | 744.0 | 817.9 | 894.7 |
| 27 | 2D-450 | 450,000 | 95.00 | 210.0 | 711.0 | 823.9 | 906.6 | 993.1 |

Table D-2. Rigid ACR Data Used to Establish Allowable Gross Weight
| | Aircraft | Gross | % GW on | Tire | Rigid ACR | | | | | |
|-----|-----------|-----------------|--------------|------------------|-----------|--------|--------|--------|--|--|
| No. | Name | Weight, lbs. | Main Gear | Pressure, psi | A | В | С | D | | |
| 28 | 2D-500 | 500,000 | 95.00 | 220.0 | 767.6 | 889.5 | 981.2 | 1077.5 | | |
| 29 | 2D-550 | 550,000 | 95.00 | 230.0 | 803.9 | 930.8 | 1030.3 | 1137.4 | | |
| 30 | 2D/2D2-40 | 640,000 | 95.00 | 210.0 | 379.0 | 437.3 | 490.7 | 553.8 | | |
| 31 | 2D/2D2-50 | 800,000 | 95.00 | 220.0 | 524.6 | 610.9 | 681.8 | 760.9 | | |
| 32 | 2D/2D2-60 | 960,000 | 95.00 | 230.0 | 692.8 | 804.3 | 890.0 | 982.4 | | |
| 33 | 2D/2D2-70 | 1,120,000 | 95.00 | 240.0 | 880.3 | 1013.5 | 1112.3 | 1215.4 | | |

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APPENDIX D – MAXIMUM AIRCRAFT GROSS WEIGHT TABLES FOR AIRPORT MASTER Record Reporting based on PCR Determination

| | Allo | wable GW for FLEX | (1000's d IBLE PC | of Ibs.) R | Allowable GW (1000's of lbs.) for RIGID PCR | | | | |
|--------|------|----------------------|----------------------|---------------|--|----------|------------|----------|--|
| PCR(A) | S | D | 2D | 2D/2D2 | S | D | 2D | 2D/2D2 | |
| 20 | 2 | | 17 | (70) | 11 | 6 875 | 2 - 15: | 24 24 | |
| 30 | 15 | | | 1.70 | 16 | | | | |
| 40 | 19 | 40 | | | 19 | | | | |
| 50 | 22 | 44 | - | - | 22 | | . := | | |
| 60 | 26 | 49 | <u>i</u> | 125 | 25 | 38 | 124 | Цŝ | |
| 70 | 30 | 53 | - | - | 29 | 42 | ° - | 4 | |
| 80 | 33 | 56 | 17 | (70) | 31 | 45 | 1.0 | 2 | |
| 90 | 35 | 60 | 101 | 1.50 | 34 | 48 | | | |
| 100 | 38 | 64 | 108 | | 37 | 51 | 101 | | |
| 110 | 41 | 68 | 116 | - | 40 | 54 | 107 | - | |
| 120 | 43 | 72 | 124 | (La) | 43 | 57 | 114 | - | |
| 130 | 46 | 76 | 132 | - | 45 | 59 | 120 | 4 | |
| 140 | 48 | 79 | 139 | 1.70 | 48 | 62 | 126 | | |
| 150 | 51 | 83 | 147 | - | 50 | 65 | 133 | | |
| 160 | 53 | 86 | 155 | | 53 | 68 | 139 | | |
| 170 | 56 | 90 | 162 | - | 55 | 71 | 145 | | |
| 180 | 58 | 94 | 169 | (La) | 58 | 73 | 151 | 2 | |
| 190 | 60 | 97 | 176 | - | 60 | 76 | 156 | 8 | |
| 200 | 63 | 101 | 183 | | 63 | 79 | 162 | | |
| 220 | 67 | 110 | 198 | | 67 | 84 | 172 | | |
| 250 | 74 | 124 | 222 | (m) | 74 | 93 | 187 | - | |
| 280 | 80 | 138 | 246 | 140 | 81 | 101 | 203 | Щ. | |
| 300 | 85 | 147 | 262 | (4) (4) | 85 | 108 | 214 | 2 2 | |
| 350 | 95 | 166 | 303 | - | 96 | 124 | 243 | - | |

Table E-1. Subgrade Category A

| | Allo | wable GW for FLEX | (1000's o IBLE PC | of lbs.) R | Allowable GW (1000's of lbs.) for RIGID PCR | | | | |
|--------|------|----------------------|----------------------|---------------|--|-----|-----|--------|--|
| PCR(A) | S | D | 2D | 2D/2D2 | S | D | 2D | 2D/2D2 | |
| 400 | 105 | 184 | 3 <mark>4</mark> 1 | 719 | 106 | 143 | 271 | 663 | |
| 450 | 115 | 203 | 379 | 801 | 116 | 158 | 300 | 718 | |
| 470 | 120 | 210 | 394 | 832 | 120 | 164 | 310 | 740 | |
| 500 | 120 | 221 | 420 | 878 | 120 | 172 | 325 | 773 | |
| 550 | 120 | 239 | 465 | 955 | 120 | 186 | 352 | 824 | |
| 580 | 120 | 250 | 493 | 999 | 120 | 195 | 367 | 853 | |
| 600 | 120 | 250 | 511 | 1027 | 120 | 200 | 378 | 871 | |
| 650 | 120 | 250 | 550 | 1100 | 120 | 214 | 406 | 919 | |
| 700 | 120 | 250 | 550 | 1120 | 120 | 228 | 442 | 966 | |
| 750 | 120 | 250 | 550 | 1120 | 120 | 241 | 484 | 1009 | |
| 780 | 120 | 250 | 550 | 1120 | 120 | 248 | 517 | 1034 | |
| 800 | 120 | 250 | 550 | 1120 | 120 | 250 | 545 | 1051 | |
| 850 | 120 | 250 | 550 | 1120 | 120 | 250 | 550 | 1094 | |
| 880 | 120 | 250 | 550 | 1120 | 120 | 250 | 550 | 1120 | |

| | Alloy | wable GW for FLEX | (1000's o IBLE PC | f lbs.) R | Allowable GW (1000's of lbs.) for RIGID PCR | | | | |
|--------|-------|----------------------|----------------------|--------------|--|--------|--------------|---------|--|
| PCR(B) | S | D | 2D | 2D/2D2 | S | D | 2D | 2D/2D2 | |
| 20 | 5 | 020 | 2 | 2 | 10 | е С | | 2 | |
| 30 | 11 | 19 2 0 | - 2 | 2 | 14 | 0 | | 2 | |
| 40 | 14 | 22 | <u>~</u> | s = | 17 | | 1 (See | 3 12 | |
| 50 | 17 | 24 | 2 | ÷ | 20 | Д | 1. See | 9 14 | |
| 60 | 20 | 38 | <u>_</u> | - | 23 | - | | а а | |
| 70 | 23 | 42 | 2 | | 26 | 38 | | . u | |
| 80 | 26 | 46 | ÷- | . ÷ | 29 | 41 | 1940 | - | |
| 90 | 29 | 50 | ÷- | . ÷ | 32 | 44 | 0 4 0 | - | |
| 100 | 31 | 54 | 5 4 | . ÷ | 35 | 47 | 0 4 0 | 34 | |
| 110 | 34 | 57 | 102 | ÷. | 37 | 50 | 100 | | |
| 120 | 36 | 61 | 108 | + | 40 | 53 | 105 | - | |
| 130 | 39 | 64 | 114 | | 43 | 55 | 110 | - | |
| 140 | 41 | 68 | 120 | | 45 | 58 | 115 | - | |
| 150 | 44 | 71 | 127 | - | 48 | 61 | 120 | - | |
| 160 | 46 | 75 | 132 | - | 50 | 63 | 125 | - | |
| 170 | 49 | 78 | 139 | | 53 | 66 | 130 | | |
| 180 | 51 | 82 | 145 | - | 55 | 69 | 135 | ्रात | |
| 190 | 54 | 85 | 151 | - | 57 | 72 | 140 | 17 | |
| 200 | 56 | 89 | 157 | 7 | 60 | 74 | 145 | | |
| 220 | 61 | 96 | 168 | - | 65 | 80 | 154 | | |
| 250 | 68 | 107 | 185 | 5 | 72 | 88 | 167 | σ | |
| 280 | 74 | 119 | 201 | - | 78 | 96 | 180 | - | |
| 300 | 79 | 127 | 215 | - | 83 | 102 | 189 | - | |
| 350 | 90 | 151 | 248 | - | 94 | 118 | 212 | - | |
| 400 | 101 | 168 | 282 | 685 | 104 | 135 | 237 | - | |
| 450 | 112 | 186 | 314 | 756 | 115 | 152 | 262 | 652 | |
| 470 | 116 | 193 | 326 | 785 | 119 | 157 | 271 | 670 | |

Table E-2. Subgrade Category B

| | Allo | wable GW for FLEX | (1000's o IBLE PC | of lbs.) R | Allowable GW (1000's of lbs.) for RIGID PCR | | | | |
|--------|------|----------------------|----------------------|---------------|--|-----|-----|--------|--|
| PCR(B) | S | D | 2D | 2D/2D2 | S | D | 2D | 2D/2D2 | |
| 490 | 120 | 199 | 338 | 811 | 120 | 163 | 281 | 689 | |
| 500 | 120 | 203 | 344 | 824 | 120 | 166 | 286 | 698 | |
| 550 | 120 | 221 | 375 | 886 | 120 | 180 | 310 | 744 | |
| 580 | 120 | 232 | 394 | 923 | 120 | 188 | 324 | 772 | |
| 600 | 120 | 239 | 412 | 948 | 120 | 193 | 333 | 790 | |
| 630 | 120 | 250 | 444 | 981 | 120 | 202 | 347 | 816 | |
| 650 | 120 | 250 | 467 | 1003 | 120 | 207 | 356 | 832 | |
| 670 | 120 | 250 | 490 | 1025 | 120 | 213 | 365 | 849 | |
| 700 | 120 | 250 | 539 | 1057 | 120 | 221 | 379 | 874 | |
| 750 | 120 | 250 | 550 | 1111 | 120 | 234 | 404 | 915 | |
| 800 | 120 | 250 | 550 | 1120 | 120 | 247 | 435 | 956 | |
| 810 | 120 | 250 | 550 | 1120 | 120 | 250 | 441 | 964 | |
| 850 | 120 | 250 | 550 | 1120 | 120 | 250 | 470 | 995 | |
| 900 | 120 | 250 | 550 | 1120 | 120 | 250 | 513 | 1033 | |
| 930 | 120 | 250 | 550 | 1120 | 120 | 250 | 549 | 1056 | |
| 950 | 120 | 250 | 550 | 1120 | 120 | 250 | 550 | 1071 | |
| 1000 | 120 | 250 | 550 | 1120 | 120 | 250 | 550 | 1110 | |
| 1010 | 120 | 250 | 550 | 1120 | 120 | 250 | 550 | 1117 | |

| | Allo | wable GW for FLEX | (1000's o IBLE PC | o <mark>f lbs.)</mark> R | Allowable GW (1000's of lbs.) For RIGID PCR | | | | |
|--------|----------------|----------------------|----------------------|-----------------------------|--|----------|-----------|--------|--|
| PCR(C) | S | D | 2D | 2D/2D2 | S | D | 2D | 2D/2D2 | |
| 20 | а ² | 2 | 2 120 | 2 <u>(</u> | 9 | 2 | 2 1120 | 2 | |
| 30 | 10 | 2 | 120 | 2 | 13 | 2 | 023 | 2 | |
| 40 | 12 | 2 | 120 | 2 2 | 16 | 2 | 020 | 2 2 | |
| 50 | 15 | - | 1 (La) | - | 19 | <u>_</u> | 1 (See | - | |
| 60 | 18 | - | (a) | - | 22 | <u> </u> | 1 (a) | - | |
| 70 | 20 | - | <u></u> | - | 25 | <u>_</u> | | - | |
| 80 | 23 | 40 | 140 | - | 28 | 38 | . c.e. | - | |
| 90 | 26 | 44 | - | - | 31 | 41 | | ~ | |
| 100 | 28 | 47 | | | 33 | 44 | | - | |
| 110 | 31 | 51 | - | | 36 | 47 | | - | |
| 120 | 33 | 54 | | * | 39 | 50 | | - | |
| 130 | 36 | 57 | 103 | . * | 41 | 53 | 102 | - | |
| 140 | 38 | 60 | 107 | . * | 44 | 55 | 106 | | |
| 150 | 41 | 63 | 112 | . * | 46 | 58 | 110 | - | |
| 160 | 43 | 66 | 117 | - | 49 | 61 | 115 | - | |
| 170 | 46 | 69 | 121 | - | 51 | 63 | 119 | | |
| 180 | 48 | 72 | 126 | - | 54 | 66 | 123 | | |
| 190 | 51 | 75 | 130 | - | 56 | 69 | 128 | - | |
| 200 | 53 | 78 | 135 | - | 59 | 72 | 132 | - | |
| 220 | 58 | 84 | 144 | - | 63 | 77 | 141 | - | |
| 250 | 65 | 93 | 157 | | 70 | 85 | 154 | - | |
| 280 | 72 | 103 | 169 | - | 77 | 93 | 166 | - | |
| 300 | 77 | 110 | 177 | | 81 | 99 | 174 | - | |
| 350 | 87 | 129 | 198 | | 92 | 114 | 194 | | |
| 400 | 99 | 151 | 222 | 638 | 103 | 130 | 216 | - | |
| 450 | 110 | 168 | 248 | 692 | 114 | 147 | 238 | - | |
| 470 | 114 | 175 | 258 | 714 | 118 | 153 | 247 | - | |

Table E-3. Subgrade Category C

| | Allo | wable GW for FLEX | (1000's o IBLE PC | of lbs.) R | Allowable GW (1000's of lbs.) For RIGID PCR | | | | |
|--------|------|----------------------|----------------------|---------------|--|-----|-----|--------|--|
| PCR(C) | S | D | 2D | 2D/2D2 | s | D | 2D | 2D/2D2 | |
| 480 | 116 | 178 | 263 | 724 | 120 | 156 | 252 | - | |
| 490 | 119 | 181 | 269 | 735 | 120 | 158 | 257 | 639 | |
| 500 | 120 | 184 | 274 | 746 | 120 | 161 | 261 | 648 | |
| 550 | 120 | 202 | 300 | 800 | 120 | 175 | 284 | 690 | |
| 580 | 120 | 212 | 314 | 828 | 120 | 183 | 298 | 715 | |
| 600 | 120 | 219 | 324 | 846 | 120 | 189 | 306 | 732 | |
| 630 | 120 | 230 | 338 | 874 | 120 | 197 | 319 | 757 | |
| 650 | 120 | 236 | 347 | 893 | 120 | 203 | 327 | 773 | |
| 670 | 120 | 243 | 357 | 912 | 120 | 208 | 336 | 790 | |
| 690 | 120 | 250 | 367 | 930 | 120 | 214 | 344 | 806 | |
| 700 | 120 | 250 | 371 | 940 | 120 | 216 | 349 | 814 | |
| 750 | 120 | 250 | 396 | 981 | 120 | 230 | 370 | 852 | |
| 800 | 120 | 250 | 447 | 1019 | 120 | 243 | 392 | 891 | |
| 830 | 120 | 250 | 495 | 1041 | 120 | 250 | 407 | 914 | |
| 840 | 120 | 250 | 531 | 1049 | 120 | 250 | 412 | 922 | |
| 850 | 120 | 250 | 550 | 1056 | 120 | 250 | 418 | 929 | |
| 900 | 120 | 250 | 550 | 1094 | 120 | 250 | 446 | 967 | |
| 930 | 120 | 250 | 550 | 1116 | 120 | 250 | 466 | 989 | |
| 950 | 120 | 250 | 550 | 1120 | 120 | 250 | 479 | 1003 | |
| 1000 | 120 | 250 | 550 | 1120 | 120 | 250 | 519 | 1039 | |
| 1030 | 120 | 250 | 550 | 1120 | 120 | 250 | 550 | 1061 | |
| 1050 | 120 | 250 | 550 | 1120 | 120 | 250 | 550 | 1075 | |
| 1100 | 120 | 250 | 550 | 1120 | 120 | 250 | 550 | 1111 | |
| 1110 | 120 | 250 | 550 | 1120 | 120 | 250 | 550 | 1118 | |

| | Allo | wable GW for FLEX | (1000's o IBLE PC | of lbs.) R | Allowable GW (1000's of lbs.) for RIGID PCR | | | | |
|--------|------|----------------------|----------------------|---------------|--|----------|-----------|---------|--|
| PCR(D) | s | D | 2D | 2D/2D2 | s | D | 2D | 2D/2D2 | |
| 20 | | 0.70 | 17 | 5 | 9 | ~ | 12 | | |
| 30 | 8 | | 37 | 5 | 12 | 2 | | | |
| 40 | 11 | - | 1 | | 15 | - | | 10 | |
| 50 | 14 | - | 1 | - | 18 | - | 0 | 68. | |
| 60 | 16 | - | - | - | 21 | - | | 12 | |
| 70 | 19 | 0 2 9 | 22 | 2 | 24 | <u> </u> | 25 | 2 | |
| 80 | 21 | 1029 ⁻ | 3 <u>2</u> | ° 2 | 26 | | 94 | 3 | |
| 90 | 24 | 38 | i i i | 8 | 29 | 38 | 92 | 3 | |
| 100 | 26 | 41 | <u>~</u> | | 32 | 41 | ्य स्ट | 3 | |
| 110 | 29 | 44 | <u>_</u> | , ÷ | 35 | 44 | 25 | 0 | |
| 120 | 32 | 47 | 2 4 | , ÷. | 37 | 47 | 85 | 0 | |
| 130 | 34 | 49 | 2 4 | . ÷ | 40 | 50 | 8 | 0 | |
| 140 | 36 | 52 | 5 4 | ÷ | 42 | 53 | | | |
| 150 | 39 | 55 | 19 | | 45 | 55 | 101 | | |
| 160 | 41 | 57 | 101 | - | 47 | 58 | 105 | | |
| 170 | 44 | 60 | 104 | | 50 | 61 | 109 | | |
| 180 | 46 | 62 | 108 | | 52 | 63 | 113 | | |
| 190 | 49 | 65 | 111 | | 55 | 66 | 117 | | |
| 200 | 51 | 67 | 115 | - | 57 | 69 | 121 | | |
| 220 | 56 | 72 | 122 | - | 62 | 74 | 129 | | |
| 250 | 63 | 80 | 132 | | 69 | 82 | 140 | | |
| 280 | 70 | 89 | 143 | | 76 | 90 | 152 | | |
| 300 | 74 | 94 | 150 | - | 80 | 95 | 160 |) | |
| 350 | 86 | 110 | 167 | - | 91 | 110 | 178 | | |
| 400 | 97 | 127 | 184 | | 102 | 125 | 197 | | |
| 450 | 108 | 148 | 201 | 5 | 112 | 141 | 218 | | |
| 470 | 113 | 154 | 209 | 5 | 117 | 148 | 226 | | |

Table E-4. Subgrade Category D

| | Allo | wable GW for FLEX | (1000's o IBLE PC | of lbs.) R | Allowable GW (1000's of lbs.) for RIGID PCR | | | | |
|--------|------|----------------------|----------------------|---------------|--|-----|-----|--------|--|
| PCR(D) | S | D | 2D | 2D/2D2 | s | D | 2D | 2D/2D2 | |
| 490 | 117 | 160 | 216 | 640 | 120 | 154 | 235 | 0 | |
| 500 | 120 | 163 | 220 | 646 | 120 | 156 | 239 | | |
| 550 | 120 | 178 | 239 | 680 | 120 | 170 | 260 | 637 | |
| 580 | 120 | 187 | 251 | 700 | 120 | 178 | 272 | 660 | |
| 600 | 120 | 193 | 259 | 714 | 120 | 184 | 281 | 676 | |
| 630 | 120 | 202 | 270 | 734 | 120 | 192 | 293 | 699 | |
| 650 | 120 | 209 | 278 | 748 | 120 | 197 | 302 | 714 | |
| 670 | 120 | 215 | 285 | 761 | 120 | 203 | 310 | 730 | |
| 690 | 120 | 221 | 293 | 775 | 120 | 208 | 318 | 745 | |
| 700 | 120 | 225 | 297 | 781 | 120 | 211 | 322 | 753 | |
| 750 | 120 | 241 | 315 | 812 | 120 | 225 | 342 | 792 | |
| 770 | 120 | 247 | 323 | 822 | 120 | 230 | 349 | 807 | |
| 800 | 120 | 250 | 334 | 838 | 120 | 238 | 362 | 828 | |
| 830 | 120 | 250 | 345 | 854 | 120 | 245 | 374 | 850 | |
| 840 | 120 | 250 | 349 | 860 | 120 | 248 | 378 | 857 | |
| 850 | 120 | 250 | 352 | 865 | 120 | 250 | 382 | 864 | |
| 900 | 120 | 250 | 371 | 892 | 120 | 250 | 403 | 900 | |
| 930 | 120 | 250 | 382 | 907 | 120 | 250 | 418 | 922 | |
| 950 | 120 | 250 | 390 | 918 | 120 | 250 | 428 | 937 | |
| 1000 | 120 | 250 | 414 | 945 | 120 | 250 | 454 | 972 | |
| 1050 | 120 | 250 | 443 | 969 | 120 | 250 | 484 | 1006 | |
| 1100 | 120 | 250 | 483 | 991 | 120 | 250 | 519 | 1041 | |
| 1120 | 120 | 250 | 500 | 1000 | 120 | 250 | 535 | 1054 | |
| 1150 | 120 | 250 | 550 | 1012 | 120 | 250 | 550 | 1075 | |
| 1200 | 120 | 250 | 550 | 1034 | 120 | 250 | 550 | 1109 | |
| 1250 | 120 | 250 | 550 | 1057 | 120 | 250 | 550 | 1120 | |
| 1300 | 120 | 250 | 550 | 1078 | 120 | 250 | 550 | 1120 | |
| 1350 | 120 | 250 | 550 | 1100 | 120 | 250 | 550 | 1120 | |

| PCR(D) | Allo | wable GW for FLEX | (1000's o IBLE PC | of lbs.) R | Allowable GW (1000's of lbs.) for RIGID PCR | | | | |
|--------|------|----------------------|----------------------|---------------|--|-----|-----|--------|--|
| | S | D | 2D | 2D/2D2 | S | D | 2D | 2D/2D2 | |
| 1390 | 120 | 250 | 550 | 1118 | 120 | 250 | 550 | 1120 | |

INTENTIONALLY LEFT BLANK